

# Powering Future Vehicles

The Government Strategy  
Second Annual Report



October 2004

*Cover photographs, left to right:*

***CUTE Bus Front display***

***LowCVP AGM Panel***

***Hybrid Taxi***

***Royal Mail CNG Van***

# Powering Future Vehicles

The Government Strategy  
Second Annual Report

Department for Transport  
Department of Trade and Industry  
Department for Environment, Food and Rural Affairs  
HM Treasury  
Cabinet Office  
Welsh Assembly Government  
Scottish Executive  
Northern Ireland Administration

October 2004



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21 October 2004

**To the Deputy Prime Minister and Members of the Ministerial Committee  
on the Environment**

The *Powering Future Vehicles* Strategy was launched in 2002. It described our ambition of achieving a significant shift towards clean, low-carbon road vehicles and fuels in the UK, with our own automotive and fuel industries at the cutting edge of these developments.

A Joint Ministerial Low Carbon Group was established to bring together key Ministers from across Government to oversee the implementation of the Strategy. This is the Group's second annual report. It describes the progress we and others have made towards achieving the objectives that we set ourselves in the original Strategy.

Since the first annual report, published in October 2003, we have continued to make good progress in a number of areas. The Low Carbon Vehicle Partnership (LowCVP) has continued to build momentum and synergies amongst the key stakeholders and I am particularly encouraged by its work on car CO<sub>2</sub> labelling. We have made great strides on the future fuels agenda this year, drawing on the expertise of the LowCVP. And the Government has been getting its own house in order, by making increasing use of low carbon vehicles and fuels on official business.

There are, of course, areas where progress has not been as rapid as we would have liked, and where we will need to keep under review the effectiveness of our policies in delivering the ambitious targets we set ourselves in 2002. There is still a lot to do. But we remain firmly committed to the goals of the original Strategy, and we are determined to do our utmost to ensure that they are achieved.

A handwritten signature in black ink, appearing to read 'David Jamieson'. The signature is stylized and cursive.

**David Jamieson MP**

Chair of the Joint Ministerial Low Carbon Group

# Introduction

- 0.1** Climate change is one of the most important issues facing the world today, and reducing emissions of greenhouse gases is a challenge for every developed country. Over the coming decades the need to tackle climate change is likely to become even more urgent. The Government is taking concerted effort to reduce UK emissions; our ambition was highlighted in the 2003 Energy White Paper, which put the UK on a path towards a 60% reduction in emissions of the main greenhouse gas, carbon dioxide (CO<sub>2</sub>), by about 2050.
- 0.2** To reach this goal, we need to develop cleaner, greener transport, and reduce reliance on fossil fuels. These aims are an important element of our commitment to tackling climate change, reflected in a Government Public Service Agreement target now shared by the Department for Transport (DfT).
- 0.3** Road transport is a major contributor to UK carbon dioxide (CO<sub>2</sub>) emissions, making up around one quarter of total emissions. To reduce these emissions, vehicles must become more fuel efficient. The fuel itself must also be considered, to determine whether alternatives can provide the same performance for a lower CO<sub>2</sub> penalty.
- 0.4** In addition to climate change, road transport plays a significant part in the problem of local air pollution, and the detrimental public health effects that this causes. Measures to improve fuel efficiency can both improve and worsen air quality performance. It is therefore vital to take a broad approach and tackle these issues together.
- 0.5** The Powering Future Vehicles (PFV) Strategy, published in July 2002, does just this, and aims to address the impacts of road transport on both the climate, and local air quality. To achieve this, the Strategy sets out a coherent policy framework to shift the UK vehicle market to clean, low-carbon vehicles and fuels.

- 0.6** The objectives of the PFV Strategy are to:
- promote the development, introduction and uptake of clean, low carbon vehicles and fuels.
  - ensure the full involvement of the UK automotive industry in the new technologies.
- 0.7** The Transport White Paper, *The Future of Transport*, published in July 2004 reiterated the Government’s commitment to these objectives, and also looked further ahead to the potential for renewable fuels to make significant reductions in CO2 emissions.
- 0.8** The PFV Strategy consists of ten elements where Government has a key role in ensuring that the objectives are delivered. Each of these elements includes a firm Government commitment for action. This second annual report details progress in each element, and against each commitment, since the first annual report, published one year ago.

# Delivering the Strategy

## 1 Engaging UK Stakeholders

**PFV Commitment – *The Government will continue to work closely with all stakeholders from the automotive, energy, and other sectors, establishing a forum to maximise the potential for UK business to gain competitive advantage from the Powering Future Vehicles Strategy.***

- 1.1** Since its launch in January 2003, the Low Carbon Vehicle Partnership (LowCVP) has become an established and high-profile organisation in the transport and environment arena – both in the UK and abroad. Its work is overseen by a Board, comprising senior representatives from the automotive and oil industries as well as from other key sectors. A small secretariat co-ordinates the LowCVP's activities.
- 1.2** The LowCVP has produced some important outputs over the past year, engaging the breadth of expertise across its six working groups:
- 1.3** The passenger car working group is preparing a paper on the future of EU Voluntary CO<sub>2</sub> Agreements. There is support in the group for continuing the voluntary approach post-2008 and for initiating a new ten-year timeframe to achieve further CO<sub>2</sub> reductions from new passenger cars.
- 1.4** A consumer information sub-group of the passenger car working group has been established to look specifically at raising consumer awareness of clean low-carbon vehicles and thereby influence purchasing decisions. The sub-group is developing a proposal for a voluntary UK colour-coded CO<sub>2</sub> labelling scheme for new cars. This scheme will provide straightforward, accessible information to consumers on the CO<sub>2</sub> emissions and fuel consumption of each vehicle, through a label similar to that in use for white goods.

- 1.5** Having been instrumental in the development of the low carbon bus programme during 2003 the bus working group is now working on a standard and procedure for testing low carbon buses. It has also submitted proposals on the operation of the Bus Service Operator's Grant in relation to the low carbon bus programme.
- 1.6** The group has also engaged with Local Authorities (LAs) with the aim of placing low carbon vehicles higher on the LA agenda and informing their policies, supply contracts and purchasing decisions.



- 1.7** The research and development working group has developed plans for the Centre of Excellence for Low Carbon and Fuel Cell Technologies. The centre will co-ordinate and showcase the UK's expertise in this area and accelerate the transition to a low carbon transport system by encouraging cross sectoral networking and helping to bring forward inventions to the market. The launch phase is underway and the centre is due to be fully open for business by Spring 2005.
- 1.8** The fuels working group has been working to combine the results of the numerous studies of whole-life, or 'Well to Wheels' CO<sub>2</sub> emissions from various fuel chains. It also provided expert input to the development of the Government's consultation paper 'Towards a UK strategy for biofuels', and to the development of the Government's assessment of the implications of achieving ultra-low carbon transport, 'Liquid biofuels and renewable hydrogen to 2050'.

