

Emissions related charging: Impacts on the vehicle market



Final Report

Transport for London

August 2007

For and on behalf of Experian	
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Executive Summary

Experian Business Strategies in partnership with the ESRC Centre for Business Relationships, Accountability, Sustainability and Society were commissioned by Transport for London to examine proposals to introduce Emissions Related Congestion Charging in which the level of the charge would depend on the level of emissions of carbon dioxide from vehicles.

The proposals are set in the context of the Government's 2007 Energy White Paper and the Mayor of London's Climate Change Action Plan which both aim to reduce emissions of CO₂. Some 22% of London's emissions of CO₂ come from road transport. London has a large market for cars, comprising 9-11% of the 26 million cars registered in Britain, so changes in London influence the national picture. The proposals build upon Vehicle Excise Duty in which cars are banded by emissions of CO₂. Cars with low emissions would receive a "low CO₂ discount" from London's Congestion Charge while cars with high emissions would pay a "higher charge".

The market for cars is changing. The past decade was characterised by little change in the price of new cars and falling prices for used cars – but rising prices for fuel and servicing. As the market changes this affects the level of CO₂ emissions, for example the adoption of diesel over petrol, or demand for smaller cars or new types of cars, are likely to shape the market in the future. There is potential for new designs of cars by remapping engines and powertrains and reducing weight, and the development of new fuel technologies – biofuels, gaseous fuels, hybrids, battery-electric, fuel cells. Each of these designs or technologies have advantages and disadvantages and different timescales to take effect.

The proposals for Emissions Related Congestion Charging follow a precedent of other policy interventions across the world that influenced the car market and emissions. There are relevant case studies from: the European Union with voluntary agreements with the car industry and proposals for new regulations; California with a long history in leading legislation to promote air quality and influence the car industry; and the 2002 reforms of company car taxation here in the UK which directly tied tax rates with CO₂ emissions and impacted on the car market.

Detailed analysis of DVLA data provided a picture of the 2006 'parc', the stock of registered cars, within London. This estimates that there are over 3 million vehicles in London of which around 2.8 million are cars. Up to 7% of these cars would meet the criteria for a higher charge – almost 140,000 because they are post-2001 cars equivalent to the high emission band G and a further 60,000 that are pre-2001 cars with engine sizes of above 3000cc; 0.4% of cars, around 12,000, would meet the criteria for a low CO₂ discount. However, both these percentages are rising. For up to 150,000 identified new registrations in London in 2006, it is estimated that 10% met the higher charge criteria while 4.5% met the criteria for a low CO₂ discount.

When a motorist chooses a car, there are many factors that shape the choice – such as price, size, safety, comfort, image etc. At present, the level of CO₂ emissions is only a minor influence on the choice of a car – the objective of the proposals is to increase the weight placed on emissions. The total annual costs of buying and running cars were analysed by emissions bands. Cars in low emission bands are almost all in 'basic' or 'small' market segments and usually have low costs. Cars in high emission bands are in executive, sports, sports utility vehicle and luxury cars, and their costs are usually high. When set with the additional costs of paying London's Congestion Charge, at present the cost for a low emission car is high as a share of the annual cost for the car while that for a high emission car is low as a share of the annual cost.

Transport for London provided data from cameras monitoring the Congestion Charging Zone for 'June 2007' (specifically 21st May to 17th June). This records that 670,000 unique cars used the zone in June and these were captured making over 8.5 million journeys. Over 54% of these

cars were registered in London – and these made over 73% of journeys illustrating that the effect of the proposals would mostly be on cars registered in London. Cars that would be required to pay the higher charge account for over 16% of cars using the zone and 20% of captured journeys – they are above average users of the zone. Cars that would be entitled to a low CO2 discount account for 0.7% of cars using the zone and 1.5% of captured journeys – they are fewer but are also above average users of the zone.

The proposals for Emissions Related Congestion Charging are likely to have five main effects on the market for cars in London:

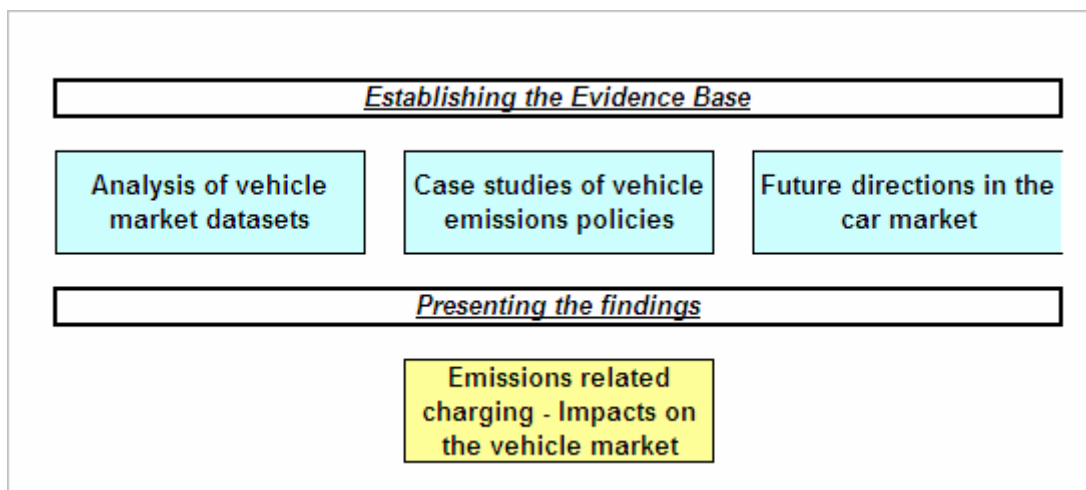
- (i) The introduction of the low CO2 discount would currently benefit a low proportion of cars currently using the zone – less than 1%. From such a low base, this does offer the potential for Congestion Charging to provide an incentive for smaller low emission cars. Indeed, for new registrations in 2006, the share of cars that met the criteria was 4.5% so the proportion of cars entitled to the low CO2 discount is certain to increase in coming years.
- (ii) The low CO2 discount also replaces the existing discount for alternative fuel cars. Around 0.8% of cars that travelled in the zone in June used this alternative fuel discount. Almost one third 30% of cars that currently travel in the zone with an alternative fuel discount would be entitled to simply transfer to the new low CO2 discount. The remainder are either cars with higher CO2 emissions or predate the necessary criteria.
- (iii) The higher charge would affect cars that were registered after 2001 and are in high emissions bands (of VED band G or equivalent). This affects a relatively high share, over 13%, of cars using the zone. It is estimated that around a third of these cars are larger-medium cars or executive type cars of which motorists could choose alternative substitutes with lower emissions. A further third are sports utility vehicles in which there are some lower emission (often diesel) alternatives that some motorists may switch to with the appropriate incentive. However, a further third are premium priced sports cars or luxury cars of which the proposed higher charge would be only a small additional cost to the total.
- (iv) The higher charge would also affect cars that were registered before 2001 and have engine sizes larger than 3000cc. This would affect less than 3% of cars using the zone. The majority of these cars are ageing and their owner would be likely to look to replace them over the next few years and may choose smaller and/or lower emission substitutes. A higher charge is likely to accelerate the exit of some of these older cars from London's parc. Others are older/classic sports cars and luxury cars and it is unlikely owners would substitute these because of the higher charge.
- (v) The proposal to withdraw the residents' discount for high emission cars would be likely to cause a significant increase in costs for those residents who choose to continue to use high emission cars. Around 2% of cars currently using the zone have residents' discounts but would be required to pay the higher charge. In 2006, a disproportionate share of new registrations located within the Congestion Charge Zone were for cars within band G and so have high emissions of CO2. It is likely that a reduction in new registrations of these cars in this part of London would affect the overall total.

Introduction: The Research Process

Experian Business Strategies (Experian) in partnership with the ESRC Centre for Business Relationships, Accountability, Sustainability and Society (BRASS)¹ were commissioned to examine proposals to introduce Emissions Related Congestion Charging (ERCC), in which the level of the charge would depend on the level of emissions of carbon dioxide (CO₂) from vehicles.

We developed a programme of research which produced a series of evidence papers which assist in providing a robust evidence base to help understand the nature of the car market in London, and the context of wider changes and trends in the car market. This evidence base also underpins economic modelling that is being undertaken separately by Experian to assess the impacts on London's car market of changes to London's congestion charging.

Figure 0.1: How the research was structured



Below, we summarise the content of the evidence papers. This final report seeks to draw together the main findings from the evidence papers and consider what this means for proposals to Congestion Charging policy in London.

1. Evidence Paper 1: Analysis of Vehicle Market Datasets

We undertook detailed analysis of vehicle market data to provide evidence of the car market in London, the parc of cars in London today and how the market is changing. Experian holds DVLA records of vehicles registered across the UK and within London – which provides data on the make-model, age, engine size, fuel type, location of registration and ownership of vehicles. The dataset is not 100% accurate as there are sometimes incomplete records and gaps, but this is the best available source for this type of research. Experian calibrated the records to match vehicles with their equivalent VED emissions bands from A through to G, and subsequently to market segments. This allowed us to present:

- An illustration of the total 'vehicle parc', i.e. every vehicle within the postal area of Greater London, as of the end of 2006.
- An illustration of the post-March 2001 parc, i.e. we can identify the VED emissions bands and equivalents of cars in London which were first registered after the date which the VED bands were introduced.

¹ BRASS includes the Centre for Automotive Industry Research at Cardiff University.

- An illustration of the pre-March 2001 parc, i.e. we can look at engine sizes of registrations from before the VED emissions were introduced.
- An assessment of London's car market in 2006, looking at new registrations by VED emissions bands and also by manufacturers and model type.

We were also provided with headline data from Transport for London (TfL) on the cars using London's Congestion Charging Zone in the June period of 21st May to 17th June 2007. This data is derived from the cameras enforcing and monitoring the area and provides a helpful indication of how the cars using the Congestion Charging Zone contrasts with London's parc of cars overall.

2. Evidence Paper 2: Case Studies of Vehicle Emissions Policies

We provided three detailed case studies, with contrasting ways in which public policy has sought to influence the vehicle market as a means to address the level of CO₂ emissions and the lessons learned from these policies. These examined the opportunities and constraints of using legislation to reduce CO₂ emissions from road transport sources. These case studies looked at:

- Policy from the European Union and how this developed from initial proposals of a carbon tax to establishing voluntary agreements with Europe's car manufacturers to produce an industry average on CO₂ emissions. This considered why the targets set by the voluntary agreement are unlikely to be met and examined the current proposals for mandatory targets.
- Legislation from California and how the State has a long history as the global leader in vehicle emissions policies. The type of intervention introduced in California has often provided a template for policy in Europe; and how the major manufacturers have responded in California has often shaped their product ranges in the rest of the world.
- Taxation on company cars in the UK and how since this was linked to CO₂ emissions in 2002, appears to have had an impact on the market for new company cars. Company cars are a major determinant of the market in the UK for new cars – and so subsequently shape the market for used cars – this provides an important background for the context of the car market within London.

3. Evidence Paper 3: Future Directions in the Car Market

We provided evidence of the future direction in the vehicle market through assessing the market, competing technologies and product development by leading automotive manufacturers and how this may shape future changes in CO₂ emissions from cars. This provided context on how levels of CO₂ from cars may change during the lifetime of the proposed scheme and beyond. This looked at:

- The pathways to reduce CO₂ emissions whether through market changes which do not require any new technologies, whether design changes such as bringing lighter cars to the market and technology enhancements through alternative fuels and engines.
- The type of future competing technologies and considering how options such as hybrid-engines and bio-fuels may emerge in the medium-term, that cars powered by fuel cells, batteries and gas-to-liquid may develop as much longer-term prospects; but that the internal combustion engine fuelled by petrol or diesel is likely to remain the dominant form of technology powering cars.
- The automotive industry's response to a changing market through providing case studies of new electric car and battery powered cars – but also a study which shows how manufacturers of larger high CO₂ emission cars may be most likely to push forward with innovation in technologies to reduce CO₂.

1 Context: Climate, carbon and cars

The policy context of climate change

This research into the proposed changes to Congestion Charging and the impacts on the vehicle market is set within the current policy context of the challenge of climate change and the resulting requirement to curb emissions of CO₂.

The UK Government's policy on emissions of CO₂ is set out in the 2007 Energy White Paper. The White Paper sets out a strategy to deliver energy security and accelerate the transition to a low carbon economy by saving energy, developing cleaner energy supplies and securing reliable energy supplies at prices set in competitive markets. Its targets for CO₂ emissions are a 60% reduction in CO₂ emissions by 2050, and a 26-32% reduction by 2020, against a 1990 baseline.

In London in particular, the Mayor of London has set out his Climate Change Action Plan – Action Today to Protect Tomorrow – to use policy to conserve energy and minimise waste in London. One of the Action Plan's three specific aims is to reduce London's contribution to climate change by minimising emissions of carbon dioxide from all sectors through energy efficiency, combined heat and power, renewable energy and hydrogen.

The rationale for these policies on CO₂ emissions is underlined by the recent report from Sir Nicholas Stern, Head of the Government Economic Service, on the economics of climate change and development. The Stern Review on the Economics of Climate Change (2006) examined the evidence on the economic impacts of climate change and the economics of stabilising greenhouse gases in the atmosphere. It considered the policy changes involved in managing the transition to a low carbon economy. The conclusion of the review was that the benefits of strong, early action considerably outweigh the costs.

