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Route Map – UK 2012 low carbon bus target project (DRAFT 1)

This document has been drafted to bring together the various papers produced by the Bus Working Group and assist in moving the Group's work on the Bus Route Map to a successful conclusion. Therefore, the members of the Bus Working Group are invited to comment all aspects of the paper including the recommendations. There remain some sections which require clarification or addition, these are appear within "<>".
The intension is for the document to represent all views within the Partnership and if consensus can not be achieved then all view points will be represented within the document. The final document is intended to form the basis of the LowCVP's recommendations to the DfT regarding the review of the Powering Future Vehicles strategy.

Executive summary

Low carbon buses have been demonstrated for three of the five drivelines capable of delivering 30% or more reduction is carbon emissions. However these buses have only been purchased with EU or other support funding to reduce the initial capital cost. There are too few buses operating to determine reliability and operating costs whilst the initial costs for such small orders are extremely high.

It is clear that technology push will not create market entry and overcome existing barriers.

Incentives to encourage bus manufacturers to develop low carbon buses are essential.

This will only be successful if the fiscal framework is put in place to create demand for low carbon buses from bus operators.

Local authorities need to be given more clear and direct powers to encourage the use of low carbon buses.

In the absence of greater incentives and powers for local authorities to encourage low carbon buses the current target for 600 low carbon buses to be sold annually by 2012 will in the view of the Partnership be unachievable.

If greater incentives or powers for local authorities can not be provided then an alternative target which would deliver similar levels of carbon dioxide emission reductions should be adopted.

Introduction

The Powering Future Vehicles (PFV) Strategy was published in July 2002 with the objective that the UK should lead the world in the shift to clean, low carbon transport. The PFV strategy provides a framework for decision making and sets out targets to support this shift over the period to 2012 (although in relation to ultra low carbon cars it does look forward to 2020).

There is a specific target within the strategy relating to low carbon buses: by 2012, 600 or more buses coming into operation per year will be low carbon, defined as 30% below current average carbon emissions. This has been further refined by the Partnership's Bus Working Group to define a low carbon bus as:

> *Producing at least 30% fewer greenhouse gas emissions than a current Euro 8 equivalent diesel bus of the same total passenger capacity. The greenhouse gas emissions are expressed in grams of carbon dioxide equivalent measured over a standard test and covers Well-to-Wheel performance therefore taking into account both the production of the fuel and its consumption on board.*

The strategy also states that the Government will support the move to a low carbon transport system by ensuring the appropriate taxation of vehicles, fuels and infrastructure, and by encouraging the up-take of low carbon vehicles and fuels through appropriate financial measures and actions to overcome market barriers.

The strategy states that the targets will be kept up to date and will be reviewed in 2005. However, due to the timing of the Energy Review and the Climate Change Programme Review it was decided to defer the review of the PFV strategy until 2006.

Officials have asked the LowCVP to provide recommendations on all targets, actual or aspired, in the PFV by the summer of 2006. This document outlines the issues foreseen in achieving the bus target and recommends actions and a potential alternative optional bus target developed by the Bus Working Group relating to the low carbon bus target.

Background

<REGISTRATION DATA TO BE ADDED HERE>

The UK no longer has any domestic bus manufacturers, but rather there are a number of bus assemblers. The major components are built on the basis of demand across Europe to achieve economies of scale and research and development is done in conjunction with that for commercial vehicles.

Bus patronage is declining across the UK with the exception of London where due to significant investment in the bus fleet and the introduction of the Congestion Charge bus patronage has increased.

<PATRONAGE FIGURES TO BE ADDED HERE>

Prior to 1986 bus services were provided by local authority owned operators, subsidiaries of publicly owned corporations and smaller private companies. The Transport Act 1985 was introduced to promote competition and efficiency, limit use of public monies in funding bus operations, it also removed the requirement for road service licensing outside London.

The new regime operates differently in London from the rest of the UK. In London a system of competitive tendering for bus routes operates, tendered by TfL as the executive agency of the GLA. In the rest of the UK bus operators now required to register services with the Traffic Commissioner giving 56 days notice of intention to set up or cease to operate a service and provide information on the proposed route. In the major conurbations public transport is then co-ordinated by the Passenger Transport Executives (PTE) who are responsible to the local authorities in their area , via the Passenger Transport authority, and act in partnership with private operators to provide public transport.

Political

At a political level both Central Government and local authorities have a role to play in encouraging the up take of low carbon buses. In addition the PTEs have an important role in acting as an interface with local authorities to provide local public transport needs.