- 1.9** The supply chain working group was established in December 2003. Its main aim is to facilitate the establishment of a UK supply chain to exploit the business opportunities arising from the implementation of the low carbon vehicle agenda. Its work has been focused on identifying key gaps in the supply chain and specifying tools, including information on market opportunities, that would help potential component and system suppliers to engage in the market.
- 1.10** The commercial vehicles working group has been developing a proposal for a support programme to encourage the uptake of fuel efficiency boosting technologies. A separate sub group is working on a testing programme for dealing with the complex volume/weight matrices that make real fuel efficiency comparison difficult.
- 1.11** The LowCVP launched a new high quality website in February 2004, ([www.lowcvc.org.uk](http://www.lowcvc.org.uk)) providing information about the work of the Partnership and giving open access to the papers for, and minutes of, Board, steering group and working group meetings, and other key documents published by the Partnership and its members.

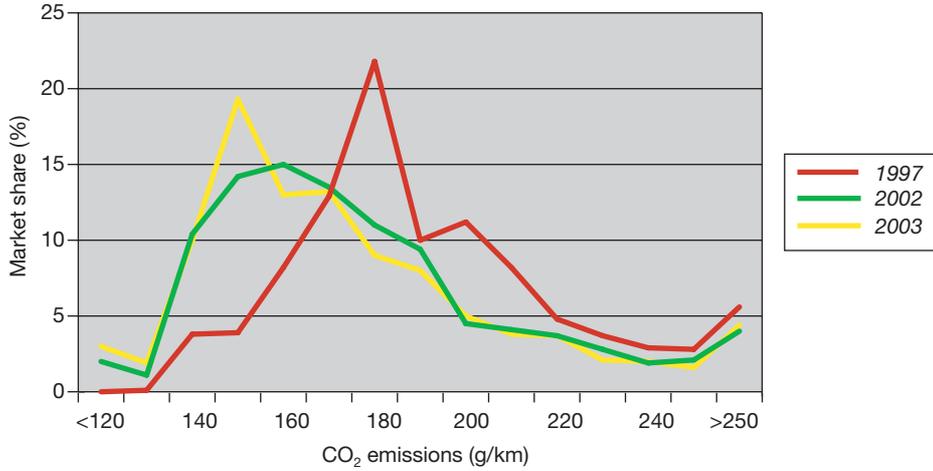
## 2 Targets for reducing vehicles' fuel consumption and carbon emissions

**PFV commitment – *The Government will set challenging targets for making the UK a world leader in the move to a low-carbon transport economy, looking to the next decade and beyond.***

- 2.1** In the Powering Future Vehicles Strategy, the Government set a challenging target for passenger cars that, by 2012, 10% of new cars sold in the UK would have CO<sub>2</sub> emissions of 100g/km or less at the tailpipe.
- 2.2** A package of measures has been put in place to help achieve this, including duty incentives and the reformed, CO<sub>2</sub>-linked Vehicle Excise Duty and Company Car Tax systems; TransportEnergy grants to encourage take-up of cleaner, more efficient vehicle technologies; and support for industrial and academic research, development and demonstration.
- 2.3** Steady progress has been made in recent years in the fuel efficiency of new cars sold in the UK, and this progress should continue to take the most fuel efficient vehicles towards the 2012 100g/km target level. In 2002, new car fleet average CO<sub>2</sub> emissions in the UK were 175 grams per kilometre (g/km), which dropped to 172.9 g/km in 2003.
- 2.4** There have also been major increases in sales of the most fuel-efficient vehicles. The Society of Motor Manufacturers and Traders (SMMT) has published its report on 2003 UK sales of new cars<sup>1</sup>, showing a significant increase in the proportion of new cars in VED band AA, (those emitting 101-120g/km of CO): 3% of new cars are now in this bracket, compared with 2.0% in 2002. At the same time the share of the top two C and D VED bands (166-185g/km and over 185g/km) fell by 3.2 percentage points from 2002 to 2003. In addition, the largest market segment, as defined by the SMMT, is the 'supermini'. 33.9% of sales were in this segment in 2003, compared with 32.4% in 2002.

1 <http://lib.smmt.co.uk/articles/sharedfolder/Publications/CO2%20Report.pdf>

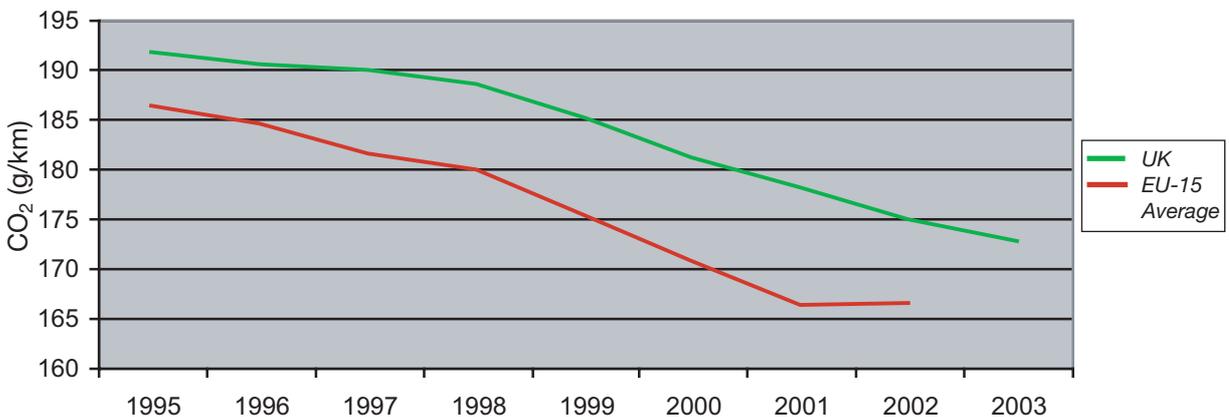
**Fig 1. CO<sub>2</sub> distribution of new car registrations in the UK (1997-2003)**



**2.5** Much of the progress on average vehicle efficiency is a result of the Voluntary Agreements between the European Commission and the European, Japanese and Korean automotive industry bodies (ACEA, JAMA and KAMA). The Voluntary Agreements set clear, long-term targets for EU average new car fuel efficiency, but are technology-neutral and flexible, allowing some manufacturers and some segments of the vehicle fleet to deliver greater savings than others.

**2.6** The targets require the industry bodies to ensure that average CO<sub>2</sub> emissions from new cars sold by their constituent members are reduced to 140g/km by 2008/9. The Voluntary Agreements have already resulted in significant improvements in average new car fuel efficiency, as can be seen from figure 1. Average CO<sub>2</sub> emissions from new passenger cars sold in the EU decreased by about 11% between 1995 and 2002 and the EU as a whole is on track to meet the targets.