The Stern Review reported that carbon emissions have already pushed up global temperatures by half a degree Celsius and if no action is taken on emissions then there is more than a 75% chance of global temperatures rising between two and three degrees Celsius over the next 50 years. A two to three degree rise in temperatures could reduce global economic output by 3% of GDP. The review found that to stabilise emissions at manageable levels, emissions would need to stabilise in the next 20 years and fall between 1% and 3% after that, which would cost 1% of GDP.

Cars and CO₂

Figures from the DTI show that in 2005, road transport accounted for 21% of total UK emissions of CO₂. The data shows that road transport is a growing source of CO₂ – in 1990 it accounted for 18% of all CO₂ emissions and by 2020 it is expected to account for almost 27% of all CO₂ emissions.

The Mayor's Climate Change Action Plan presents similar evidence specifically for London. This reports that London's road transport currently involves up to 27 million trips per day, resulting in CO₂ emissions of 9.6 million tonnes of per year, 22% of London's total emissions. Private road transport, mostly cars with some motorcycles, accounts for around half of this. Therefore, around 11% of London's CO₂ emissions come from cars.

Therefore, road transport is a major and growing source of CO₂ emissions. This means that if the UK generally and London in particular is to be successful in reducing, or even curbing the growth of, CO₂ emissions then it is necessary to address CO₂ as a result of car use. There are a number of broad approaches and combinations of approaches with which this is likely to be possible, for example:

- Reducing the number of cars and other vehicles on the roads
- Reducing the number of trips
- Reducing the distances travelled
- Reducing the levels of CO₂ produced by each car or other vehicle

In March 2001, the UK Government introduced reforms to Vehicle Excise Duty (VED), the road taxation paid each year by vehicle owners in the UK, to reflect CO₂ emissions. This was a small step to influence the nature of the car market through a more progressive system in which new cars that emitted, on average, lower levels of CO₂, would be charged a lower rate of VED than those cars which emitted, on average, higher levels of CO₂. This saw the introduction of six “VED bands”. Cars with the lowest levels of CO₂ (measured in terms of grams of CO₂ emitted in relation to kilometres travelled under test conditions) were VED band A. Cars with the highest levels of CO₂ were in VED band F. In 2006, a new seventh VED band G was introduced for cars with the very highest levels of CO₂.

Figure 1.1: VED bands by CO₂ g/km

VED Band	CO₂ g/km
Band A	Up to 100
Band B	101 -120
Band C	121 - 150
Band D	151 - 165
Band E	166 - 185
Band F	186- 225
Band G	226+

Source: DVLA

In this report, and for the purposes of Congestion Charging policy, all cars registered after March 2001 with CO₂ emissions above 226g/km are classified as being equivalent to VED band G. Therefore, those cars identified as band F between March 2001 and March 2006 but with CO₂ emissions above 225g/km are classified as band G.

These VED bands only apply to cars registered after the reforms of March 2001. For cars registered before this date, the rate of VED is based on engine size. The rate of duty for cars with engine sizes above 1549cc is higher than that for cars with engine sizes not above 1549cc.

2 Context: The national car market and the significance of London

The national picture for cars

The number of vehicles on Britain's roads has increased substantially throughout the past decade. Figures from the Department for Transport report that the total number of vehicles increased from over 25 million in 1995/6 to almost 33 million by 2004/05 – an increase of almost 30%. Similarly, the number of licence holders grew from 30 million to 32 million, an increase of almost 7%. The number of vehicles is now greater than the number of licence holders.

Figure 2.1: The context of cars in Great Britain

Great Britain	1995/6	2004/05
Number of vehicles	25.4m	32.9m
Number of licence holders	30.2m	32.2m
Households with no car	31%	26%
Households 2+ cars	25%	29%

Source: Department for Transport

One of the main changes in recent years has been the change in household ownership of cars. In particular:

- The decline in the number of households without a car. This fell from 31% of households in 1995/6 to 26% in 2004/05.
- The rise in the number of households with two or more cars. This increased from 25% in 1995/6 to 29% in 2004/05.

Across Great Britain, there are now more households with two or more cars than there are with no cars.

The London picture for cars

London has a large car market which to some extent influences the shape of the car market for the country as a whole. The Department for Transport (DfT) Regional Transport Statistics 2006 report that:

- There are around 3 million registered vehicles in London which amounts to approximately 9% of around 31 million vehicles registered in Great Britain.
- There are 2.5 million cars registered in London, around 9.5% of over 26 million cars registered in Great Britain.
- Over 8% of all new car registrations in Great Britain are in London. In 2005, this represented around 200,000 new car registrations out of a national total of around 2.4 million.

The headline DfT regional statistics may underestimate total car registrations and new car registrations in London because of the effect of company cars which may be kept in London but registered at another location i.e. the location of the fleet operating or lease operating company. The DVLA data we present later in this report may produce higher total of cars chiefly because Experian have undertaken additional research to identify the actual location of these company cars. However, the headline DfT statistics effectively illustrate the point that the car market within London contributes significantly to the overall picture for the UK.

However, within London, the market for cars is different to that for Great Britain. The pattern of change is also different. The DfT reports that the total number of vehicles in London increased from 2.6 million in 1995/6 to 3 million in 2004/05. This is growth of 15% – but it is half the rate of growth for Great Britain as a whole.

In London, 41% of households do not have a car. This is much greater than the share of car-less households for Britain – and the share of households without a car is increasing i.e. this is the opposite trend to that for the rest of the country. The number of households in London with two or more cars is 19%. This is less than for the country as a whole and the share appears to have decreased little over the past ten years.

Figure 2.2: The context of cars in London

London	1995/6	2004/05
Number of vehicles	2.6m	3.0m

	1997/8	2004/05
Households with no car	36%	41%
Households 2+ cars	19%	18%

Source: Department for Transport

3 Context: Emissions related Congestion Charging proposals

The proposals for emissions related Congestion Charging

The London Congestion Charge is a weekday charge that must be paid daily by the registered keeper of a vehicle that enters or travels within the congestion charging area in Central London. The Congestion Charge has had amendments and enhancements since its introduction:

- February 2003. Introduction of the original Congestion Charge Zone following the boundary of London's "inner ring road". The charge was £5.00 for trips in the zone on Monday to Friday (excluding public holidays) between 7am and 6.30pm.
- July 2005. The charge was increased to £8.00.
- February 2007. The Western Extension to the Zone was introduced, increasing significantly the area covered by Congestion Charging to include much of Kensington and Chelsea. In additions, the hours for Congestion Charging were reduced to between 7am and 6pm.

The Mayor of London has proposed that he would like to take forward the policy of encouraging behavioural change in London by introducing emissions influenced charging to the London Congestion Charging Scheme. The aim is to discourage the use of the most CO₂ polluting cars in London and influence car purchasing behaviour in favour of cars with lower levels of CO₂ emissions.

Figure 3.1: Proposal for Emissions Influenced Charging to the London Congestion Charging Scheme

Proposed Charging Band	Charge	Eligibility	Relating to post-March 2001 VED bands
Low CO ₂ discount	No charge	Cars which emit up to 120g/km CO ₂ and are Euro 4 compliant.	<i>This equates with VED bands A and B that meet Euro 4</i>
Standard Charge	£8.00	<ol style="list-style-type: none"> 1. Cars which emit 121-225g/km CO₂. 2. Cars which emit less than 121g/km but are not compliant to Euro 4 3 Cars which were registered pre-March 2001 and have engine sizes less than 3000cc 	<i>This equates with VED bands C, D, E, F (which emit less than 226g/km of CO₂) and VED band B cars that do not meet Euro 4.</i>
Higher Charge	£25.00	<ol style="list-style-type: none"> 1. Cars which emit more than 225g/km CO₂ 2. Cars which were registered before March 2001 and have engine sizes of over 3000cc. 	<i>This equates with VED band G and cars equivalent to VED band G.</i>

Source: Transport for London

This would mean that cars with very low levels of CO₂ emissions would pay nothing while those with very high levels would pay much more, at £25.00, than the standard £8.00 charge. The ranges reflect the latest DVLA VED bands. Although Band G was only introduced in March 2006 many cars registered before then have emission levels above 225g/km and so would also be considered to be subject to the higher charge.

Discounts from Congestion Charging

There are currently a range of Congestion Charging exemptions and discounts available to certain categories of drivers and certain categories of vehicles and individuals. Some of these would not be affected, for example:

- Vehicles such as buses, minibuses, taxis, minicabs, emergency service vehicles and motorcycles would continue to be exempt from the charge.
- Disabled people, or institutions for disabled people, who hold a Blue Badge would continue to have a 100% discount.

However, some other Congestion Charging discounts would be affected. These are:

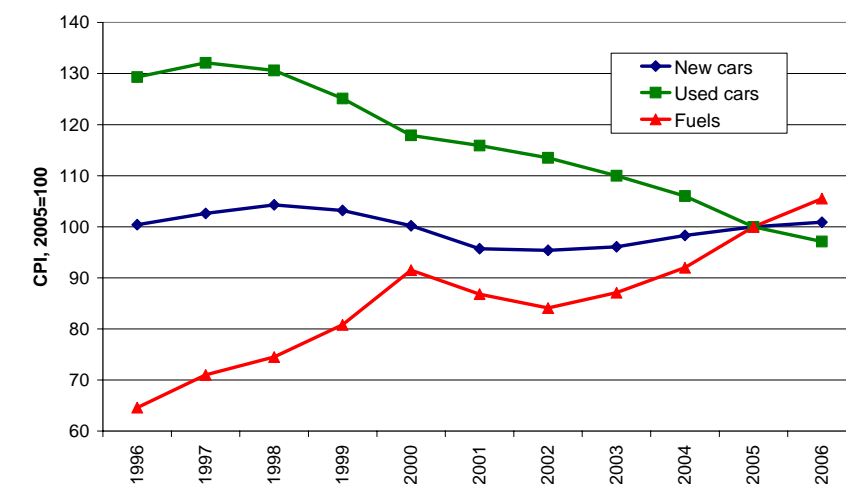
- **Alternative fuel vehicles:** that is cars which are powered by an alternative fuel and not solely by petrol or diesel, are currently entitled to a 100% discount. Under the proposals, only those alternative fuel cars with CO₂ emissions of less than 120g/km and so in bands A and B (and compliant with the Euro 4 standard) would be eligible for the discount. Alternative fuel cars with higher emissions and therefore in bands C – F, or in band B but not compliant with Euro 4 would be liable for the standard charge and alternative fuel cars that are VED band G or equivalent would be liable for the higher charge.
- **The Residents' Discount:** Residents living in the Congestion Charging Zone (or in some localities neighbouring the area) are presently entitled to a 90% discount on the Congestion Charge. Residents with cars in VED bands A or B (not Euro 4), C, D, E and F would continue to pay the discounted rate of 90% and those with cars in VED bands that meet the low CO₂ discount criteria would receive the full discount. It is proposed that the Residents' Discount would be withdrawn for those residents continuing to use band G equivalent cars. These would be required to pay the higher charge of £25.

4 Drivers of change: Costs and spending

The change in cost of motoring

The past ten years have been a decade in which the retail prices for new cars have scarcely changed. The ONS Consumer Price Index shows that new cars in 2006 were only fractionally more expensive than in 1996. Meanwhile, the price of used cars has fallen year-on-year. Consumers pay more than 30% less for used cars in 2006 than in 1996. In contrast the price of fuel for cars (i.e. petrol and diesel) has risen over the same period by over 30%.

Figure 4.1: Consumer price changes in car related spending



Source: ONS Consumer Price Index

This suggests that there is a rebalancing occurring in the costs of motoring. The cost of the actual car, whether new or used, is decreasing relative to the costs of running the cars such as fuel. This changes the economics of motoring. If purchasing costs are high relative to running costs, then this creates an incentive to use the car to make a journey. For example if a motorist chooses to leave the car at home and use public transport then the motorist is paying a high price for a car that is not being used. If, however, the purchasing cost is low relative to the running costs, then the motorist may be more likely to choose to leave the car at home; there is less of a cost to the motorist in not using the car.

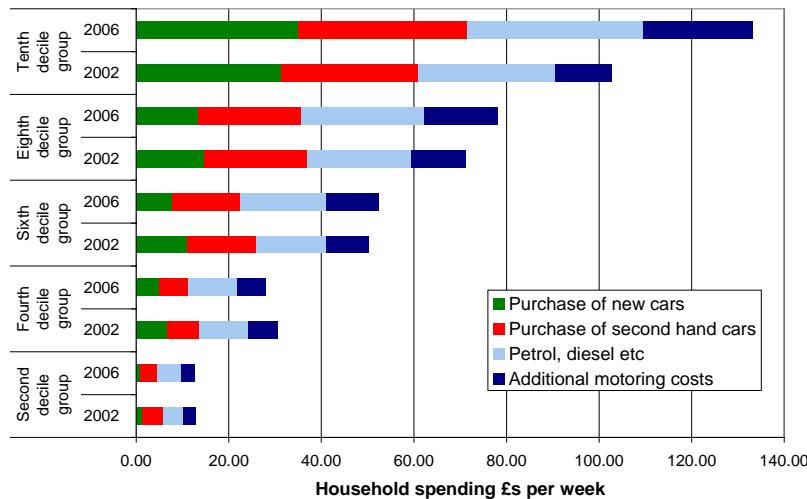
The change in spending on motoring

The trend of the changing economics of motoring is supported by evidence of household spending on motoring in different household income groups. The ONS Family Spending Survey presents detailed household expenditure at the UK level by gross income decile groups i.e. the second decile group represents the lowest income 10-20% of households and the tenth decile group represents the highest income 10%. Spending on cars and motoring rises with household income. In 2006 the lowest income groups spent on average almost £13.00 per week on motoring – reflecting lower levels of car ownership. The sixth income decile group (the 50-60th percentage of households) spent over £52.00. In contrast the highest income group spent on average over £133.00 per week.