Central Government

Government provides significant funding support for the provision of bus services through a number of schemes; including the Bus Service Operators Grant (BSOG), urban and rural bus challenges and funding for local transport plans. The level of funding is not a barrier to the introduction of low carbon buses but rather the fact that existing Government policies conflict with each other.

At the core of Government policy relating to public service vehicles is the need to encourage model shift from private to public transport and to assist this public service vehicle services should be at a minimum cost. To this end the Government supports public service vehicles through the BSOG which rebates fuel duty paid by bus operators for the mileage which the buses are employed on public service routes. Currently the BSOG rebates 80% of fuel duty paid for diesel and 100% of fuel duty paid on natural gas, LPG or bio-fuels. Unfortunately, this has the effect of negating the incentives provided through fuel duty by the Government to encourage low carbon fuels.

The DfT undertook a review of the operation of BSOG in 2004/05 and whilst understanding concerns regarding of the conflict in objectives in BSOG and Fuel Duty policy, it has been decided that BSOG should remain in its current state. Given this state of affairs other fiscal incentives need to be considered if low carbon buses are to be viable.

Other fiscal incentives which might be deployed by central Government are:

- Enhanced capital allowances for the purchase of low carbon buses,
- Grant support of research and development of low carbon bus technology,

- Grant support for field trials and demonstration projects of low carbon bus fleets,
- Renewable transport fuel obligation, and
- Emission trading scheme for transport.

Local Authority

Local authorities can have a significant impact in co-ordinating action and marshalling resources in their area. However there is no direct and simple power which allows a local authority to directly influence the market for low carbon buses. The powers local authorities have are spread across a number of Acts, the most important described below.

The 1985 Transport Act generally precludes local authorities from operating regular bus services. Although Section 7 of the Act does give the local authority the power to ask the Traffic Commissioner to place regulations on an operator's public service licence. However, to do so the Traffic Commissioner has to be satisfied there is a compelling case and this would not necessarily extend to environmental issues.

The Transport Act 2000 introduced the concept of Quality Partnerships, which is a partnership approach to improve services by in kind action between bus operators, local authorities and users. The objective of quality partnerships is to improve local bus services rather than to tackle climate change issues, although it could be used to gain local consensus to employ low carbon buses.

The Local Government Act 2000 gives local authorities the power to do anything which they consider is likely to achieve the promotion or improvement in one or more of the following;

- The economic well being of their area,
- The social well being of their area, and
- The environmental well being of their area.

This, in theory, should allow local authorities to incur expenditure on low carbon buses provided it is consistent with other primary legislation, benefits all residents, and conforms with state aid regulations.

Section 106 under the Town and Country Planning Acts allow local authorities to enter into legal agreements with developers by which a local authority can require a developer to undertake specific actions or make contributions to the provision of services. This could be used to support the introduction of low carbon buses.

The powers given to local authorities are primarily focused on air quality, social deprivation, economic development and not on low carbon buses or climate change specifically.

<u>Public procurement</u>

Local authorities can have a role to play in procurement through the formation of joint procurement consortiums in order to gain economies of scale. The DfT has established a local authority work stream aimed at increasing efficiency of local authority tendered bus services which might be extended to include specifically low carbon buses.

This has been used to secure clean low carbon vehicle technologies in the past, most notably through the ZEUS and is currently being explored by the Cenex through the use of Forward Commitment agreements to overcome the risk of introducing low carbon vehicle technologies.

Under the new EU directive on energy services and public procurement, public authorities have to make provision for the purchase of energy efficient products and this includes vehicles. The Directive provides that public bodies, including operators contracted by public bodies to supply transport services, will be obliged to allocate a minimum quota of 25% of their annual procurement of heavy-duty vehicles for the purchase of "enhanced environmentally friendly vehicles" (EEV).

Projects

The most influential area in which local authorities have played a role in introducing clean low carbon vehicle technology has been through project initiatives. These are funded through Government programmes such as the Energy Saving Trust's grant programmes and the DTI grant programmes, and the European Commission through the Framework Programmes and other initiatives. Virtually, all clean low carbon buses demonstrated in the UK to date have been funded through this manner.

Technology Pathways

There are a number of potential technology pathways which hold out the potential for significant carbon dioxide emission reductions. These can be characterised as falling into three groups (refer annex I and II for more details):

1. **Interim technologies**: capable of significant carbon reduction but not sufficient to achieve a 30% WTW carbon dioxide emission reduction compared to current diesel buses. These technologies would include energy storage devices, infinitely variable transmissions, reducing vehicle mass by materials substitution and optimised design and low blend bio-diesel.
2. **Low Carbon technologies**: capable of achieving a 30% reduction in WTW carbon dioxide emissions. These would include battery-electric, diesel-electric and high blend bio-diesel.
3. **Renewable technologies**: capable of achieving more than 50% reduction in WTW carbon dioxide. These technologies would include fuel-cell and bio-gas where the fuel production provides a significant proportion of the carbon saving but appropriate supply chains for mass introduction have yet to be developed.