**Fig 2. UK and EU Average New Car CO<sub>2</sub> Emissions**



- 2.7** For a number of reasons, in the UK, there has been a slightly slower, although still significant, rate of improvement. The UK car market has traditionally been weighted towards larger vehicles, and the UK baseline figure for 1995 was higher than the EU average. In the intervening period, the UK has experienced considerable economic growth, as a result of which consumers have been able to afford generally larger, less efficient vehicles. Further improvements are forecast in the UK average figure by 2008, although on current progress it is unlikely that the UK itself will reach the 140g/km figure by that date. However, as the target is for the new car fleet across the EU, it is EU average performance that is important.
- 2.8** The UK Government is actively pressing the European Commission to finalise a new round of Voluntary Agreements with the automotive industry, as it committed to do in the 2003 Energy White Paper. The Government wrote to the Commission in December 2003, setting out its support for further voluntary agreements and its views on some of the elements that such agreements should incorporate.
- 2.9** The current rate of improvement in average vehicle efficiency may not be sufficient in itself to ensure that the 2012 100g/km target is met. The introduction of innovative technologies, such as those in development through New Vehicle Technology Fund (NVTF) projects, should help to accelerate that progress towards the end of the decade. The Government will monitor the situation closely and keep the existing package of measures under review, to ensure that it is delivering the progress required.
- 2.10** Hybrid-electric vehicles, or ‘hybrids’ are being developed by many major manufacturers and take their power both from fossil fuel and from electricity, with the ability to capture the energy that is usually lost through braking. There are currently two hybrid-electric cars on sale in the UK: the Toyota Prius and the Honda Civic IMA. Hybrid vehicles have seen a rapid increase in sales over the past year, and both manufacturers project strong sales for the year ahead. The availability of these vehicles, and their adoption by a number of high-profile individuals is helping to raise awareness of the impact that motoring has on the environment and the contribution that technology can make to mitigating this.

**2.11** As a way of exploring what further fuel efficiency achievements might be possible in the medium term, the Government has also sponsored a number of research, design and demonstration projects, the details of which are summarised in chapter 3. These projects should help to bring forward and prove the kinds of technologies that will be crucial to the continued improvement of fleet average fuel efficiency and to the achievement of the 2012 100g/km target.

**2.12** The original PFV strategy stated that the Government would consider further long-term targets for vehicles in 2020. The Government asked the LowCVP for advice on the most effective form of a target, and the issue was considered by the passenger car working group. The group agreed that setting very specific targets at this stage might not be helpful, in view of the great uncertainty as to which technologies will prove successful over such a long timescale.

## 3 Supporting research, development and demonstration

**PFV commitment – *The Government will use its grant programmes to fund research, development and demonstration projects and will review them regularly to ensure that they are properly focused and working effectively together.***

- 3.1** The Government has a number of grant programmes to help fund the research, development and demonstration of future, low carbon vehicles. The total amount that the Government spends on this area is in excess of £100m per annum. The main programmes are summarised below.

### New Vehicle Technology Fund

This has been a busy year for the NVTF with a number of innovative projects being demonstrated throughout 2004. In June, three vehicles were launched:

- A hybrid electric black taxi was launched in Trafalgar Square by London Taxis International and Azure Dynamics. This series hybrid black cab has the ability to run in zero emission mode and has the potential to reduce emissions by up to 50% in inner city operation.
- David Jamieson launched a new electric shuttle bus demonstrating state of the art Zebra battery technology in the city of Lincoln. The walk and ride bus service is specifically suited to the electric bus with its very low noise and zero emissions. The bus will be used to transport visitors up Steep Hill between the market and cathedral sectors of the city. By using innovative regenerative braking, the bus is able to recharge its batteries when descending the hill on the return trip.
- London Technology International also launched a range of innovative electric delivery vehicles. These concept vehicles have been specifically designed for inner city operation with very low noise and zero emissions in use. The design concept is adaptable for a number of different vehicle uses including a milk float, delivery vans and also a minibus.



*Photo of David Jamieson with NVTF Project*

- 3.2** Also with funding from the NVTF, the Connaught Hybrid sports car was launched in September at the Goodwood Festival of Speed. This concept hybrid has been designed to show that the hybrid concept can be applied to high performance vehicles.
- 3.3** The Ultra Low Carbon Car Challenge (ULCCC), was launched in April 2003 by the Secretary of State for Transport and offered grants to car manufacturers to build, demonstrate and test full size full performance cars that could be mass produced at an affordable price, with well to wheel carbon emissions of less than 100 grams/km (equating to fuel consumption of at least 75mpg).
- 3.4** The five winners of the ULCCC were announced in the PFV first annual report. Successful consortia include major automotive manufacturers and engineering companies such as the MG Rover Group Ltd, Ricardo, Peugeot Citroen Automobiles and Bertrandt.
- 3.5** Good progress has been made with the projects. Four have successfully completed the feasibility stage and are progressing to the build and demonstration stage, and the fifth project should commence the feasibility stage before the end of this year. The first of the completed demonstration vehicles should be on the road in 2005.
- 3.6** The low carbon bus programme was launched in September 2003 with the aim of supporting the introduction of demonstration fleets of low carbon buses, with carbon emissions 30% lower than equivalent conventional buses. The programme is intended to develop confidence in the effective operation of these buses amongst operators to help kick-start the market for these vehicles in the UK.
- 3.7** There was a good response from a number of consortia of bus manufacturers and local authorities. The technical criteria for a low carbon bus have been defined by the Energy Saving Trust in collaboration with the LowCVP bus working group. The fleets are expected to begin operation in the first half of 2005.

**3.8** Two low carbon buses have also been developed with the support of the NVTf in the last year. The Transport Minister David Jamieson launched the Eneco Hybrid bus in September, which has demonstrated tailpipe carbon reductions of over 50% in trials in Manchester. A further Hybrid bus is being developed by Alexander Dennis which is likely to be demonstrated in 2005.

**3.9** The HyTrans Ford Transit project was officially launched by David Jamieson at the Ford plant in Southampton. This ‘mild’ hybrid Transit (so-called because it will not be able to operate in electric-only mode) will use an integrated starter generator to allow stop-start operation and regenerative braking to reduce fuel consumption by up to 25% on an urban delivery cycle. A demonstration vehicle is expected on the road in early 2005.



*Photo of HyTrans*

### General Motors Fuel Cell Marathon

General Motors successfully completed a ‘Fuel Cell Marathon’ between May and June 2004, driving a GM ‘HydroGen3’ Fuel Cell vehicle over 10,000km through major cities across Europe to test its on-road durability and reliability under a variety of conditions. On the UK leg of the Marathon, the vehicle was brought into central London and parked at the Houses of Parliament, where David Jamieson was given a demonstration.

The vehicle was followed by a travelling exhibition to provide information to the public about fuel cells and the use of hydrogen as a source of energy.