Over 2002 to 2006, the average weekly spending among lower income groups on motoring scarcely changed. However, the balance of this motoring expenditure did change. The sixth decile group spent around £52.00 per week on motoring in both 2002 and 2006 – but in 2002,

over 50% of this was for purchasing the car; by 2006 just 43% was of the car and most spending was on fuel and additional motoring costs. Meanwhile, among the highest income groups, spending on motoring increased substantially with increasing amounts on purchasing the car.

Figure 4.2: UK spending on cars by household income decile



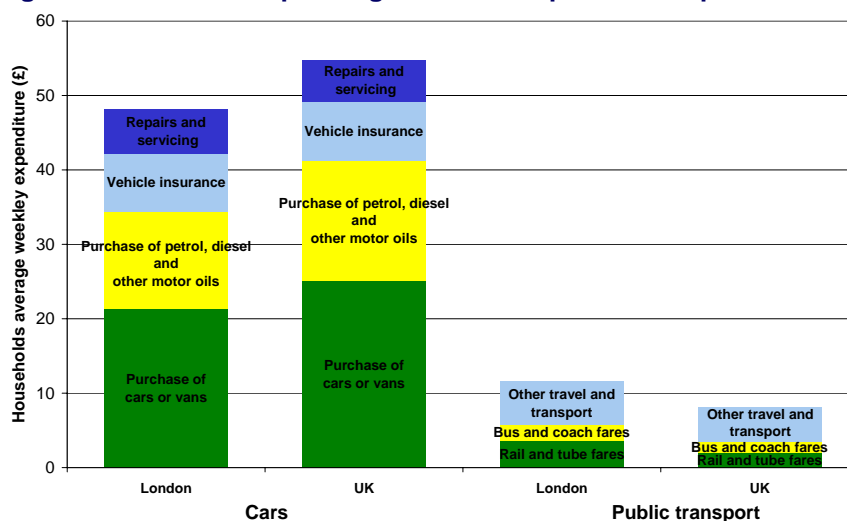
Source: ONS Family Spending 2005/06 and ONS Family Spending 2001/02

How spending in London is different

In London, the context of spending on cars is very different to that in the UK as a whole. Regional data from the ONS Family Spending survey highlights that London residents on average spend less on car use, and more on public transport, compared to other regions in the UK. Figure 4.3 illustrates that in 2006 London households spent around £48 per week on motoring (£21 on cars, £13 on petrol, £8 on motor insurance and £6 on repairs and servicing) and £12 on public transport (£4 on trains and Underground, £2 on buses, £6 on other transport).

These headline results are illustrative that car ownership and car use in many parts of London is comparably low; and that the use of public transport in London, for either work or leisure related travel, is a much more viable option than many other parts of the country. Recent levels of growth in the use of public transport in London, whether by buses or by rail, is an important driver of change in the future of car use in the city.

Figure 4.3: London's spending on cars and public transport



Source: ONS Family Spending 2005/06

5 Drivers of change: Market change

Changes in the market for cars affects the level of CO₂ emissions without a specific need for technological change or new designs. The market for cars in the future is likely to be affected by such factors as consumer preferences for the types of cars they wish to drive, the running costs such as the price of fuel – and also by public policy which affects the cost of motoring whether through vehicle excise duty, taxation of company cars, taxation on fuel, or more innovative policies such as relating congestion charging or road pricing to the types of car being used.

There are three principal ways in which the market may change which would reduce average CO₂ emissions without the need for technological change:

- Adoption of diesel over petrol
- Segment shift toward smaller cars
- Segment innovation with new types of cars

1. Adoption of diesel over petrol

Diesel engines on average produce 20% fewer grams per kilometre of CO₂ than their equivalent petrol cars. The market for diesel has increased. Figures from the DfT put diesel market penetration in the UK at over 30% compared to less than 20% in 2001. Figure 5.1 illustrates examples of the comparable CO₂ emissions for variations of petrol and diesel cars.

Figure 5.1: Examples comparing CO₂ emissions of diesel and petrol cars

Make	Model	Type	Diesel CO ₂ g/km	Petrol CO ₂ g/km
BMW	X83 Series 83	3.0	232	248
Land Rover	Freelander	2	224	265
Mercedes-Benz	S Class	320/350	220	242
Toyota	Avensis	2.0	146	191
Peugeot	307	1.6	129	174
Renault	Clio	1.4/1/5	117	158
Ford	Fiesta	1.4	119	145
MINI	Cooper	R56	118	139

Source: Vehicle Certification Agency

Diesel cars are potentially cleaner in terms of CO₂ emissions than petrol cars mostly due to their greater fuel economy. However, diesel cars have different emission characteristics, and an increase in diesel cars at the expense of petrol cars would have other implications for emissions. Compared to petrol cars, diesels have higher emissions of nitrogen oxide and much higher emissions of particulate matter. Therefore, although a shift to diesel engines is likely to bring benefits in terms of CO₂ emissions, it raises other concerns around urban air quality and health impacts.

2. Segment shift

The car market may change through “segment shift”. This occurs where manufacturers of high-value, larger, and so relatively high emitting cars, look to expand the value of the brand into different market segments. This is a strategy that is being developed particularly by German based manufacturers whose product range is traditionally in the high value market segments of executive saloons or sports cars. For example:

- Mercedes have moved into making smaller cars with their “baby Benz”. The Mercedes Benz A-Class is a small family car, a three or five-door hatchback, introduced in 1997 and redesigned in 2004. The Mercedes-Benz B-Class is a compact car introduced in 2005, essentially as an enlarged A-Class. These cars marked a significant departure for Mercedes from its traditional prestige models.
- BMW retained the MINI following its sale of the Rover Group and developed this as a small but high-value car focusing on the city based market. This is widely seen as a sales success for BMW.
- Audi developed the Audi A2 ‘supermini’ and although sales were disappointing is moving to produce the Audi A1, as a supermini coupe to be launched in 2009.

This means such companies are entering into competitive markets of small or lower medium cars, but seeking to retain their premium branding.

3. Segment innovation

Segment innovation involves the potential development of whole new types of market segments. There are innovations within existing market segments with preferences for alternative fuel types. For example, Toyota developed its range with the petrol hybrid Prius as did Honda with the petrol electric Civic. These represent the emergence of fuel technologies (reviewed separately) but they also point to the innovation of new market segments for motorists looking specifically for alternative fuel cars.

Segment innovation also allows for new types of vehicles– for example vehicles that are somewhere between a motorcycle and a car. This is currently rare but examples include the “Tango”. The Tango is an ultra-narrow electric sports car, built by Commuter Cars, an American company. It is thinner than some motorcycles and is designed to carry one person although is capable of seating two. It only takes up a fraction of a standard parking space and is able to park sideways. This type of narrow bodied car, often running on electric power, already exists and their growth in popularity would mark a significant change in the market.

Implications for Emissions Related Congestion Charging

Each of these drivers of change in the car market has implications for the proposals for Congestion Charging in London:

- Motorists with band G and equivalent petrol cars with CO₂ emissions of over 225g/km may look to shift to comparable diesel cars with CO₂ emissions below 225g/km. There are several examples among these cars – such models of Land Rover, BMW and Mercedes in which there are diesel substitutes which would fall into band F and so result in a saving from Congestion Charging. There are also several examples of band C cars with CO₂ emissions of 120-150 g/km with equivalents in band B, for example types of Renault Clio, Ford Fiesta or MINI in which again there may be diesel substitutes that would enable savings from Congestion Charging. There is therefore potential for emissions related Congestion Charging to result in a shift to diesel cars. This would help reduce CO₂ but could raise other issues around air quality in London.
- The changing market segments, both through segment shifts and segment innovation, offer opportunities for car manufacturers to respond to changing consumer needs. The introduction of emissions related Congestion Charging may conceivably encourage a demand from customers with brand loyalty to higher end car makers such as Mercedes, BMW and Audi for them to move into mid range market segments or to develop new segments based on new types of cars or fuel technologies.

6 Drivers of change: New designs

The level of CO₂ emissions produced by cars is also likely to change as a result of new designs. This requires some design change in cars on the market, for example:

- Remapping of engines and powertrain
- Weight reduction

1. Remapping of engines and powertrain

It is highly probable that despite development of new technologies, conventional petrol and diesel fuels and conventional petrol and diesel powertrain will continue to dominate in new cars. At the same time, oil-derived fuels are likely to increase in cost and so the car industry is likely to enhance conventional internal combustion technologies. There are a number of developments that are likely to have the effect of keeping conventional internal combustion engines environmentally competitive. Table 6.1 highlights some of the more important of these.

Figure 6.1: Likely improvements to internal combustion engines

Technology	Likely introduction	Leading players
Variable valve actuation	now	Honda
Electronic valve actuation	2010	Already available on some truck engines
Direct injection petrol engines (GDI)	now	Pioneered by Mitsubishi in 1990s (and Mercedes 300SL in 1950s),
Cylinder switch off	2010	Already available on some US V8 engines (e.g. Cadillac)
Stop-start	2006	Available on some PSA cars
Starter-generator	now	Citroen
Variable compression	?	Saab
Turbocharging and supercharging	now	Saab
Improved transmissions	now	More efficient transmissions can enhance overall efficiency, often without more expensive engine technologies.)

Source: BRASS

Transmissions are also subject to rapid development as a whole powertrain approach is now needed; this can often avoid spending on more complex engine technologies. More and more control is being taken away from the driver, who is increasingly regarded as interfering with optimum (emissions) performance. Even manual transmissions will therefore become more automated even though at their core there is a conventional gearbox. Automatic transmissions have already enjoyed improvements which significantly reduce frictional losses, while other novel technologies in electronic control systems well established in Japan are likely to be increasingly seen in Europe, especially on small cars.

2. Weight reduction

Steel is still the main material used in vehicle manufacturing – around 70% of a vehicle's weight is steel. The use of aluminium has also increased, mainly in engines, drive trains and chassis. It is estimated that a 10% weight reduction can improve fuel economy by between 4% and 8% and consequently reduce CO₂ emissions. This depends on changes in the size of vehicle and also changes in engine size. There are a number of ways to achieve weight reduction. This includes:

- Switching from conventional steel to high strength steels. There are various types of high strength steel from relatively low strengths to hardened strengths. At present, the average usage of high strength steel in a vehicle is around 7% to 10% but is used more extensively in some new cars such as the Mercedes A-class. The international ULSAB-AVC project (Ultra Light Steel Auto Body – Advanced Vehicle Concept) investigated intensive use of high strength steels and demonstrated this could reduce vehicle weight by around 20-30% for passenger cars.
- Replacing steel with lighter materials; for example metals such as aluminium or plastics. The use of plastics in vehicles has increased to about 8% of total vehicle weight but the growth rate of plastics content has been decreasing in recent years, possibly because of concerns over recycling. The weight reduction potential for plastics is high, maybe as much as 60% for fibre-reinforced plastic which is commonly used in aviation. However, its application to cars has been limited due to its high cost and long processing times.

While the amount of lighter materials in vehicles has increased over time, this has not always resulted in weight reductions or improved fuel economy. This is because lighter materials may also enable manufacturers to increase the size or the performance of the vehicle. The average weight of vehicles is estimated to have increased over the past ten years. This has been shaped by customer demand for safety and comfort; but also producers supplying new gadgets in cars to increase their selling potential on the market – but with the side-effect of increasing weight.

Implications for Emissions Related Congestion Charging

The development of new designs for cars, whether through remapping engines and powertrains or through reducing car weight with new designs or materials – implies that some CO₂ reductions are achievable without the need for alternative fuels to replace petrol or diesel. This offers some support to using policy to promote low emissions generally rather than target the development of alternative fuels. For example, offering discounts simply because a car runs off alternative fuel offers no incentive for motorists or car manufacturers to switch to redesigned or lighter cars.

However, design improvements in engines and weight cannot be regarded as a simple solution to reducing CO₂. For example, evidence from the Low Carbon Vehicle Partnership reports that the average weight of cars is becoming heavier – despite the increasing use of lighter materials. This suggests that the content of cars with electronics such as stereo sound systems, satellite navigation and air conditioning is adding to the overall weight. Therefore, even if the structure of cars becomes lighter, motorists may want to get more into their car which offsets the gains of weight reduction. This suggests the CO₂ reduction requires additional incentives to shift the market in favour of lighter cars. It is possible that the reported weight increase in cars has levelled off and there may, with the appropriate incentives, be gradual reduction in average car weights over the coming years.