<INSERT TABLE OR GRAPHIC SHOWING ESTIMATED COST V CARBON SAVING>

Bus economics & oil prices

Buses perform a public service and their occupancy is dependent upon the ticket price and hence their running cost. Oil prices have risen by a more than a factor of 3 over the past 3 years from $22 to in excess of $70/barrel. Oil prices are expected to continue to rise steadily as a tend due to the rapid depletion of large, easily accessible oil fields (like the North Sea) and the time and cost to develop much smaller and deeper and less accessible fields like west of Shetlands.

For diesel buses eligible for 80% fuel duty rebate the BSOG is worth 36.8p/litre so the *average cost to the operator has risen from 25.4 p/litre to 44.2 p/litre.*

So if the bus is a low carbon bus using 30% less carbon, then the fuel cost per km would be reduced from 22.1p to 15.5p. For a city bus with an average consumption of 50 l/100 km and distance of 50,000 kms a year, *the savings in fuel would be £3300/year or £50000 over the 15 year life of a low carbon bus*

The savings in BSOG to the Treasury by replacing a conventional diesel bus by a low carbon bus under the same operating conditions are 0.3 X 36.8 p/litre or 11 p/litre *that is BSOG savings of £2750/year or £41250 over the life of the bus*

The BSOG in its present form provides no incentive for operators of diesel buses to switch to low carbon buses; however as shown above the Treasury will benefit by having to pay a substantially smaller grant.

Moreover the societal and environmental benefits associated with low carbon buses such as lower SOX, NOX, CO, particulates and CO2 carry no credit for the operator. To transform the market for low carbon buses, the basis of the BSOG should be changed to reflect the environmental benefits to society

At the same time one can retain the prime benefit of encouraging social cohesion for those persons who cannot drive (young or old) and those who wish to live a more sustainable lifestyle by moving back from private to public transport. The simplest way of doing this is to switch the basis of BSOG from that based on fuel consumption to one of distance covered.

<IS THERE AN ALTERNATIVE?>

The target for buses is as challenging as the target for cars, due to the current fiscal regime in the UK and the broadly competitive nature of the UK bus market. Low carbon buses in the UK will have to be price competitive with their high carbon counter parts, implying a price premium only equal to the operating cost savings within an acceptable payback time of no more than 5 years.

<INSERT TABLE OF COST BASED UPON ELEMENT ENERGY WORK & RESULTS OF CPT SURVEY OF OPERATORS>

Given the current fiscal framework there is little if no incentive for bus manufacturers to develop low carbon buses or for bus operators to demand them.

UK Automotive Supply Chain Impacts

The UK automotive sector has a number of strengths, of which the most notable are:

- Automotive component supplier diversity
- Powertrain manufacturer
- Design engineering

<u>Automotive Component Supplier Diversity</u>

The UK automotive component sector is well developed and covers all aspects of automotive supply. It is dominated by major tier 1 suppliers who operate at a global level, with a large number of small to medium sized companies. There are a number of innovative first tier suppliers developing low carbon powertrains in the UK currently.

Powertrain Manufacturer

The UK has developed a specialism in powertrain manufacturer as a result of major recent investments in addition to its existing facilities. The UK now has 12 major Powertrain manufacturing facilities. As a consequence the UK is in a good position to benefit from developments in low carbon vehicle technology which relate to Powertrain.

Design engineering

The UK has a long-established, independent, design engineering sector whose services cover the full range of capabilities from concept design through to limited-series vehicle production. The sector's assets include major testing facilities for vehicles, systems and sub-systems. The sector employs over 10,000 and has a turnover in excess of £0.75 bn with a continued rise of the export proportion to a current value of around 70%. Its more successful companies are those that have best responded to the market's demand for world-class expertise, integrated into appropriate packages and delivered locally to the customer.

Impact on UK Production

UK bus production is mainly through integrators and assemblers which will tend to work against UK producers developing a competitive advantage because the IP is likely to reside with the first tier suppliers.

Impact on UK Supply Chain

- UK design engineering sector is likely to benefit from the development and integration of low carbon vehicle technologies.
- UK first tier suppliers may benefit from demand for low carbon vehicles to the extent that they are innovative and are able to develop a competitive or first mover advantage.
- UK second tier suppliers may benefit given that innovative first tier suppliers are successful.