*Photo of David Jamieson with GM Fuel Cell Marathon car*

- 3.10** In 2003, Ricardo updated their study into a feasible route to highly efficient hybrid-electric diesel vehicles and hydrogen fuel cell vehicles<sup>2</sup>. The original study proposed that, by 2020, it would be theoretically possible to produce diesel-powered vehicles that would be around 50% more efficient than a standard 2003 vehicle<sup>2</sup>. Based on industry feedback received and technological developments in the interim, Ricardo were able to improve the estimated performance of the proposed vehicles, revising upwards the estimated CO<sub>2</sub> savings.
- 3.11** The DfT commissioned two important studies to underpin the Government's assessment of the overall energy implications of the large-scale use of renewable hydrogen and biofuels. E4tech (UK) Ltd produced a technical analysis of the possible future energy needs of UK road transport and the potential to satisfy these from indigenous renewable resources<sup>3</sup>. The National Society for Clean Air and Environmental Protection and the Institute for European Environmental Policy led a study into the social and environmental impacts of biofuels production and use in the UK, co-funded by the BOC Foundation<sup>4</sup>. The Government responded to some of the conclusions of this study in the DfT's 'Liquid Biofuels and Renewable Hydrogen to 2050 – An assessment of the implications of achieving ultra low carbon road transport'<sup>5</sup>.
- 3.12** The Department of Trade and Industry (DTI) is supporting a major new fuel cell project which aims to develop and evaluate novel design approaches, materials and production processes for making membrane electrode assemblies (MEAs) for proton electron membrane (PEM) fuel cells. The aim is to achieve the lower production costs required to meet the challenging cost targets for fuel cells in large-scale automotive applications.
- 3.13** The grant has been placed with Johnson Matthey PLC who will conduct the work through its business unit Johnson Matthey Fuel Cells Ltd, together with its collaborators Intellicoat Technologies Ltd, Technical Fibre Products Ltd, Primasil Silicones Ltd and MAST Carbons Ltd.

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2 [http://www.dft.gov.uk/stellent/groups/dft\\_roads/documents/page/dft\\_roads\\_026217.hcsp](http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_026217.hcsp)

3 [www.dti.gov.uk/energy/sepn/futuretransport.shtml](http://www.dti.gov.uk/energy/sepn/futuretransport.shtml)

4 [http://www.nasca.org.uk/pages/topics\\_and\\_issues/biofuels.cfm](http://www.nasca.org.uk/pages/topics_and_issues/biofuels.cfm)

5 <http://www.dti.gov.uk/energy/sepn/h2bioassessment.pdf>

- 3.14** Lord Sainsbury announced the second Open Call of the DTI Technology Strategy and Programme, worth £50 million on 26 April 2004. Proposals were invited from within seven technology areas, which included technologies to support environmentally friendly transport. Twenty-four collaborative research and development projects were invited to submit full proposals within this area and will be assessed later this year.
- 3.15** The Foresight Vehicle Programme is now administered by the Society of Motor Manufacturers and Traders. It is the UK's prime knowledge transfer network for the automotive industry. The initiative aims to promote technology and stimulate suppliers to develop market driven enabling technologies for future motor vehicles (cars, taxis, HGVs, buses and light commercial vans).
- 3.16** The Foresight Vehicle technology roadmap has been developed to identify technology and research themes for road transport, aiming to support UK industry in the globally competitive market for transport products and to provide sustainable mobility for UK citizens. The roadmapping process has brought together experts from across the road transport sector, from more than 60 organisations. The goal is to use the roadmap structure to capture and share views about how road vehicle markets, products, systems and technologies will (and could) evolve in the next 20 years.
- 3.17** Work has also been going on in developing biofuels from waste products. Under the Sustainable Energy Programme, DTI are supporting two projects that are looking at developing a commercially viable process for converting waste tallow from animals into biofuels. A bioethanol project has been running for 16 months and a £2m pilot plant has been constructed and is being tested. A biodiesel project began in November 2003. Work to date has concentrated on characterising the tallow feedstock and evaluating enzymes for the esterification process.

## 4 Encouraging consumer take-up of clean, low carbon vehicles and fuels

**PFV commitment – *The Government will encourage consumer take-up of low carbon vehicles and fuels, through financial measures, and overcoming market barriers.***

- 4.1** The Government continues to support the take-up of low carbon vehicles and fuels by means of the fiscal incentives described in chapter 6 and through a number of grant programmes to help offset the additional costs of new vehicle technologies.
- 4.2** The three TransportEnergy Grant programmes – PowerShift, CleanUp and the New Vehicle Technology Fund, were very successful in 2003/4, with all available funding being fully taken up for the first time, reflecting the growing market in clean vehicles using new technologies. However the grant hiatus following the commitment of all the funding caused some difficulties for the sector, and therefore a new, more transparent funding system has been introduced for 2004/5. In addition the DfT jointly with the Welsh Assembly Government and the Scottish Executive have issued a consultation document seeking views on how well the programmes are working and how they might be developed in the future. The consultation closes on 29 October<sup>6</sup>.

### **Biodiesel at the supermarket**

Biodiesel is now available at some 150 sites in the UK, including a number of supermarket forecourts. David Jamieson launched Tesco's roll-out of biodiesel on a pilot basis to over 20 of its stores in May 2004. Some supermarkets are also making use of biodiesel blends for their internet shopping delivery services.



*Photo of David Jamieson at launch*

6 [http://www.dft.gov.uk/stellent/groups/dft\\_roads/documents/page/dft\\_roads\\_029321.hcsp](http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_029321.hcsp)

**4.3** The European Commission is currently reviewing the success of its existing car labelling Directive, with a view to improving its effectiveness in providing information to consumers. The UK has formally submitted its views to the Commission on the current label and a preferred format for a future label and is playing an active role in discussions. The Commission is working to a timetable that should see a revised labelling Directive in force by 2008.

### New Car Labelling

Both the Government and the LowCVP believe that new car energy efficiency labelling is important in influencing consumer behaviour. The passenger car working group of the LowCVP is currently developing a proposal for a comparative consumer information label and is aiming soon to provide detailed advice to the Government on the precise format.

The LowCVP's proposal will build on the work undertaken by the Government in 2003, in which an Energy label was piloted across six car showrooms. The results of the pilot indicated that consumers find such labels helpful in providing clear, simple information about the climate change impacts of different vehicle makes and models. The Government hopes to have such a system of labelling in place, on a voluntary basis, by the second half of 2005.