7 Drivers of change: Fuel Technologies

The automotive industry has several technology pathways that are under development and which will impact upon the level of CO₂ emissions. The mix of technology and when it is introduced will depend upon the context of CO₂ emissions policy and the markets of each vehicle manufacturer. Technological change will cause long-term changes in the market, in particular with development of alternative types of fuel and engines that are likely to move the market away from a dependence on oil-based petrol or diesel. The main technologies to consider are:

- Biofuels
- Gaseous fuels and Gas-to-liquid
- Hybrids
- Battery electric
- Fuel cells

1. Biofuels

Biofuel for cars can be defined as liquid or gas fuel derived from biomass – this is usually from agricultural products specifically grown for use as biofuel such as corn and soybeans, flaxseed and rapeseed, sugar cane and palm oil. There are two biofuels currently used for transport purposes – ethanol and biodiesel:

- Ethanol is made primarily by fermenting sugars produced by plants. It is produced in large quantities in Brazil from sugar cane and in the USA from corn. In Brazil, ethanol is widely used as car fuel although this situation, because of Brazil's extensive sugar cane industry, would be difficult to repeat elsewhere in the world.
- Biodiesel is produced from a chemical reaction between vegetable or animal oil with ethanol or methanol. This has properties that are similar to diesel and its main advantage is its compatibility with conventional diesel but it has large disadvantages in terms of costs.

The interest into biofuels for fuelling cars raises many issues around sustainability such as:

- The actual impact on CO₂ reduction. The benefits of biofuel, especially that produced from corn, are believed to be mixed, depending on the agricultural processes used.
- The growth of biofuels would require agricultural intensification. This includes increasing use of pesticides and agrochemicals and/or an increasing need for agricultural land which would threaten biodiversity, in turn causing deforestation and the release of carbon.
- Concerns on the impacts of food supplies as switching to biofuels on a large scale would require considerable use of agricultural land which would crowd out food production.

Biofuels may have some role to play in reducing carbon but their role is likely to remain small. Demand will be driven for some time by the EU Directive and growing public interest. However, it is likely to settle at a level determined by the regulation and mixed with fossil fuels for use in mainstream engines.

2. Gaseous fuels and Gas-to-liquid

Two gaseous fuels are currently used in road vehicles worldwide. Liquefied petroleum gas (LPG) is a mixture of hydrocarbon gases manufactured during the refining of crude oil. Compressed Natural Gas (CNG) is made by compressing methane extracted from natural gas. Both fuels have lower carbon content than petrol or diesel although fuel consumption tends to

be slightly higher. The process of deriving CNG produces methane which is itself a greenhouse gas that is considered more damaging than CO₂.

Another option is turning natural gas into a liquid fuel that can be handled at normal temperatures. This GTL (gas-to-liquid) technology can produce a pure form of diesel which can make diesel cleaner. It allows the careful engineering of vehicle fuel, is more fuel efficient than oil and has lower carbon content. The product is currently available in its pure form in a number of countries and is blended with conventional diesel. Oil firms could introduce the fuel using the existing forecourt infrastructure. A Shell GTL refinery is coming on stream in Qatar during 2007, which will greatly increase global capacity for this fuel.

3. Hybrids

Hybrid technology combines two fuel sources for a car's powertrain. Toyota has made an impact in London with its Prius model – a petrol-electric hybrid. In typical urban stop-start driving, such powertrains give a CO₂ emissions advantage. Several other manufacturers are also introducing or preparing hybrid vehicles. European manufacturers are following two development trajectories. The first involves stop-start systems that switch off the engine when the car is stationary and start it immediately when the car needs to move. The system can be introduced on many cars currently in production. These systems give many of the advantages of a hybrid – particularly in urban driving – at considerably lower cost. It may even be possible to retrofit some of these systems to existing cars.

Another development is the diesel hybrid. This is thought to provide significant savings in fuel consumption as well as CO₂ emissions compared even with a petrol-electric hybrid. However, its integration in a car with acceptable noise, vibration and harshness is challenging and costly. Diesel-electric hybrid technology is currently used on trains, heavy earth-moving equipment and some light-medium trucks and buses. It is proven technology but with some problems in integration into cars. There are various prototypes and PSA Peugeot Citroen has announced it will have a diesel-electric hybrid car available from 2010.

4. Battery electric

Battery electric cars use chemical energy stored in rechargeable battery packs, and electric motors and motor controllers. Products in this niche have combined electric conversions from mainstream producers (e.g. Peugeot) or dedicated vehicles by niche producers (e.g. Th!nk). The development of battery electric cars was encouraged through California's zero-emissions mandate, which led to the development of electric cars such as the Tesla. Battery electric cars have become more viable in urban areas and their competitiveness is likely to grow further.

The mainstream car industry has reservations about battery electric cars, perhaps because it undermines one of the industry's core technologies – the internal combustion engine. Smaller manufacturers are likely to develop more credible battery electric cars over the next few years. Mainstream car makers are unlikely to enter this area in significant numbers although Toyota in the USA has announced a 'plug-in' (mainly rechargeable) version of some of its hybrid cars for launch in 2008 and GM's Volt prototype is also a step in this direction as it is proposed as a mainly rechargeable series-hybrid. Of course, a life-cycle or well-to-wheel approach means battery electric vehicles are not really zero emissions. These batteries require electricity generation which produces CO₂ emissions as most power is generated using coal, oil or gas.

5. Fuel cells

A fuel cell allows energy conversion by producing electricity from external supplies of fuel. Fuel cell cars are often regarded as the answer to environmental concerns in auto-mobility. All

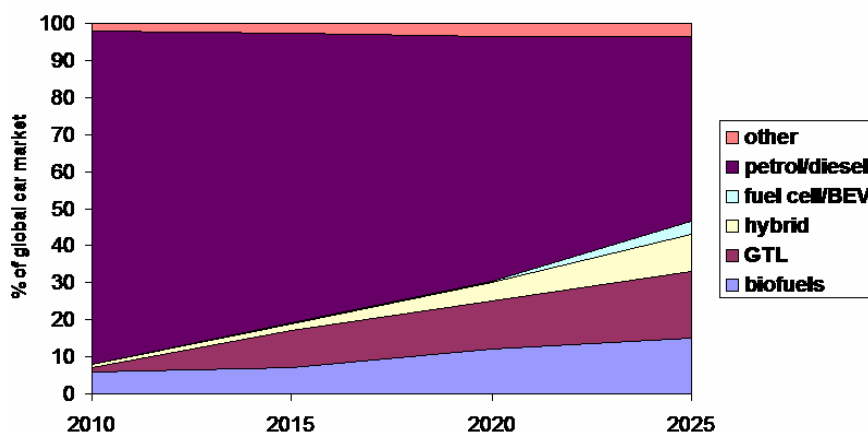
that has so far emerged are a few prototypes even though the technology is progressing rapidly. In many respects the fuel cell car is already competitive with the internal combustion engine car – however, there are many challenges:

- **Vehicle integration:** Before the 1990s, a panel van was the smallest possible fuel cell vehicle as the system required so much room. The 1990s saw a rapid reduction in size and today's experimental fuel cell vehicles look similar to conventional vehicles. However, the system continues to take-up too much space, for example the rear storage area.
- **Material cost and availability:** Fuel cells require platinum but this is scarce and reserves are likely to be stretched by expected production cars as platinum is also used in catalytic converters. The fuel cell industry and its suppliers are looking at ways of reducing this platinum dependency.
- **Fuel supply:** Most current automotive fuel cells run on pure hydrogen which needs to be extracted from water or from hydrocarbons – processes that require substantial energy. This means the total lifecycle impact of hydrogen is not necessarily environmentally optimal. On-board vehicle reforming of hydrogen is a possible future development but this would add weight and complexity to cars.
- **Manufacturability:** Manufacturers such as Ballard Power Systems are in early phases of establishing a process for producing automotive fuel cells. Forecasts envisage an incremental increase in annual production to reach a peak of around 1 million a year by 2015. However, with the total number of vehicles forecast to exceed 75 million units by 2015, fuel cells would remain only a small fraction of new vehicles.
- **Infrastructure:** The use of fuel cells would mean a need to replace or replicate the existing fuel supply infrastructure with a hydrogen version. This is likely to be highly costly. Few fuel cell vehicles would be sold without a sufficient fuelling infrastructure, while no commercial organisation would build an infrastructure without relative certainty of demand. An alternative approach is that hydrogen would not need to be distributed in the way that petrol or diesel is today but with on-board reforming systems – but this would instead add to the cost and complexity of cars.

Timeline

The combined effect of technological changes in the vehicle market point in our view to a future timeline as presented in figure 7.1.

Figure 7.1 Estimated UK Fuel/Powertrain mix 2010-2025 (%)



Source: BRASS estimates

Petrol and diesel engines with internal combustion engines are likely to remain the main form of technology in new cars – but this will weaken from around 90% of new cars in 2010 to about

80% in 2015 and 66% by 2020. This is a significant decline in the dominance of petrol/diesel engines which leaves scope for new technologies. Of these new technologies:

- Gas to liquid (GTL options) are likely to emerge more significantly from 2010 and reach around 10% of market share by 2015 and over 13% by 2020.
- Hybrid technologies are likely to have a longer lead time but perhaps reaching up to 5% by 2020.
- Biofuels are likely to play a significant role in the short-term, perhaps over 5% as soon as 2010 but this is likely to slow, reaching 12% by 2020.
- Fuel cells and battery vehicles are a much longer timeframe, remaining marginal at less than 1% by 2020 but then increase beyond this point.

Implications for Emissions Related Congestion Charging

There is a range of new fuel technologies emerging on the market which will widen the choice for motorists in London. Recent years have seen a number of cars with hybrid engines and battery electric emerge on to the market. Many of these are specifically designed and marketed as cars for urban driving and so have taken a foothold within London's market. It is likely that the existing alternative fuel discount for London's Congestion Charging has supported this. For example, we estimate from DVLA data of sales of new cars that in 2006, over a third of new registrations for the hybrid electric Toyota Prius in the UK were within London.

Simply because a car is "alternative fuel" does not mean it is low emission. For example the hybrid-electric version of the Lexus is not in the lowest CO₂ emission bands. Moreover, while alternatives such as bio-fuels and battery cars are likely to result in lower CO₂ emissions from cars, a broader 'well to wheel' approach suggests that the production of bio-fuels and electricity supplies are likely to generate CO₂ and other emissions.

The development of alternative fuels as a solution to reducing CO₂ emissions is a long-term process. While the market is seeing the emergence of hybrids, electrics and bio-fuels they are currently only a small share of the total market and this is likely to remain so; while other development such as gas-to-liquid are even longer term prospects. As the petrol/diesel internal combustion engine is likely to remain the dominant form for powering cars, a policy that encourages more efficient use of these cars is likely to be a more effective means of meeting CO₂ objectives. This favours a view that public policy should promote low CO₂ levels rather than favour specific alternative fuels.

8 Policy intervention: The EU

History of EU policy in road transport emissions

At the Rio Summit in 1992, the European Union established a target of stabilising CO₂ emissions at 1990 levels by the year 2000, with reductions thereafter. The EU proposed Carbon Tax of the mid-1990s can be understood as a policy initiative to meet these commitments.

The road transport sector is one of the main areas showing growth in CO₂ emissions. The European Commission estimated in the mid-1990s that, under a business as usual scenario, CO₂ emissions from cars would grow by about 20% by the year 2000, and 36% by 2010 from 1990 levels. It was in this context that in 1996 the first EU Carbon Tax on cars was proposed.

The principle of the proposed EU Carbon Tax was that cars which had fuel consumption over a specified target would be penalised by an extra purchase tax while those with better performance would benefit from a tax reduction. This would provide a clear economic incentive for consumers to reduce demand for less fuel efficient vehicles. It was proposed that the Carbon Tax would be sensitive to different size or weight classes of vehicle, so avoiding a direct attack on makers of larger cars, although larger powerful heavier cars would be penalised more than small cars. The main features of the proposals were:

- The performance target would have to be met by 2005.
- A CO₂ reference standard to be incorporated into the vehicle type-approval procedures.
- Fiscal incentives for vehicles with CO₂ emissions below the reference standard.
- Links to other policy measures e.g. reduction in car use.
- Proposed scrapping incentives to remove older cars from circulation.
- A refusal to allow fuel efficiency measures to compromise safety standards.
- A recognition of the need for any proposed policy to be equitable in social terms.

However, many of the details of the proposal were never decided and within the proposals lay a risk that certain European car manufacturers would be penalised, especially those in the market for larger cars including Volvo, Mercedes, Porsche, Jaguar, Audi, Saab, and BMW. It was also unclear if this tax would be sufficient to achieve aggregate fuel economy targets.

Therefore, an alternative approach was developed in which the car industry agreed voluntary targets with the European Commission in 1997. This helped to avoid outright regulation, new taxation, and potential problems with European Governments, particular vehicle manufacturers and pro-car consumer organisations. In contrast with the initial proposals, the eventual voluntary agreement was weak. Its main principle was that the industry as a whole should reach a figure of 140g/km of CO₂ emissions for new car sales by 2008. There were no penalties for non-compliance and no targeting of those models or manufacturers that produced high CO₂ emissions.

By mid-2003, the European Vehicle Manufacturers Association (ACEA) reported that the industry as a whole was unlikely to meet EU targets for the reduction of CO₂ from cars. Despite progress in introducing more efficient engines, vehicle manufacturers with sales in Europe are not going to achieve an average CO₂ emissions performance of 140 g/km by the required date in 2008.

ACEA reports that the level of average per car CO₂ emissions declined from 174 g/km in 1999 to 165 g/km by 2002 and 160 g/km by 2005 for ACEA members. At this rate of progress, by 2008 the industry average will at best reach 150g/km with a target of 120 g/km by 2012 being

improbable. Much of the early fall in average CO₂ emissions can be attributed to the growth in the market share of diesel engines and for this reason further improvements were always going to be much more challenging.