Targets & Carbon Saving

To assess the achievability of the original low carbon bus target as stated in the PFV strategy, the market transformation model developed by Element Energy and Ricardo, and funded by EST was used to estimate the business as usual case given current policy framework. This was then compared with two alternative cases, the first based upon market up-take of the intermediary technologies, the second based upon an enhanced set of policy tools to encourage the up take of low carbon buses.

Scenario 1: Original target with business as usual

This scenario assumes that BSOG remains in its current form, no further incentives are provided and that the low carbon bus programme is not given State Aid approval and is therefore not launched.

<Add to this section an assessment of the likely outcomes from the Market Transformation Model and carbon savings.>

Scenario 2: Alternative target based upon intermediary technologies
This scenario is based upon the same business as usual policy framework that is used in scenario 1 but assumes that a revised target is adopted for low carbon buses, based around intermediary technologies. The revised target is assumed to be:

> *By 2012, 1,500 or more buses coming into operation per year will be low carbon, defined as 15% below current average carbon emissions.*

<Add to this section an assessment of the likely outcomes from the Market Transformation Model and carbon savings.>

Scenario 3: Original target with enhanced policy framework
The final scenario is based upon sufficient incentives being provided directly by Government and through additional powers to local authorities to make low carbon buses as originally defined, by the PFV strategy, cost neutral compared to current diesel buses.

<Add to this section an assessment of the likely outcomes from the Market Transformation Model and carbon savings.>

Recommendations and conclusions
There is an urgent need to increase the efficiency of public transport rapidly – the benefits include using less fuel, lowering running, reducing environmental emissions, preventing climate change and less pressure on increasingly scarse resources.

As the bus market is coherent and substantial, it is able to serve as a technology demonstrator for other markets which are much more diffuse and are not generally within the domain of influence of public authorities.

Technology is now available which will produce carbon savings or 30% or more, although some driveline options remain to be demonstrated.

Whilst the target for low carbon buses is appropriate, the UK needs to involve other European countries and the Commission to agree a common target which will be sufficiently large that the European bus manufacturers will be willing to commit to produce low carbon buses. This should be undertaken within the scope of the new EU energy efficiency action plan.

Like all other energy efficient technologies, the low carbon buses have a higher initial cost and will have a lower running cost once the new technology has matured.

Extra funding is not required, but existing sources of financing need to be re-examined to understand how these can be used to finance the additional capital cost

The major beneficiaries in terms of competiveness and employment would be to the UK component supply chain and bus assemblers.

Annex 1

Status of low carbon technology

The three fundamental drive line options for attaining 30% low carbon involve a step change in the technology –

- diesel/electrical
- diesel/mechanical
- all electric

Diesel/electric involves a diesel/electric energy conversion through a diesel engine driving an electric generator; battery storage can be included to provide zero emission operation – suppliers in UK are Enerco and Wright – 10 (?) buses in operation.

Diesel/mechanical involves an infinite variable transmission and flywheel storage; grant request lodged with EST/DfT 4 years ago - no demonstration yet available.

Note that diesel could be replaced by natural gas, biogas or bio-diesel as the prime fuel source

All electric – three options

1. fuel cell bus: 3 prototypes operating in London through EY funded program – high initial cost.

2. battery buses: 12 mini size buses operating in Liverpool (?) – limited range.

3. battery/flywheel: grant request lodged with EST/DfT 3 years ago - no demonstration yet available.

Of the 5 major types of drive-line, 3 are operating in small numbers to provide proof of concept and to obtain limited operating experience.

Current data is insufficient to understand the true operating costs because there are so few low carbon buses operating and these are effectively prototypes.

Annex II

Likely improvements in driveline efficiency

(from report to DFT by Mayer and Davies (2003)

Table 4.2 Possible efficiency improvements in diesel drive lines

Component	possible efficiency improvement	comment
Euro 3 engine	base line	
Euro 4 engine	?	by 1 October 2006
Continuously variable transmissions (CVT)	10 - 15%	like Torotrak
CVT + regenerative braking system	25 -30%	requires on board storage like flywheel

Table 4.3 Possible efficiency improvements in electric drive lines

Component	possible efficiency improvement	comment
Traction drives	base line	
Industrial drives	2 - 3 %	
Traction motors	base line	
High efficiency motors	1 - 2 %	
Battery lower depth of discharge	5 - 10%	dc link voltage kept within close limits
Small diesel generator	2 – 5%	helps maintain dc link voltage so increasing battery efficiency
Regenerative braking system	25 - 30 %	requires on board storage like flywheel