Fuel economy and carbon dioxide emissions data		
Make/Model		
Engine capacity (cc)		1388
Fuel Type		Petrol
Transmission Type		5 speed manual
<b>Fuel Consumption</b>		
Measured according to the test of Directive93/116/EC		
Drive cycle	Litre/100km	mpg
Urban (e.g. town centre)	8.5	33.4
Extra-urban (e.g. motorway)	5.3	53.5
Combined (e.g. town centre and motorway)	6.5	43.7
In addition to the fuel efficiency of a car, driving behaviour as well as other non-technical factors play a role in determining a car's fuel consumption and CO2 emissions. Carbon dioxide is the main green house gas responsible for global warming		
<b>Fuel Cost</b>		
Calculated on a combined (town centre and motorway) drive cycle with a base fuel price of 75 pence/litre. Fuel costs may differ from this due to driving behaviour as well as other non-technical factors.		
Approximate fuel costs for 10,000 miles or 16,000 km (Average distance for 1 year)		£752
<b>Carbon dioxide emissions</b>		
grams per kilometre		
A-G bands	VED bands Equivalent	This car is
A: <100	AA	
B: 101-120	AA	
C: 121-150	A	
D: 151-165	B	154g/km
E: 166-185	C	
F: 186-210	D	
G: >210	D	
<b>Further information</b>		
A free guide on fuel economy and CO2 emissions which contains data for all new passenger car models is available at any point of sale and on the web at: <a href="http://www.vca.gov.uk">www.vca.gov.uk</a> . Some specifications of this make/model may have lower CO2 emissions than this. Check with your dealer.		

Example of trial label used in Mori 2003 car labelling consumer research

**4.4** The Vehicle Certification Agency makes data on the fuel economy of every passenger car on sale in the UK available in a booklet and online. The website has recently been enhanced to make it more user-friendly. The data is available on the Agency's website at <http://www.vcacarfueldata.org.uk>.

**4.5** The Inland Revenue has now made a company car tax calculator available on its website at [www.inlandrevenue.gov.uk](http://www.inlandrevenue.gov.uk) to help people compare the tax implications of different vehicle choices.

## 5 New fuels – production and distribution infrastructure

**PFV Commitment – *The Government will facilitate the quick and smooth development of new fuel distribution infrastructure as it is needed.***

- 5.1** The Energy White Paper suggested that if deep carbon reductions were to be delivered from the transport sector, low carbon fuels – including biofuels and renewably produced hydrogen – would have an important role to play. This section summarises recent developments on both biofuels and hydrogen, as well as providing information on other fuel initiatives.

### Biofuels

- 5.2** The 2003 EU Biofuels Directive requires Member States to set indicative targets for biofuels sales for 2005 and 2010, and to introduce a specific labelling requirement at sales points for biofuel blends in excess of 5%.
- 5.3** The UK has already taken a number of steps to promote the uptake of biofuels; there has been a 20 pence per litre duty incentive for biodiesel since July 2002 and the same incentive for bioethanol will take effect from January 2005. The Government has also committed to a rolling three-year period of certainty on the levels of the incentives for both biodiesel and bioethanol. Sales of biodiesel have increased rapidly since the introduction of the incentive: from 150,000 litres a month in August 2002 to over two million litres a month in July 2004. At the present time no bioethanol is sold in the UK, though this could change when the fuel duty incentive comes into effect next year.

## UK Biofuels Strategy

The DfT published a consultation paper, 'Towards a biofuels strategy for the UK' on implementation of the Directive in April 2004. The deadline for responses was 16th July. The consultation sought views on what more the Government might do to encourage the development and use of biofuels, and on the levels of biofuels sales targets that might be set for 2005 and 2010.

The consultation emphasised the balance to be struck between the costs of today's conventional biofuels and the benefits that they can offer, outlining some possible options for biofuels support in the UK.

The Government will continue to develop its strategy in light of consultation and the expanding area of research dedicated to biofuels and other renewable fuels.

- 5.4** As reported in the consultation paper on biofuels, UK biodiesel sales are forecast to increase steadily through 2004 and more rapidly in 2005. Much of this growth is predicted to be as a direct result of increasing UK biodiesel production. Based on current and planned biodiesel production, monthly sales figures could reach some 12 million litres by the end of 2005 – a six-fold increase over the current position.
- 5.5** The consultation sought views on the possibility of introducing a Renewable Transport Fuel Obligation (RTFO) for the road fuel sector, drawing on the experience of the Renewables Obligation that applies to licensed electricity suppliers. In essence, an obligation would require specified sections of the road transport fuel industry to demonstrate that a specified proportion of their aggregate fuel sales were 'renewable transport fuels'.
- 5.6** The Government considers that an RTFO could provide a mechanism to ensure the gradual substitution of fossil fuels for biofuels – and other renewable fuels – over the long term. Many questions remain however as to how such an obligation might work and whether it would be the most effective mechanism. Views were therefore invited on this in the consultation. The 2004 Energy Act has given the Government primary powers to introduce an RTFO, should the Government decide – in light of the consultation – to proceed down this route.

- 5.7** There are also a number of developments on the processing side that offer the possibility of reducing costs and/or improving environmental benefits. For example, a number of oil majors are currently exploring the possible use of biomass material (in the short term rapeseed and other vegetable oils, in the medium to long term other forms of biomass such as wood, grass and organic wastes) in conventional oil refineries. The product of this process would be conventional diesel or petrol – the only difference would be that the inputs to the process would be a mixture of mineral and bio-products.
- 5.8** Potentially, this could have a number of advantages. It could give a lot of the benefits of conventionally-processed biofuels without the cost and complication of separate fuel blending and distribution arrangements. It would avoid the current need for vehicles to be adapted to run safely on higher blends of biofuels; and it would avoid the possible fuel quality concerns associated with small-scale, independent production. It could also allow considerable economies of scale.

## Hydrogen

- 5.9** The Energy White Paper committed the Government to undertaking an assessment of the overall and long-term energy implications of the very large-scale use of hydrogen and biofuels in road transport, with a time-horizon of 2050. The DfT prepared this assessment, working closely with other Government departments and drawing on two commissioned academic studies and wide-ranging stakeholder input.
- 5.10** The assessment was completed and published alongside the Transport White Paper, *The Future of Transport*, in July 2004<sup>7</sup>. The assessment concluded that:
- significant use of renewable hydrogen or biofuels could reduce total carbon emissions from road transport to very low levels.
  - Improvements in fuel efficiency are essential but may not be sufficient to achieve very large carbon savings.

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7 <http://www.dft.gov.uk/strategy/futureoftransport/>

- It is not certain that a hydrogen economy will ever be realised. If it is, the UK could produce sufficient hydrogen for road transport from renewable resources, but at the expense of other energy sectors.
- The UK is capable of growing about a third of the biomass that would be required if road transport fleet were fuelled entirely with biofuels.