Therefore, the main reasons for vehicle manufacturers in the EU being unable to meet the requirements of the voluntary agreement are:

- More efficient engines are being placed into larger and heavier cars with the market's emphasis on cars' acceleration and speed rather than fuel economy. Car manufacturers claim consumers are demanding large SUVs, MPVs and sports cars.
- The overall balance of the car market has changed with a greater proportion of sales in the relatively high-CO₂ emitting segments such as SUVs and MPVs. Across Europe as a whole the segments most in decline are mid-range vehicles, especially family saloons.
- There is also a drift upwards in size and weight of cars within market segments. For example, a leading mid-sized car such the Volkswagen Golf has increased in size and weight over different generations of the model.

Current developments in EU policy

The EU Voluntary Agreement would inevitably face problems if, or indeed when, the industry fails to meet the targets. This now poses a challenge for the European Commission because it has to devise a mechanism to reduce CO₂ emissions without:

- Unfairly penalising specific vehicle manufacturers
- Reducing or distorting consumer choice by precluding certain types of vehicle or segment
- Transgressing Member State priorities and policies on vehicle taxation
- Precluding any particular technology or fuel choices.

The task is to devise an approach that shifts downwards the overall curve of fuel consumption and CO₂ emissions. This raises fundamental dilemmas. For example, small cars are generally held to produce less CO₂ per kilometre. However, the demand for such cars tends to be the most sensitive to price; while for manufacturers they are the cars with the lowest profit margins. Whatever measures are introduced at the EU level then there will be some type of market impact. The European Commission could be accused of distorting the market; although the car market is already distorted by various policies of national governments.

In February 2007, the European Commission launched a public consultation on proposals to reduce CO₂ emissions cars and light-commercial vehicles. The Commission announced that it would: *"...pursue an integrated approach with a view to reaching the EU objective of 120 g/km CO₂ by 2012. This can be achieved through a combination of EU and Member States action. The Commission will propose a legislative framework, if possible in 2007 and at latest by mid-2008, to achieve the EU objective of 120 g/km CO₂, focusing on mandatory reductions of the emissions of CO₂ to reach the objective of 130 g/km for the average new car fleet by means of improvements in vehicle motor technology, and a further reduction of 10 g/km of CO₂, or equivalent if technically necessary, by other technological improvements and by an increased use of bio-fuels"*

However, Europe's vehicle manufacturing association, ACEA, has criticised the proposals from the Commission and in June 2007, ACEA members agreed a response. ACEA argues that:

- The proposed timescales for an average of 120g/km CO₂ emissions by 2012 are unrealistic
- The proposals place the burden for reducing CO₂ mostly on the car industry – this is considered costly and could add an average of €2,500 to the cost of a new car. This in turn will lead to a diminished level of vehicle manufacturing in Europe with costs to jobs and Europe's economy
- CO₂ emissions from new cars have already significantly decreased over the past ten years

- Any future reduction target should not be an industry average but must differentiate between manufacturers according to the average weight of their model range, with makers of smaller cars subject to tighter targets than those making larger ones
- Car makers should also be able to average any individual target across their range, so that improvements to one model can compensate for increases in others
- The majority of CO2 emissions from cars in Europe is caused by a combination of the existing and ageing car fleet, by growing congestion and increasing mileage and that a more “integrated approach to cutting CO2 emissions” is required.

Implications for Emissions Related Congestion Charging

The developments at the EU level set the broad context for developments in the car market for the UK. Almost all cars on the UK’s roads are manufactured within the European Union with the leading manufacturers having plants established across European countries. Therefore, any agreement – or disagreement – between ACEA and the European Commission will have direct implications for the future parc of cars in London. However, as this is an ongoing consultation process then we cannot state with certainty what these implications will be.

If we envisage a scenario in which ACEA agrees to, and/or the EU enforces its proposals then it is likely that making cars that comply would not be impossible nor prohibitively expensive. There are already cars on the market that meet these requirements and there are many car models just above the 140g/km limit which with some technical improvements could comply with the lower limits. This would mean a substantial increase in the number of cars on the market with CO2 emissions of less than 120g/km and which would be entitled to a Low CO2 discount for London’s Congestion Charging. This may in turn increase the number of cars actually travelling in central London. TfL would keep the impacts of emissions related Congestion Charging under review and, if necessary, bring forward changes to the scheme. These could include, for example, amending the discount rate or the eligibility criteria.

The main challenge under this scenario would be for heavy and high performance cars. Here technical measures – some very expensive – would be needed to make them anywhere near compliant. Advanced powertrain (e.g. hybrids), alternative fuels and weight reduction would need to be used to substantially reduce their CO2 emissions. The implication is likely to see a polarising market developing between smaller cars similar to those available today; and larger cars with significantly increased technology but at a cost more expensive than their equivalents today. These improvements would be likely to push many high emission cars below 225g/km of CO2 and so be eligible for the standard charge rather than the higher charge.

Therefore, under the scenario of agreement or enforcement at an EU wide level then we could expect to see more band A/B cars on the market and fewer high band G cars within the next four to five years. This would therefore complement the impact of emissions related Congestion Charging. However, under a scenario in which there is not an EU wide agreement, then this would place more importance on meeting policy objectives for CO2 reduction at a national and regional level – giving scope for Congestion Charging to influence the market.

9 Policy Intervention: California legislation

History of California legislation in road transport emissions

Nearly all modern environmental regulation of motor vehicles can be traced back to initiatives in the State of California. As early as the 1950s, air quality issues in California had reached a stage where action was felt to be needed even though little was then known about how vehicle emissions could contribute to smog formation. The California Air Resources Board (CARB) was established and mandated the introduction of “positive crankcase ventilation” from 1963. This was subsequently introduced in Europe in 1971 and set a precedent for legislation in California to shape legislation in Europe.

The car industry in the US; namely the big three of GM, Ford and Chrysler; have resisted California’s environmental measures. It is the Japanese car makers with a strong position in the US market such as Toyota and Honda that adapted quickly to new regulations – and this is reflected in the market leadership of these manufacturers in lower-emission cars today. Some European car makers with a significant share of their sales in the US, such as Volvo, BMW and Mercedes also adapted to new regulations. As a result, these manufacturers offered ‘catalytic converters’ in the European market, several years before this was necessary.

By 1990, emissions from US new cars had been cleaned up to a considerable extent. But air quality in California’s urban areas was not improving as had been hoped. This was partly due to the increasing numbers of vehicles which negated the improvement in per-vehicle emissions. CARB introduced new standards for California which created pioneering vehicle categories: the Transitional Low Emission Vehicle (TLEV), Low Emission Vehicle (LEV), Ultra-low Emission Vehicle (ULEV), and Zero Emission Vehicle (ZEV). The California ZEV mandate required at least 2% of new cars sold in the state in 1998 to be zero-emissions. This was to promote battery electric vehicles which are zero emissions at point of use (if not zero emissions overall).

The ZEV requirements were eventually weakened, partly in response to intense lobbying from the car industry and oil industries. The ZEV requirement was finally abandoned in 2005 although many elements of the original proposals remain, including the emissions categories of ULE). The legislation also continues to set a technological trajectory informed by the need to move from conventional mechanical towards electric powertrain in some form. This is required for the main clean candidate technologies currently under consideration including hybrid electric vehicles and fuel cell electric vehicles.

In September 2006, California took another step with the Global Warming Solutions Act. The legislation granted CARB powers to set regulations and enforcement for a 25% reduction in greenhouse gas emissions by 2020. This legislation is highly significant and is likely to be followed by other US states that opt to adopt California type regulation. More recently, the State of California has taken one further step: it is suing six leading auto makers under “nuisance law” for causing damage to water supplies, coastline, forests, wildlife and health. The car industry is likely to base its defence on a cost-benefit analysis, for example arguing that the benefits their products bring to Californians outweigh the impact on the environment.

Research into impacts of California legislation

California has paid particular attention to the cost and benefits of its legislation to address emissions. The importance of assessing the impact of such regulation established is necessary to

underpin future regulation but also to establish rules in the American legal system. A series of studies were conducted at the Institute of Transportation Studies, University of California during 2004 to assess the financial cost of California Air Emissions Regulations.

The total cost of environmental compliance can be divided into what is borne by the producers, the car manufacturer, and what is passed on to the consumer, the motorist. The car manufacturer must invest to meet the regulation with R&D, equipment and marketing. The studies reported that car manufacturers were able to absorb the cost of emissions control equipment immediately and then in the subsequent years able to pass two thirds of that cost to the motorist.

It is also suggested that compliance costs diminish over time. The initial costs after the new regulation are normally the highest since firms do not have much time to properly adapt to the required measures. These costs fall over time as the manufacturer is able to redesign product and the investment costs are distributed over a longer period of time. The reasons for such cost and price reductions can be summarised as:

- Recovery of development costs in the initial production phase
- Hedging against lower future demand than eventually realised
- Tooling up for mass production whereby initial high tooling costs are recouped on initial production runs
- Product improvement and development costs are much lower than initial R&D
- Increasing competition has a depressing effect on prices realisable in the market

The research estimates that the regulatory requirements in California have added 12.5% to 20% onto the final price of the product to the consumer – but it has shown that this type of “technology forcing” can work with Californian regulation and lead to cleaner cars using:

- Conventional technology
- More radical technologies needed to make hybrids and possible future fuel cell vehicles.

It is also evident that environmental technologies are beginning to be used as a competitive tool. Toyota has consistently shown market leadership in this. PSA Peugeot Citroen has also recently led in the German market by offering particulate traps. Other car manufacturers may now also recognise the possibilities offered by the CO₂ reduction agenda and the California-inspired (but Japanese car maker led) drive into hybrid and fuel cell technologies.

Implications for Emissions Related Congestion Charging

The global multinational nature of vehicle manufacturing means that legislative developments in California filter through to shape the car market in the UK and in London. It was the response of car manufacturers to Californian legislation, in particular Japanese-based corporations such as Toyota and Honda, which helped to bring hybrid-electric cars to the market. For example, the Toyota Prius was marketed in California from 2001 as an Ultra-low Emission Vehicle (ULEV) and one tenth of all its worldwide sales to date have been in California – thereby underpinning the market viability for this type of car as it was rolled out into Europe. We can expect that as car manufacturers respond to the latest legislation in California – with the focus now on hybrid development rather than battery electric cars then this will point to a greater choice of lower CO₂ emission cars emerging in the London market over the next few years.

However, the policy implications from California are very different to the approach suggested in London. The Californian approach has been to shape the supply of the car market by enforcing manufacturers to introduce certain types of car to the market. Manufacturers have had to invest or face the costly risk losing the right to sell their cars in the State. The proposals in London are to redefine the demand for cars by changing the costs faced by the motorist.

10 Policy intervention: Company car taxation in the UK

The UK company car market

The company car market as a proportion of the total new car market is highly significant in the UK. Around half of all new car sales are company car sales. Therefore, the type of cars in total circulation in the UK is strongly influenced by company car sales. Private fleets usually retain cars for around 36 months (much less than the average private new car of around 60 months) – then the company car will usually be sold on the private used car market.

Company car fleets include those that are specifically needed for employees to perform their jobs, while others are essentially a ‘perk’ in lieu of salary. Typically, sales for private fleets have enjoyed price discounts related to the volume of vehicles purchased and are almost exclusively for new cars. Some companies have large fleets, in particular those which buy and then lease to third parties. There is therefore an attraction to develop policy towards fleet cars rather than the more difficult private retail sector – if major fleet purchases can be influenced by policy it is a quick and effective means of achieving policy aims.

The fleet market has a large proportion of ‘benefit in kind’ cars which means that employees have historically not been exposed to the full cost of purchase and use. This may, for example, include the provision of insurance, road tax, servicing and expenses of fuel. The effect of this has been a tendency for company cars to be larger than new cars sold through private retail, meaning that the overall parc of cars has developed as less fuel-efficient than would otherwise have been the case.

UK company car taxation

From April 2002, a reform of company car tax was introduced. The ‘benefit in kind’ charge for company cars is now calculated as a percentage of the car's price and linked to CO2 emissions. A summary table of the company car taxation system for petrol cars is presented in figure 10.1. The minimum charge is 10% of the car list price and the maximum charge is 35%. Diesel cars are subject to a further 3% surcharge and this charge will also be limited to 35%.

Using DVLA data held by Experian we have sought to illustrate the impact of the change in taxation on company cars following its immediate introduction in 2002. We have focused on UK company car sales by estimated VED equivalents in 2000 as this was a year shortly before the new system was introduced and also before companies would have been likely to pre-empt a change in the taxation regime, and in 2003, the year in which the revised taxation system would have fully taken effect. This is shown in figure 10.2.

Figure 10.1: CO2 Emissions and Benefit in Kind Tax, from 2002

CO2 emissions (grams per Kilometre)				Tax % of Car Price
2002/03	2003/04	2004/05	2005/06 - 2007/08	
n/a	n/a	n/a	n/a	10
165	155	145	140	15
170	160	150	145	16
175	165	155	150	17
180	170	160	155	18
185	175	165	160	19
190	180	170	165	20
195	185	175	170	21
200	190	180	175	22
205	195	185	180	23
210	200	190	185	24
215	205	195	190	25
220	210	200	195	26
225	215	205	200	27
230	220	210	205	28
235	225	215	210	29
240	230	220	215	30
245	235	225	220	31
250	240	230	225	32
255	245	235	230	33
260	250	240	235	34
265	255	245	240	35

Source: SMMT 2007

Figure 10.2: UK sales of new company cars by VED equivalents

VED Band (Equivalent)	2000		2003	
	Number	% share	Number	% share
B	600	0.1	2,500	0.3
C	105,500	12.7	130,100	16.7
D	96,700	11.6	103,300	13.3
E	259,900	31.3	263,800	33.9
F	334,100	40.2	249,100	32.0
G	34,000	4.1	29,200	3.8
Total	830,700	100	778,000	100

Source: Experian from DVLA

In 2000, before the change in company car taxation, there were over 830,000 company cars sold in the UK. In 2003, there were fewer than 780,000. This may reflect taxation changes although the total figure is also influenced by wider economic change such as a slowdown in economic growth over this period. However, in terms of VED band equivalents, the pattern of the company car market appears to have shifted and this is likely to be influenced by the taxation changes:

- Band G equivalents represented only 4% of new company cars in 2000 – but this had reduced by 2003. These cars, with CO2 emissions of over 225g/km were taxed in 2002 at 27-35% of the car price.
- New company cars in band B were almost negligible in 2000 and had remained small though experienced growth by 2003. These cars, with CO2 emissions of up to 120g/km were taxed in 2002 at 10% of the car price.
- Within the ‘mid-range’ bands that make up 96% of new company car sales there was a clear shift away from band F which fell from 40% to 32%. The cars at around 186-225g/km of CO2 were taxed in 2002 at 10% to 27% of the car price.
- This reduction in sales of company cars in band F appears to have contributed to an increase in sales spread across bands E, taxed at 15-19%, and also bands D and C which at less than 165g/km of CO2 were both taxed at 10% – the same as band B.

Therefore, the main impact of the company car taxation system in 2002 appears to have been a disincentive for company cars in band F – and generated incentives for company car drivers to shift to bands E, D and C. It did not have such a significant impact among the band G equivalent cars with the highest CO₂ emissions as these were, and continue to be, only a small share of company cars. The new system did not create incentives to shift to cars with the lowest CO₂ emissions in band B – largely as the tax rates compare with those for bands C and D but also because there were simply fewer band B options at this time.

However, by addressing the company car sector – representing more than half of new car registrations – the Government has helped to enable change in the new car market in favour of lower CO₂ emissions. Furthermore, as ex-company car sales represent an important source of used cars for the private market, this measure has a wider longer term effect.

Evaluation of reform in company car taxation

The case study of company cars provides a practical UK example in which taxation was used to adjust behaviour in the choice of car used by company car drivers specifically in relation to CO₂ emissions. HM Revenue & Customs (HMRC) conducted an evaluation in 2006 looking at the effects of the company car tax reforms of 2002. Some of the main findings from this evaluation are:

- The total number of company cars had reduced to around 1.2 million in 2005 compared with around 1.6 million in 2001. The company car tax reform is a major reason for this.
- There was a substantial increase in company cars running on diesel to around 50–60% at the end of 2004 from around 33% in 2002.
- Survey results suggest that 60% of company car drivers who were given a choice of car were influenced by the tax reform and chose cars with lower CO₂ emissions.
- The reform is believed to have led to reductions in CO₂ emissions from company cars –it is estimated that CO₂ emissions from company cars were around 15g/km lower in 2004 than if the reform had not taken place.
- The evaluation work also suggests that if drivers no longer have company cars, on average, they will choose private cars with CO₂ emissions figures that are around 5g/km higher.

The evidence on company cars illustrates that a change in motoring costs related to CO₂ emissions was effective in influencing car choices. It appears to have achieved this in two ways:

- (i) By contributing to a shift away from company car ownership. The reforms led to a rebalancing in the relative costs of using a company car and a private car. This led to a fall in the number of company cars and it is likely that this shaped an overall reduction in the number of new car registrations over recent years. The effect of this shift away from company cars on CO₂ emissions is ambiguous: if drivers switch to private cars they are exposed the full purchasing and running costs which should favour a small fuel efficient car; but the HMRC evaluations suggests former company car drivers switch to private cars with higher CO₂ emissions – this may suggest former company car drivers switched to older/larger cars.
- (ii) By contributing to a choice of company car with lower CO₂ emissions. The reform successfully reduced the average CO₂ emissions of company cars. This is supported by the HMRC evaluation and the results presented in figure 10.2. It appears that this may partly reflect a substitution towards diesel cars which may offer tax saving through lower CO₂ despite being subject to a further surcharge.

There is no existing evaluation of the effect the reform of company car taxation has had on the market for used cars. However, given that up to half of new car sales are of company cars and assuming that company car fleets are retained for an average of 36 months, then it is likely that the UK market for new company cars in 2003 shaped the market for used cars in 2006.

Implications for Emissions Related Congestion Charging

Company car tax reform provides evidence that motorists are sensitive to price changes and that public policies can impact on the market. Emissions related Congestion Charging would be a pricing mechanism that complements existing taxation regimes – both for company car taxation and vehicle excise duty.

A less certain implication for emissions related Congestion Charging is that one of the main areas in which charging could have been expected to have an impact – on the emissions of company cars that travel in the Congestion Charging Zone – is likely to be limited. Existing taxation policy has already shifted the distribution of company cars away from VED band G and into lower emissions bands. Emissions related Congestion Charging would strengthen the existing structure of company car taxation, for example by providing a further incentive for companies with car fleets that use the zone to use cars that are not affected by the higher charge. However, it is unlikely that there is a significant number or share of company cars that would be exposed to the higher charge. Band G cars are much more likely to be concentrated in private ownership in which owners may have already been willing to pay higher purchasing and running costs associated with band G.

11 London's market: The total vehicle parc

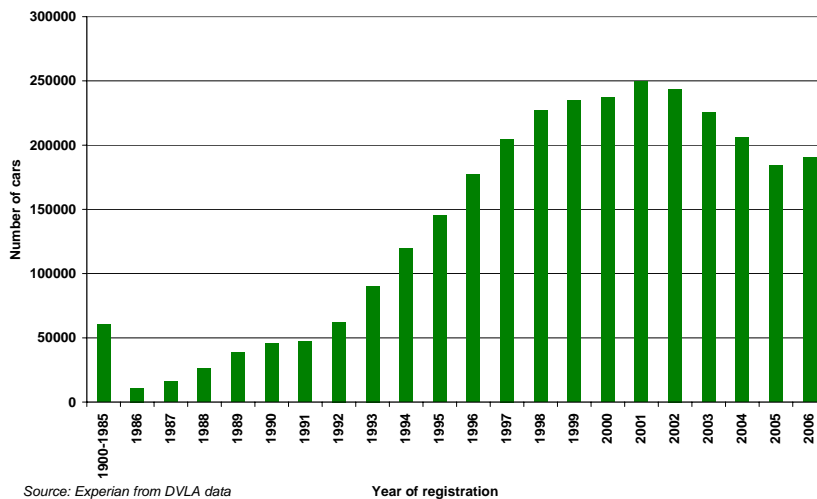
DVLA data and London's vehicle parc

The analysis of London's vehicle parc is derived from DVLA data held by Experian Business Strategies. The data for the total vehicle parc is for 2006 Q4 and in London. This shows us that in 2006 Q4 there were a total of just over 3 million *vehicles* registered in London. By vehicles, this includes cars, light-goods vehicles such as vans, and vehicles such as taxis. It does not include larger heavy goods vehicles or buses.

The ownership of these 3 million vehicles is mostly private. The DVLA data records that some 2.5 million (83%) are privately owned and over 200,000 (7%) have "other owners". The 'other' classification is where current ownership is unclear or unknown to the DVLA and we can assume most of this consists of privately owned cars i.e. 2.7 million vehicles (90%) are private. This leaves 300,000 vehicles (10%) as owned by companies.

The age of vehicles registered in London spans over a century of motoring with vehicles dating back to 1900. Figure 11.1 illustrates the age of vehicles in London in 2006 by the year in which they were first registered. Less than 2% of vehicles in London, around 60,000, pre-date 1986. There are a little over 53,000 vehicles in London that were registered over 1986 to 1988, around 1.7%. This suggests a scale of attrition in that by the time a vehicle is 20 years old it is unlikely to be on London's roads. The number of vehicles by year of first registration increases for each year up until 2001, rising from almost 11,000 registered in 1986 to almost 250,000 registered in 2001. The number of vehicles registered after 2001 begins to decline each year until 2005 when 184,000 of London's vehicles were registered

Figure 11.1: London's vehicles by year of registration



The key date from the perspective of the proposed changes to Congestion Charging is March 2001. This is when the VED emission bands came into effect. There are 249,000 vehicles in London that were registered in 2001. Some 29,000 of these were registered in January or February 2001, then 220,000 for the rest of the year.

Therefore, 58% of London's vehicles, some 1.77 million, pre-date the introduction of the VED emission bands. We refer to these as older vehicles. This means that 42% of London's vehicles (some 1.26 million) were vehicles that were registered after the introduction of the new VED regime of emission bands.

Identifying cars from commercial vehicles

Experian undertook further analysis to disaggregate “cars” from “commercial vehicles” within the vehicle dataset. This is necessary because commercial light goods vehicles and trade vehicles are treated separately in terms of national vehicle excise duty – they are required to pay standard excise duty which is not related to VED bands for CO₂.

Therefore, we filtered these vehicles from the dataset so the analysis could focus on cars. This includes light goods vehicles not over 3,500kg in weight such as a small, medium or large size van or pick-up truck. This includes a broad range of vehicles such as those by specific commercial vehicle manufacturers such as DAF, LDV and Iveco and by commercial models; from other manufacturers such as the Ford Transit, Volkswagen Caddy, Mercedes Sprinter, Renault Kangoo or Vauxhall Combo to name just a few; and specifically designed taxis such as those produced by London Taxis or Metrocab. It is estimated that there are over 200,000 such commercial vehicles registered in London, almost 7% of London’s total vehicles.

This leaves over 2.8 million cars (including estimates for company cars) registered in London. Over 1.66 million of these cars, 59%, were registered before March 2001 and 1.17 million cars, 41%, registered after March 2001. The overall picture of London’s vehicle parc is presented in figure 11.2.

Figure 11.2: Overall picture of London’s vehicle parc, 2006

	Total	% of total vehicles	% of total cars
Total vehicles	3,041,000	100.0	
Total cars	2,835,000	93.2	100.0
Total commercial	206,000	6.8	
Pre-March 2001 vehicles	1,771,000	58.2	
Pre-March 2001 cars	1,665,000	54.7	58.7
Less than 1500cc	556,000	18.3	19.6
1500-2000cc	852,000	28.0	30.0
2000-2500cc	130,000	4.3	4.6
2500-3000cc	67,000	2.2	2.3
Over 3000cc	62,000	2.0	2.2
Pre-2001 commercial	106,000	3.5	
Post-March 2001 vehicles	1,270,000	41.8	
Post-March 2001 cars	1,170,000	38.5	41.3
B (Euro 4) and A	12,000	0.4	0.4
B (not Euro 4)	9,000	0.3	0.3
C	239,000	7.9	8.4
D	225,000	7.4	7.9
E	202,000	6.6	7.1
F (equivalents)	244,000	8.0	8.6
G (equivalents)	137,000	4.5	4.8
Cars with unidentified VED bands	102,000	3.4	3.6
Post-2001 commercial	100,000	3.3	

Source: Experian from DVLA data

12 London's market: The parc of cars pre and post-March 2001

London's post-March 2001 cars

DVLA data held by Experian tells us that the number of post-March 2001 cars registered in London is 1.17 million. For these cars we can mostly apply the VED bands required for emissions related policy. The VED band G was not formally introduced until March 2006 although we can consider band G “equivalents” for cars after March 2001.

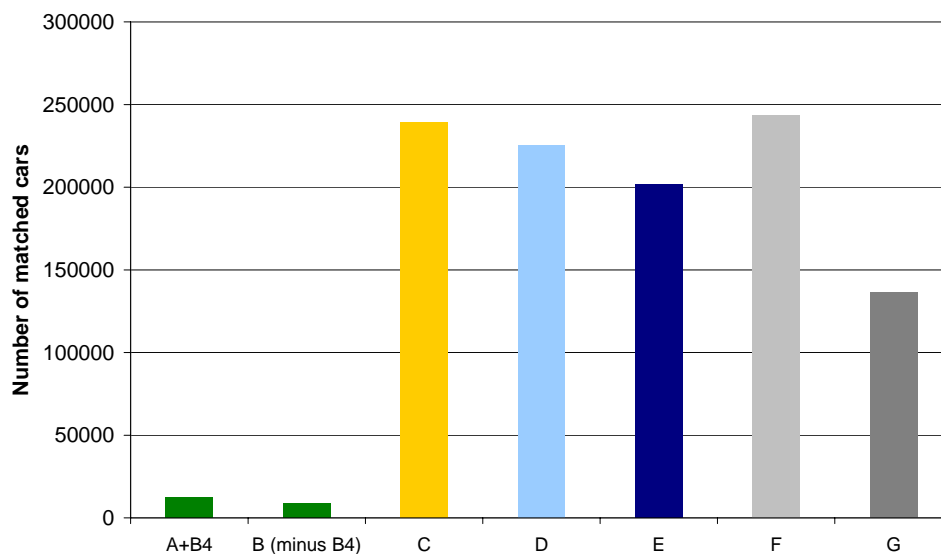
We can identify the VED band for a total of 1.07 million cars – over 91% of post-March 2001 cars. However, this means there are some 100,000 post-March 2001 cars for which we cannot identify the VED band:

- There are some cars that are unidentified models. For example, within the DVLA dataset, a car may be recorded simply as Ford, Vauxhall, Toyota, Peugeot etc. Its precise model and description is unknown which means we are unable to identify what the car is or what VED band it belongs to.
- There is also a small selection of cars that are imported directly by the owner. This includes examples of cars from large manufacturers such as Opel, it includes sports cars produced by companies like Ferrari or Maserati; but it also includes electric cars such as those manufactured by REVA.