**5.11** The Government has now begun work to develop a UK hydrogen energy strategic framework. DTI has awarded a contract to a team led by E4tech Ltd (comprising E4tech, Element Energy and Eoin Lees Energy) to develop a strategic framework for hydrogen energy activities and support in the UK, with regular reference to key stakeholders. This follows from a scoping exercise earlier this year and will conclude in November 2004. The final framework will contain the following elements:

- *The hydrogen energy pathways to 2030 that most closely match the UK's overall policy objectives.* The consultants will meet with policymakers to gain clarity over the UK's policy objectives that affect hydrogen energy. The UK's capabilities in hydrogen energy will also be assessed in an international context. Together these factors will provide criteria against which different energy pathways can be assessed. The pathway(s) that most closely match UK objectives and strengths will be described.
- *An action plan for UK hydrogen energy activities that addresses the barriers to the preferred pathways.* Particular attention will be paid to the UK's role in international initiatives as well as the role of regional bodies and devolved administrations.
- *An overall vision for a UK hydrogen economy in 2030 and the choices facing policymakers in bringing this about.*

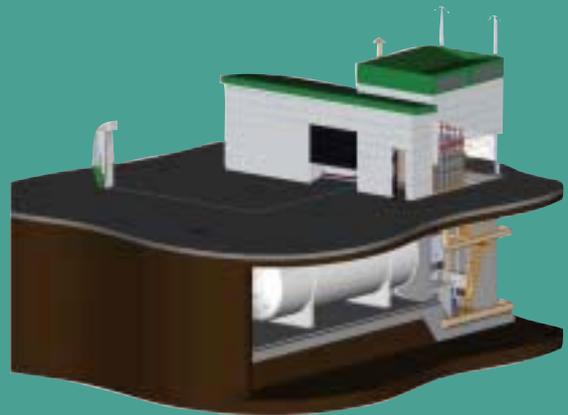
**5.12** Clean Urban Transport for Europe (CUTE) is an EU project for the demonstration of hydrogen fuel cell bus fleets in major cities across Europe. The project is mainly EU-funded, but significant funding has also been provided through the TransportEnergy New Vehicle Technology Fund.

### The UK's first hydrogen filling station

Planning permission has recently been given for BP to build the first hydrogen refuelling station at Hornchurch in Essex. The Hornchurch facility will be the first project within the CUTE programme to install and operate a hydrogen refuelling facility alongside conventional transport fuels. It will provide sufficient hydrogen to fuel the fleet of three fuel cell buses provided by Daimler Chrysler and operated by First Group on behalf of Transport for London.

The operation of this new facility should help BP and other fuel suppliers in:

- assessing the viability of providing hydrogen within the constraints of existing retail stations.
- developing the appropriate codes and standards to do so.
- giving customers the opportunity to see hydrogen being used in a familiar retail environment.
- and enhancing public awareness, understanding and acceptance of the benefits hydrogen offers.



*Image of proposed filling station*

**5.13** London is one of the cities taking part, and three buses entered service in January 2004 for the start of a two-year trial. The buses operate on a public route in central London. They offer a very smooth, quiet and comfortable ride and, to date, have proved very successful. Data will be collected on the buses' performance under operating conditions in London, which will feed into a final report on the overall project.

## Other Fuel Technologies

**5.14** Shell is developing a new gas to liquids (GTL) fuel technology in which natural gas is converted into very pure diesel oil. The sulphur content is negligible which allows catalytic converters to function more effectively. Shell carried out a trial of a GTL fuel on a London bus in the second half of 2003.

The results of the trial were promising and showed that replacing ultra-low sulphur diesel with GTL can lead to reductions in emissions of key air pollutants and a small reduction in emissions of tailpipe CO<sub>2</sub>. Another Shell trial of GTL is now underway in conjunction with Toyota cleaner engine and catalyst technology in a fleet of Avensis cars. The vehicles have been loaned to a number of charities and their emissions will be monitored in order to determine the combined effect of these technologies.



*Photo of CUTE bus on London street with DTI Minister Stephen Timms*

**5.15** The Government is also interested in the potential of water diesel emulsion (WDE) fuels to deliver carbon reductions and air quality improvements. The DfT has supported some emissions tests carried out on behalf of the London Borough of Camden which have shown some positive results. The Government will keep the possibility of further support for WDE under review.

## 6 Taxation measures for clean, low carbon vehicles and fuels

**PFV Commitment – *The Government will support the move to a low carbon transport system by ensuring the appropriate taxation of vehicles, fuels and infrastructure.***

- 6.1** In the 2003 Pre Budget Report the Government published details of its alternative fuels framework. The purpose of the framework is to ensure that policy continues to reflect the environmental benefits of alternative fuels and to establish a clear rationale for decisions on Government support. The main application of this framework is to policy regarding the level of fuel duty and duty differentials for alternative fuels. To justify Government support, a fuel must prove that it can offer genuine environmental benefits and be economically sustainable. The Government is not prepared to support alternative fuels whose long-term survival is dependent on excessive levels of subsidy unjustified by environmental benefit.
- 6.2** The Government realises that certainty is vital to ensuring that investment can be made. For this reason, the Government has made a commitment to a rolling three-year period of certainty on the duty differentials for all alternative fuels. The environmental benefits of a fuel will be measured primarily in terms of quantifiable benefits such as life-cycle carbon emissions, but other factors like air quality and waste reduction benefits will also be taken into account.
- 6.3** Budget 2004 also confirmed the Government's intention to explore new taxation methods that could enable the direct processing of biomass into mainstream conventional refinery processes, as described in chapter 5.
- 6.4** The Government is very interested in such direct processing, as we believe it could enable a significant shift in the scale of biofuel production and facilitate the mainstreaming of biofuel products. There is however much work to be done – both in fully understanding the relative carbon benefits of this process and in exploring adaptations to the tax system that could enable it economically. The UK Government is currently exploring both of these issues, and will discuss them further with stakeholders.

- 6.5** Capital Allowances allow the costs of capital assets to be written off against a business's taxable profits. The 2004 Budget announced that the Government will discuss with stakeholders the application of enhanced capital allowances to support investment in the most environmentally beneficial biofuel processing plants.
- 6.6** The Chancellor announced in the 2004 Budget a new three-year rolling horizon on duty differentials for road fuel gases (RFGs). RFGs currently benefit from very low duty rates making them around half the price of petrol and diesel. The Chancellor announced that the duty differential for natural gas would remain frozen until at least 2007, and the differential for liquefied petroleum gas (LPG) would only reduce slightly by 1 penny per litre per annum until 2007.
- 6.7** The Government remains committed to the introduction of sulphur free fuels. The Chancellor is due to make a further announcement in the Pre Budget Report, later in 2004.
- 6.8** The Inland Revenue has been carrying out an evaluation of the reforms to the CO<sub>2</sub>-based company car tax system. The carbon savings brought about by the reforms are already apparent. It is estimated that in 2003 alone the reforms have saved 0.15 to 0.2 million tonnes of carbon, equivalent to around 0.5% of total CO<sub>2</sub> emissions from all road transport. Details of the evaluation are available at [www.inlandrevenue.gov.uk](http://www.inlandrevenue.gov.uk).
- 6.9** Graduated Vehicle Excise Duty (VED) was introduced in 2001. Since then, new cars with CO<sub>2</sub> emissions below pre-defined levels have benefited from a reduced VED tariff. Motorists under the new system can save up to £110 in VED each year by choosing the most efficient and least polluting cars. This reform of VED was to provide motorists with incentives to choose more environmentally-friendly vehicles.

**6.10** As part of the ongoing support for, and monitoring of, the graduated VED initiative, the DfT commissioned MORI to conduct an independent study to assess its impact on new car purchasing decisions by private motorists in the UK<sup>8</sup>. The study showed that environmental factors were not the most significant in influencing new car purchasers, and that VED has not been the main driver behind car purchasing decisions. Nevertheless, the Government believes that graduated CO<sub>2</sub>-linked VED is an important tool for providing signals to consumers about the environmental impact of their vehicles. The Government keeps fiscal policy under continuous review and will take results of the study into consideration, along with all other relevant factors.

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8 [www.dft.gov.uk/stellent/groups/dft\\_control/documents/contentservertemplate/dft\\_index.hcst?n=11192&l=4](http://www.dft.gov.uk/stellent/groups/dft_control/documents/contentservertemplate/dft_index.hcst?n=11192&l=4)

# 7 European and international actions

**PFV commitments – *The Government will work proactively with the EU and other partners in the international aspects of securing the development, introduction and take-up of new vehicles and fuels.***

***The Government will ensure that appropriate standards and testing procedures are put in place for new vehicles, fuels and fuel distribution infrastructure.***

- 7.1** The Government has continued to play an active role in promoting the low carbon transport agenda in a number of international fora.
- 7.2** The Government has pressed the European Commission (EC) to develop a new round of Voluntary Agreements on new car fuel efficiency with the automotive industry. It believes that the scheme should be updated, and that a new, long-term fuel efficiency target should be set as soon as possible.
- 7.3** The Government has also presented its views to the EC on the benefits of a mandatory ‘energy efficiency’ style label for new passenger cars. In addition to the development of a voluntary UK scheme as described in chapter 4, the UK will continue to work closely with the Commission to ensure that an EU-wide scheme is developed and implemented as soon as possible.
- 7.4** The EC is in the process of preparing a proposal on Euro V pollutant emission standards for cars and vans, with an anticipated implementation date of around 2010. Responses from industry to a questionnaire on costs, capabilities and availability of emissions control technology are being analysed and a proposal is expected by February 2005. It seems likely that the focus will be on stringent cuts in diesel particulate emissions and some reduction in diesel NO<sub>x</sub> emissions. However tightening of petrol vehicle emissions limits and other changes such as extended durability requirements are not ruled out.

- 7.5** The Commission has also been working to bring forward legislation to reduce greenhouse gas (GHG) emissions from mobile air conditioning (MAC) devices fitted in new cars. The proposed legislation would first set maximum leakage standards (which are currently being developed in consultation with the automotive industry) followed by an eventual ban on the use of refrigerants with high global warming potential (GWP). Potential GHG reductions from such legislation would be significant due to the high GWP of hydrofluorocarbon 134a, the refrigerant most commonly used.
- 7.6** The UK holds the G8 Presidency in 2005 and the EU Presidency from July 2005. The Prime Minister has announced that Climate Change will be one of the UK's priorities for both Presidencies. We hope to use this opportunity to push the issue up the international agenda and re-inject some momentum to the process. To do this we plan to demonstrate how it can be possible to reduce emissions without compromising the services that we increasingly rely on. Low-carbon technologies, and the PFV strategy will form part of this wider effort.
- 7.7** The Netherlands currently holds the Presidency of the EU, and, as part of its agenda during this time, is holding an EU conference on sustainable mobility. The conference will focus on vehicle and fuel technologies and bring together representatives of governments, industry, non-governmental organisations and the scientific community. The main objective will be to provide the EC with a set of concrete recommendations that it can take forward in the form of a new European transport white paper. The UK has contributed positively to the development of the conference and will play an active role in discussions there.
- 7.8** The UK has formally agreed to host the second International Environmentally Friendly Vehicles (EFV) meeting in 2005, to continue the work begun by the Japanese. The meeting will be held in the second half of 2005, during the UK's Presidencies of the EU and G8. The plan for the meeting is at an early stage, but it is hoped that the meeting will achieve a common recognition of the policy direction of participating governments on EFVs; a system of international co-operation, with a particular focus on science and technology; and agreement on the direction of EFV development.

**7.9** The UK has been an active participant in UNECE/GRPE fora, where a number of regulations have been amended to accommodate alternative technology and fuels within the existing vehicle type-approval framework. ECE Regulation 115 has set design standards for LPG/CNG kits, and the emissions and fuel consumption regulations, R83 & R101, have been amended to enable hybrid-electric vehicles, including externally charged vehicles, to be tested and approved for general use. Work is also ongoing to define standards for hydrogen and fuel cell vehicles, aimed at removing potential barriers to trade.

**7.10** The International Partnership for the Hydrogen Economy (IPHE) is a US-led initiative, launched in Washington at the end of 2004. Fifteen countries including the UK were invited to join initially, and a number of others have subsequently expressed strong interest in participating. The IPHE will act as a mechanism for international collaborative research and also as a forum for advancing policies which will accelerate the cost-effective transition to the hydrogen economy. The Partnership is managed through a Steering Committee and a separate Implementation and Liaison Committee, and the Secretariat is provided by the US Department of Energy. The IPHE is not currently a funding mechanism but IPHE activities are expected to leverage additional resources, both public and private sector. The work programme is still being developed but will address hydrogen production, hydrogen storage, fuel cells, socio-economic aspects, codes and standards, and hydrogen education and outreach. Further information is available at [www.iphe.net](http://www.iphe.net).

## 8 Health and safety matters

**PFV Commitment – *The Government will continue to ensure that health and safety and environmental concerns are fully dealt with in the move to new vehicle technologies and new fuels.***

- 8.1** The Health and Safety Executive (HSE) has published guidance on the safe use of fuel cells entitled ‘Understand the hazards, control the risks’<sup>8</sup>. The guidance provides an introduction to the hazards associated with fuel cells and the fuels that they use. It gives simple, straightforward advice to help designers and users become more aware of the hazards and understand how the risks from this rapidly developing technology can be minimised.
- 8.2** The HSE has established a joint industry project to develop a recognised code for installation of hydrogen fuel cells in domestic and transport situations, paralleling the existing CORGI codes for gas. The development of a recognised code for the installation of hydrogen devices in domestic and commercial situations would represent the removal of a major obstacle to, and facilitate the more rapid deployment of, innovative technology.
- 8.3** Throughout the CUTE hydrogen bus trial, addressing health and safety concerns in a sensible manner was a priority for all the project partners. The specialist facilities which were built to house and, temporarily, refuel the buses were designed using latest knowledge on safe handling of hydrogen to minimise the hazards to operators. The HSE were involved with the design of the facilities from the outset, ensuring that they complied with appropriate standards and best practice. This project has provided the project partners with invaluable experience of the design, construction and operation of appropriate hydrogen facilities in a transport context.