It is not possible to provide the precise totals or proportions from these groups and the nature of the dataset means that a large number of cars are simply unidentified.

Therefore, there are 1.07 million cars in London that are registered after March 2001 and for which we can assess the VED bands A to G (or G equivalents) for those registered before March 2006. The counts of these cars by VED band are shown in figure 12.1.

Figure 12.1: London's matched younger cars by VED band



Source: Experian from DVLA data

The large majority of these cars are within the ‘mid-range’ VED bands C to F. The largest number of cars, some 240,000, is in band F. Band F cars have relatively high emissions but they would not be required to pay a higher charge. Band E has over 200,000 cars, band D represents over 225,000 cars, and there are up to 240,000 cars in band C.

The number of post March 2001 cars in band G (or G equivalent) is over 135,000. The number of post March 2001 cars in band B is over 21,000. Among these 21,000 band B cars, a little under 9,000 are compliant to Euro 3 but not to Euro 4. Over 12,000 band B cars are compliant with Euro 4. There are scarcely any cars in band A. This means that only 1% of younger cars in London would be eligible for the low CO₂ discount.

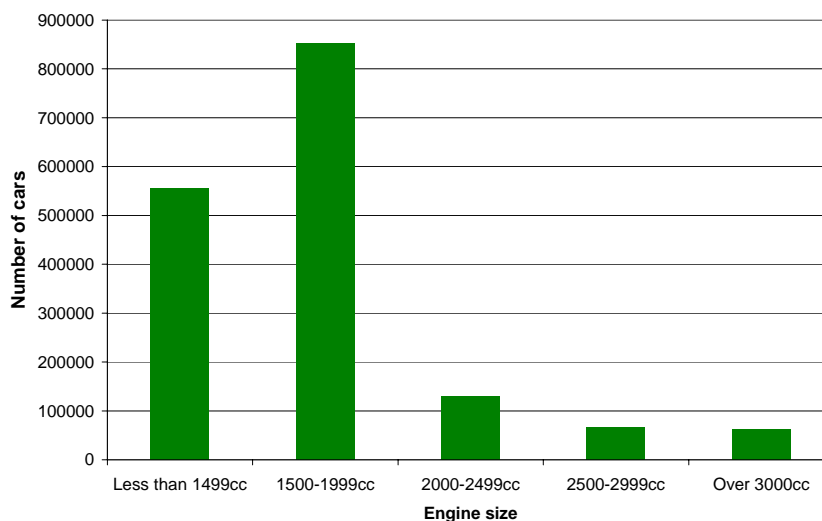
London’s pre-March 2001 cars

Experian used DVLA data to estimate that the number of post-March 2001 registered in London is 1.67 million. For these older cars we cannot apply the VED bands required for emissions related policy.

The ownership of pre-March 2001 cars in London is overwhelmingly private. Just 80,000 (5%) are owned by companies. This demonstrates a contrast with post-March 2001 cars in which up to 18% are owned by companies.

Over 50 % of cars registered pre-March 2001 had an engine size of between 1500-1999cc, that is over 850,000 cars. Those with an engine size of between less than 1500cc made up 33%. Therefore around three quarters of older cars still registered in London in 2006 had an engine size of less than 1999cc.

Figure 12.2: London’s pre-2001 cars by engine size



Source: Experian from DVLA data

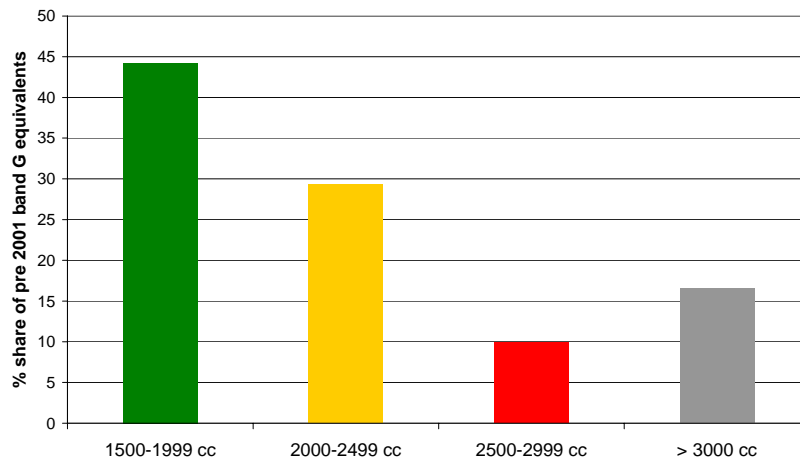
The provisional proposals for changes to Congestion Charging are that the higher charge would apply to older pre-2001 cars with an engine size of over 3000cc. Almost 4% of pre-2001 cars, almost 62,000, had an engine size of over 3000 cc. There is a further 4% of pre-2001 cars, around 67,000, with an engine size of 2500-2999cc.

Experian’s automotive analysts undertook further work to match older pre-2001 cars with VED equivalents. The analysts were able to model VED equivalents for around 930,000 cars (55%) which left over 730,000 cars that cannot be equated with a VED band.

Among those older cars that can be matched, Experian analysts were able to identify matches for 9,500 “band G equivalent” older pre-2001 cars. This would suggest that a little over 10% of older cars (i.e. 9,500 of 930,000 matched cars) are equivalent to band G. We could expect this share to be an underestimate if we allow for higher average emissions of CO₂ among older cars; however it provides a baseline estimate.

Further analysis of the estimated band G equivalents explored a possible relationship with engine size. This suggests that many of the band G equivalents have engine sizes of 1500-1999cc or 2000-2499cc. Only a minority have engine sizes of above 3000cc. This is shown in figure 12.3. This infers that a large share of older cars that are actually high in CO₂ emissions would be exempt from the higher charge because the engine size is below 3000cc.

Figure 12.3: London’s pre-2001 “Band G equivalent” cars by engine size



Source: Experian, modelled from DVLA data

13 London's market: New cars in 2006

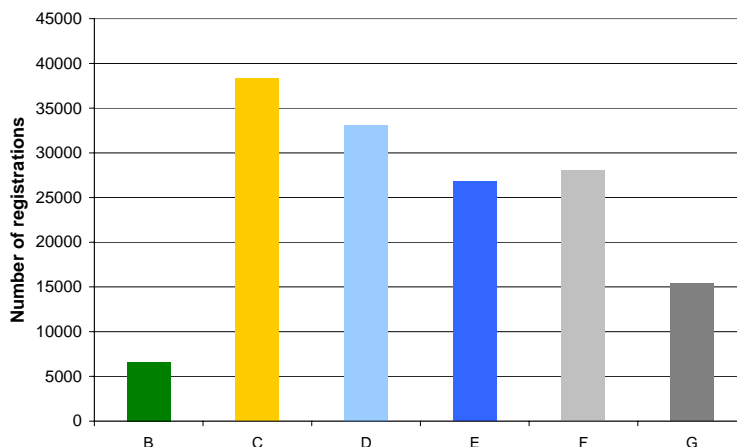
New car registrations by VED band

DVLA data held by Experian allows us to undertake detailed analysis of the latest picture of the car market in London, i.e. the number of 'new' first time registrations, in 2006. The data records a total of over 190,000 new vehicle registrations in London. This includes over 148,000 car registrations for which we can identify the VED band. We estimate that there are over 10,000 unknown cars that cannot be matched either because their full make and model is not identified or they are direct imports.

Here we provide a snapshot of London's 148,000 new cars in 2006 by identified VED band. This is illustrated in figure 13.1:

- Band B had over 6,600 registrations, 4.5% of the total. Over 6,400 of these band B cars (97%) were compliant with Euro 4. It appears that car manufacturers were prepared to meet the new Euro standards well in advance of the deadline January 2007.
- Band C had over 38,000 registrations, 26% of the total, making this the largest VED group among London's new registrations.
- Band D had 33,000 registrations, 22% of the total, making this the second largest group.
- Band E had almost 27,000 registrations, 18% of the total.
- Band F had almost 28,000 registrations, 19% of the total.
- Band G had over 15,000 registrations – this is 10% of new registrations in London. New registrations of band G cars were more than double those for band B.

Figure 13.1: London's 2006 registrations by VED band



Source: Experian from DVLA data

Some 55% of new car registrations in London were with private owners; 45% were with companies. However, we can also identify distinctive patterns of ownership by VED band as presented in figure 13.2. For example:

- In band G, 71% were for private owners. This is the largest share of private ownership, and conversely the lowest share of company ownership, 29%, for any VED band.
- In band B, of 6,600 registrations, 63% were for private owners. This is the second largest share of private ownership, and conversely the second lowest share of company ownership.
- The middle bands of D and E have the largest share of company ownership of cars at around half of new car registrations.

Figure 13.3: London's 2006 registrations by VED band and ownership, %

	Private/other	Company
B	63	37
C	54	46
D	49	51
E	51	49
F	57	43
G	71	29
Total	55	45

Source: Experian from DVLA data

New car registrations by make of car

The market for new cars in 2006 also allows us to provide analysis of the role of different car manufacturers within London's car market in 2006. Cars registered in London span some 50 manufacturers. Figure 13.4 shows those which featured in the 'top eight' for each VED bands.

Figure 13.4: London's 2006 car registrations by VED band and manufacturers, %

% of London 'market' in each Band by manufacturer							
Manufacturer	VED Band						
	All market	B	C	D	E	F	G
Top 8 manufacturers							
FORD	19	18	24	27	21	8	
VOLKSWAGEN	10		10	15	11	10	3
VAUXHALL	7	1	8	9	12	6	1
RENAULT	7	11	7	9	7	6	1
PEUGEOT	7	17	4	9	8	6	
MERCEDES	6		2	3	4	12	17
BMW	5		1	3	7	10	10
TOYOTA	5	34	5	2	4	5	2
Other key manufacturers for VED bands							
FIAT	4	1	14	1	2		
HONDA	3	3	7	2	1	3	
AUDI	3	0	1	4	2	5	6
NISSAN	3	0	4	4	3	1	2
CITROEN	2	6	4		4	1	
MINI	2			2	4	5	
LAND ROVER	2					1	14
VOLVO	1				1	3	5
SAAB	1			1	1	2	5
SUZUKI	1	2	1	1	1	1	1
PORSCHE	1						8
CHRYSLER	1						4
SMART		6	1				
Total	100	100	100	100	100	100	100

	Ranked 1-2
	Ranked 3-5
	Ranked 6-8

Source: Experian from DVLA data

The data is for those cars for which we know the VED bands so some manufacturers may be a little under-represented because they have a higher proportion of unmatched vehicles. However, this illustrates how manufacturers have a different presence across the VED bands and so would be differently affected by policies to change London's car market. For example:

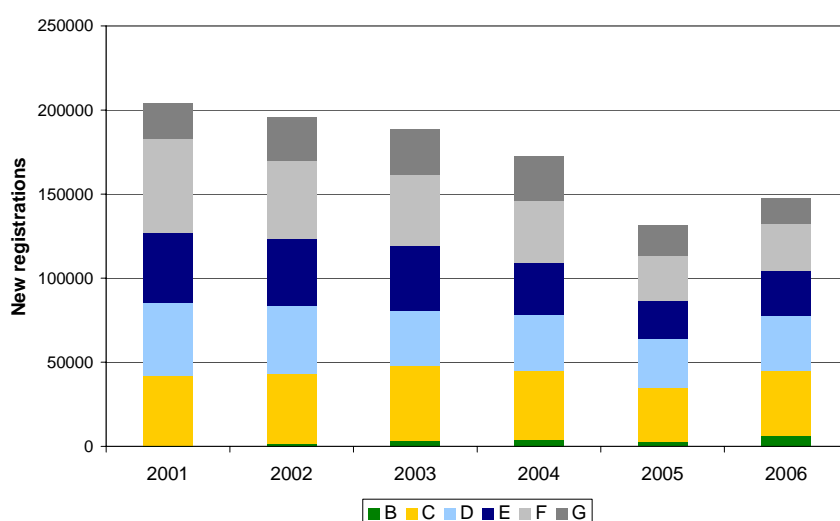
- Almost two thirds of new car registrations in London are through a few leading manufacturers. This overall market is largely shaped by sales of cars within the mid-range VED bands of C to F.
- Among new band B cars that would be entitled to a low CO2 discount, there is currently only a narrow range of manufacturers and models. Toyota, Ford and Peugeot have the largest presence in this group with the introduction of new Toyota's hybrid-electric cars and small engine city cars.
- Among band G cars – the manufacturers that are present are very different to those within band B. This includes the manufacturers that specialise in prestige or larger cars such as Mercedes, Landrover and BMW.