## 9 Transport participation in Emissions Trading

**PFV Commitment – *The DfT will work with business transport users to develop projects through which carbon savings made in the transport sector can be brought within the Government’s Emissions Trading Scheme.***

- 9.1** The EU Emissions Trading Scheme (ETS) is due to start on 1 January 2005 and is expected to cover up to 10,000 installations across Europe; it will build on the work of the earlier voluntary UK ETS. The EU scheme will work on a ‘cap and trade’ basis. Each Member State is required to set a cap on the total level of CO<sub>2</sub> emissions for all installations covered by the EU ETS within that country. Each installation is then allocated allowances equal to their proportion of the total cap; one allowance is equal to one tonne of CO<sub>2</sub>. Operators have the option to: keep emissions at their current level and purchase allowances from the European market to cover the shortfall in allowances; reduce emissions to the level of their cap; or reduce emissions below the level of their cap and sell excess allowances on the market. The scheme provides a financial incentive for industry to be as environmentally conscious as possible, and tries to address the problem of industrial CO<sub>2</sub> emissions within the structure of the free market. The scheme is moving forward, and the Commission is in the process of assessing National Allocation Plans notified to them earlier this year, and Member States are due to make their final allocation decision in October 2004.
- 9.2** At present, transport is not included within the EU ETS, but the UK is in principle in favour of it being included in future phases. The 2004 Transport White Paper stated the Government’s commitment to consider the scope for including surface transport in the EU ETS. This will be taken forward across Government, and will be considered as part of the review of the UK Climate Change Programme.

**9.3** As outlined in the 2003 Air Transport White Paper, *The Future of Air Transport*<sup>10</sup>, the Government is actively pursuing the inclusion of intra-EU aviation in the EU ETS, and this will be a priority for the UK presidency of the EU in 2005. If the UK is successful, it is hoped that intra-EU aviation could be included within the second phase of the EU ETS, beginning in 2008. The UK is also pressing for the development and implementation of a well-designed international emissions trading regime.

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10 <http://www.dft.gov.uk/aviation/whitepaper/>

# 10 The Government's vehicle fleet

**PFV Commitment – *The Government will make maximum use of new vehicles and fuels in its own vehicle fleets, and encourage other public authorities to do so.***

- 10.1** The Government's framework for sustainable development on the Government estate has targets for travel, water consumption and environmental management systems. This new approach, agreed by all the central Departments, is the main vehicle for systematically assessing, managing, reporting and improving Government's sustainable procurement performance.
- 10.2** The agreed travel targets are that, against a baseline year of 2002/3, all departments by 31 March 2006 will:
- Reduce road transport vehicle carbon dioxide emissions by at least 10%, to be achieved through any combination of:
    - Reducing total business vehicle mileage.
    - Improving the average fuel efficiency of vehicles.
    - Reducing total fuel consumed.
  - At least 10% of all Departments' fleet cars to be alternatively fuelled.
  - All departments to reduce single occupancy car commuting by 5%.
- 10.3** The performance of individual Departments can be checked via the sustainable development in Government website, [www.sustainable-development.gov.uk](http://www.sustainable-development.gov.uk).
- 10.4** From 1 November 2004, all new central Government department contracts must apply minimum environmental standards when purchasing certain types of product, which cover aspects such as energy efficiency, recycled content and biodegradability. To assist departments in achieving this standard, a number of environmental 'Quick Wins' have been identified<sup>11</sup>.
- 10.5** Cars have been identified as one of these quick wins. The defined minimum environmental standard, which must be adhered to wherever practicable, is that new cars purchased for official use must emit less than 150g/km of carbon dioxide. This level will be kept under review.

11 [http://www.ogcbuyingsolutions.gov.uk/environmental/products/environmental\\_quickwins.asp](http://www.ogcbuyingsolutions.gov.uk/environmental/products/environmental_quickwins.asp)

- 10.6** Three per cent of the Government Car and Despatch Agency’s (GCDA) fleet is made up of low or zero carbon dioxide emission vehicles, comprising of two battery powered light vans and one experimental battery operated car. These three vehicles are recharged by electricity generated from a sustainable resources contract and are therefore truly zero emission vehicles.
- 10.7** In addition, during the latter part of 2003, the GCDA undertook a technical trial using 5% blend Biodiesel on a proportion of its diesel fleet. This was successful and the Agency now stores its own supply of biodiesel and operates the majority of its diesel fleet on this fuel.
- 10.8** The Government Car Service, part of the GCDA, which provides the ministerial fleet, has taken delivery of a number of hybrid electric vehicles and a number of members of the Ministerial Low Carbon Group have adopted hybrid vehicles as their official transport. The GCDA delivered two hybrid electric Toyota Prius cars to No. 10 Downing Street in August 2004 for use by the Prime Minister’s officials.
- 10.9** HM Customs and Excise, one of central Government’s largest fleet operators, has recently signed up to Energy Saving Trust’s (EST) TransportEnergy BestPractice Motorvate programme. The programme will help HM Customs and Excise to achieve a 12% reduction in fuel use, which includes a 3% reduction in mileage over a three-year period.



*Photo of Royal Mail CNG van*

# Next Steps

This second year of implementation of the PFV strategy has seen continued good progress, building on the achievements of the first year. The LowCVP has firmly established itself as powerful force for change, driving forward important initiatives and providing invaluable expert advice to Government. A number of New Vehicle Technology Fund projects have come to fruition, and ongoing projects, such as the Ultra Low Carbon Car Challenge, have continued to make good progress. The Government has further developed its fuel policies, setting out a clear fiscal framework, publishing its assessment of the impacts of the large-scale use of renewable hydrogen and biofuels, and consulting on the UK's future biofuels strategy.

The right framework is in place to ensure that this progress continues, but the Government, through the Ministerial Low Carbon Group, will keep this progress under constant review to make sure that the strategy remains on track. Although it is still very early in the Strategy's timeframe, it will be important to monitor closely progress towards the 2012 targets and make sure that we remain confident of achieving them.

Over the coming months the Centre of Excellence for Low Carbon and Fuel Cell Technologies is due to become operational. This will help to co-ordinate and showcase the UK's expertise in low carbon and fuel cell technologies and help UK industry exploit the opportunities that emerge.

The forthcoming review of the UK's Climate Change Programme will provide an excellent opportunity to take stock of the contribution of the PFV Strategy to the UK's overall climate change commitments. The transport workstream of this process will consider this alongside other measures to reduce CO<sub>2</sub> emissions from transport, ensuring that the right balance of social, economic and environmental factors is achieved.















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