14 London's market: Recent trends

Recent trends by VED band

Experian automotive analysts explored the nature of the market for new car registrations in London over the years 2001 to 2006. This showed that the number of new registrations in London had been in decline. There were over 200,000 new registrations in 2001 but this had fallen almost as low as 130,000 in 2005. This recovered to 148,000 in 2006 but this is still below the number of new registrations recorded a few years previously.

Figure 14.1: New car registrations in London 2001-2006 by VED band



Source: Experian from DVLA data

These new registrations over 2001 to 2006 can also be approximated by VED emissions bands. These estimates suggest that share of new registrations by bands has remained largely consistent in London. The share for band G (and equivalent) cars appears to have peaked in 2003 and 2004 and fallen back slightly since then while the share of band F cars has decreased steadily in favour of cars in bands E and D, as shown in figure 14.1.

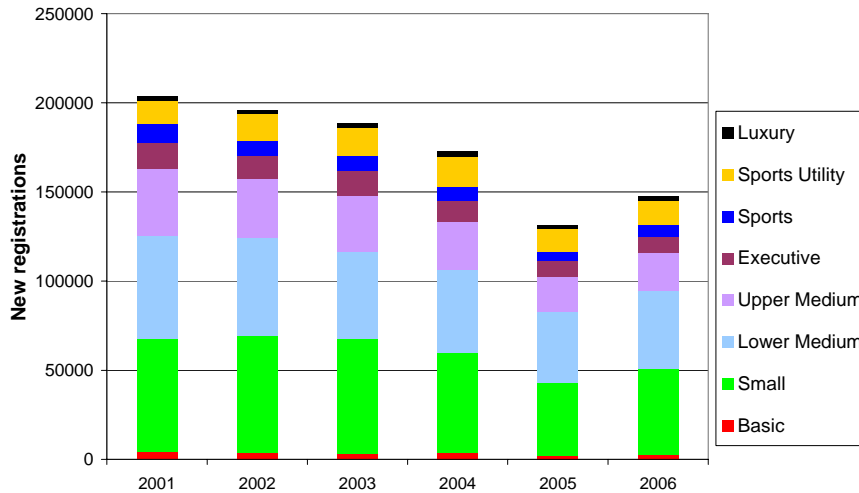
Recent trends by car market segment

However, this analysis of recent trends is more insightful in that Experian's automotive analysts matched new registrations with vehicle market segments from the Society of Motor Manufacturers (SMMT). This analysis of market segments in London tells us that:

- Basic cars represent around 1.5-2% of new registrations each year
- Small cars are consistently the largest market segment in London at around 33% of new registrations
- Lower medium cars are consistently the second largest market segment in London at around 28-30% of new registrations.
- Upper medium cars have diminished as a share of London's car market falling from around 18% of new registrations in 2001 to 14% in 2006
- Executive cars have also diminished as a share of the market in London, steadily falling from over 7% of new registration in 2001 to 6% in 2006
- Sports cars consistently average around 4% of London's market

- Sports utility vehicles represented only 6% of London’s new registrations in 2001 but this had climbed to 10% in 2004 – falling a little to 9% by 2006
- New registrations of luxury cars have held steady in London and so the share has climbed from just 1% in 2001 to 2% in 2006.

Figure 14.2: New car registrations in London 2001-2006 by market segments



Source: Experian from DVLA data and SMMT

The trends points to a slight shift in the market for new cars in London. In the context of an overall decline in new registrations, this decline is most acute in upper medium and executive cars. This has coincided with an increasing share of new registrations for sport utility vehicles and for luxury cars.

These trends are important in the context of VED emissions bands:

- The “basic” market segment is that in which cars in VED band B are most likely to be found. However, most basic cars are currently in band C which suggests there is scope for this “basic” market to move into the lowest VED bands. The “small” market segment, which has the largest market share, is mostly in bands C and D and so also has potential to move into lower bands.
- The declining “upper medium” and “executive” car segments are both characterised by cars in band F. In recent years an increasing share are in band E.
- The growth in the market for “Sport Utility Vehicles” and for “luxury cars” has helped sustain a market for cars that are in band G.

15 Congestion Charging: Understanding the costs of motoring

The choice of car

When a driver chooses which car they wish to purchase and/or drive, there are a number of factors that shape that choice, including the attributes of the car such as safety, comfort, and style. Survey work commissioned by TfL on motorists' behaviour in London provides examples of the most important and second most important factors that motorists consider when purchasing a car. This is shown in figure 15.1. At present, the level of CO₂ emissions is a minor factor influencing the choice of car compared to size, running costs and safety – although it is not a factor that is ignored. The objective of emissions related Congestion Charging is to increase the weight placed on CO₂ emissions as informing the choice of car.

Figure 15.1: Most important factors when purchasing a car

	Most Important	2nd Most Important
Purchase price	40%	18%
Size (e.g. boot, seats, doors)	18%	13%
Running costs	15%	20%
Fuel consumption	7%	14%
Safety	7%	6%
Fuel type (e.g. petrol, diesel, LPG)	4%	15%
Image and appearance	4%	3%
Emissions	3%	8%
Brand name	2%	1%
Performance/power	1%	2%
Other	1%	1%

Source: TfL Behavioural Survey 2007

Illustrating the costs of motoring

Experian analysts explored the costs of purchasing and running types of new cars to identify the relative annual costs of motoring across the range of VED emissions bands. Data on the motoring costs of purchasing, excise duty, fuel, insurance and servicing was drawn from What Car and the Vehicle Certification Agency. Data was collated on a sample of up to 100 cars and examples of the makes and models of cars for which data was used are shown in figure 15.2.

Figure 15.2: Example of new cars by VED band used in cost sampling

VED band	% 2006 register	Key makes and models
B	5	Toyota Prius, Aygo; Ford Fiesta Zetec, Fusion; Peugeot 107 Urban
C	26	Ford Fiesta; Fiat Punto; VW Jetta; Toyota Yaris; Vauxhall Corsa
D	22	Ford Focus, Mondeo; Renault Clio; Peugeot 207; VW Golf
E	18	Peugeot 307; Vauxhall Zafira; VW Golf
F	19	Ford Mondeo; VW Sharan; Mercedes Kompressor
G	10	Land Rover Rangerover; Porsche Cayman; Mercedes M-Class, S-Class; Bentley Continental
Total	100	

The results of the calculations for average annual costs are presented in figure 15.3. This consists of:

- The annual “purchase” cost. This is the current market price for a new car minus its expected resale price in three years, divided by three to provide an annual figure. Larger higher priced cars are typically in higher VED bands. However, the purchase costs of these cars are often reduced by their resale value – after three years they may be resold for as much as 50% of their original price while many lower priced cars depreciate at a faster rate.
- The annual “vehicle excise” cost. VED bands ensure a relatively progressive scale for the annual level of vehicle excise duty. Cars in band B are required to pay only £35 each year and this rises to up to £300 for cars in band G.
- The annual costs of “fuel” are based on an average of 12,000 miles each year. This is not adjusted to reflect different driving conditions or whether cars in different bands are likely to be used for different annual distances.
- The annual costs of “insurance”. This insurance is specifically in relation to the car and so does not reflect other factors that may shape insurance such as the age and gender of the driver or where the car is kept.
- The annual costs of “servicing” and maintenance. This is based on average annual servicing costs over the first three years of a car’s life.

Figure 15.3: Average annual costs of cars by VED band (£s)

VED band	Purchase	Vehicle Excise	Fuel	Insurance	Servicing	Total Annual Costs
B	2030	35	800	300	240	3405
C	2070	115	980	320	230	3715
D	3030	140	1110	370	200	4850
E	3200	165	1290	410	230	5295
F	4000	205	1390	460	250	6305
G	7170	300	1900	700	330	10400

Source: Experian from What Car? and VCA

This clearly shows that cars in higher bands tend to have much higher annual costs. The average total annual cost of purchasing and running a car in band G is three times that of a car that is band B. However, the annual costs of cars in higher bands are much more likely to be costs that are already ‘sunk’ costs i.e. they are within the purchase price. The more variable running costs, mostly fuel but also insurance and servicing, are a much lower share of the total costs among higher priced cars. This is shown in figure 15.4. When running costs are low relative to purchasing costs, then there is a likely implication of a greater incentive to drive.

Figure 15.4: % share of total annual costs of cars by VED band

VED band	Purchase	Vehicle Excise	Fuel	Insurance	Servicing	Total Annual Costs
B	59.6	1.0	23.5	8.8	7.0	100.0
C	55.7	3.1	26.4	8.6	6.2	100.0
D	62.5	2.9	22.9	7.6	4.1	100.0
E	60.4	3.1	24.4	7.7	4.3	100.0
F	63.4	3.3	22.0	7.3	4.0	100.0
G	68.9	2.9	18.3	6.7	3.2	100.0

Source: Experian from What Car? and VCA

16 Congestion Charging: Impacts on the cost to motoring

The additional effects of Congestion Charging

Congestion Charging provides a cost to motoring for those cars which drive through the Congestion Charging zone. The extent to which Congestion Charging is an additional cost of motoring is sensitive to the frequency of which it needs to be paid. For simplicity this is presented as 50 days per year, 100 days per year, and ‘heavy-users’ of 200 days per year who use the Congestion Charging zone most weekdays.

Figure 16.1 shows the estimates of annual Congestion Charging costs in relation to total annual motoring costs under the current charging system. This broadly assumes that all cars entering the zone pay £8.00 (e.g. no adjustment for any alternative fuel discounts). This demonstrates that Congestion Charging is not a trivial addition to annual motoring costs; even for relatively low use it is a more significant cost to motoring than vehicle excise duty. Under the current system, the share of Congestion Charging as part of annual costs appears to disadvantage cars in lower emissions bands. Taking a usage of 100 days as an example, then the charge adds 8% to the annual cost of a band G car but adds up to 23% to the annual costs of a car in band B or C.

Figure 16.1: Current Congestion Charging as addition to annual costs by VED band (£s)

VED Band	Annual Costs	Congestion Charge	50 days CC Cost	%	100 days CC Cost	%	200 days CC Cost	%
B	3405	8	400	12	800	23	1600	47
C	3715	8	400	11	800	22	1600	43
D	4850	8	400	8	800	16	1600	33
E	5295	8	400	8	800	15	1600	30
F	6305	8	400	6	800	13	1600	25
G	10400	8	400	4	800	8	1600	15

Source: Experian

Figure 16.2 shows the estimates of annual Congestion Charging costs in relation to total annual motoring costs under the proposed emission related charging system. This assumes that all new band B cars are entitled to the low CO2 discount and new band G cars pay a higher charge.

Figure 16.2: Proposed Emissions-related Congestion Charging as addition to annual costs by VED band (£s)

VED Band	Annual Costs	Congestion Charge	50 days CC Cost	%	100 days CC Cost	%	200 days CC Cost	%
B	3405	0	0	0	0	0	0	0
C	3715	8	400	11	800	22	1600	43
D	4850	8	400	8	800	16	1600	33
E	5295	8	400	8	800	15	1600	30
F	6305	8	400	6	800	13	1600	25
G	10400	25	1250	12	2500	24	5000	48

Source: Experian

The effects of these changes are, as anticipated, to favour the use of band B cars through ensuring no additional costs and to disadvantage band G cars through greatly increasing the

additional cost. Using 100 days as an example, then the charge now adds 24% to the annual cost of a band G car. This provides incentives in favour of band F in which the additional cost would be only 13%. There are disincentives to band C cars with additional costs of 22% which means motorists could favour a switch to band B.

Other additional costs

There are other additional costs to motoring in London. In particular:

- Costs to parking in Central London. It is likely that most cars entering the Congestion Charging Zone may then wish to park and so incur a further cost. There is no standard parking rate in central London – this varies by location and time of day. However, our research estimated an average parking cost in public car parks of around £4.70 per hour. This implies a 2 hour stay results in a parking fee greater than the cost of the standard Congestion Charge.
- Costs of residential parking in London. Few residential properties in Central London have allocated parking places or driveways – those which do may command a large premium in the property price. Almost all of London's boroughs have introduced systems of parking permits for residents with costs of over £100 each year in Central London. Some boroughs have introduced permit discounts for electric or 'eco-friendly' cars. Richmond-upon-Thames in outer London is the first to directly relate the costs of permits to VED bands.

17 Congestion Charging: Cars travelling in the zone

Cars using the Congestion Charging zone

Transport for London provided camera monitoring data on the cars which use London's Congestion Charging Zone. The most recent data available is for the period of June 2007. This records that almost 670,000 "unique" cars travelled in the Congestion Charging zone – unique cars mean that a car could have travelled in the zone multiple times throughout the month. The data also records the number of "captures" which is the number of journeys made into or within the zone. This records over 8.5 million such captures, meaning, for example, that each car on average made 12.7 days journeys into the zone. This camera monitoring data enables a specific picture to be built up of the types of cars using the Congestion Charging Zone and how this may be affected by proposals for emissions related charging.

Figure 17.1: Cars using the Congestion Charging zone by age, engine size and emissions band

	Cars	% share	Captures	% share	Captures per car	Proposed charge
Total Cars	670,000	100.0	8,527,000	100.0	12.7	
Pre-March 2001 Cars	246,000	36.7	2,671,000	31.3	10.9	
Less than 2000cc	186,000	27.8	1,877,000	22.0	10.1	£8.00
2000cc - 2,500cc	14,900	2.2	335,000	3.9	22.6	£8.00
2500cc - 2999cc	26500	4.0	187,000	2.2	7.1	£8.00
Over 3000cc	18,700	2.8	271,000	3.2	14.5	£25.00
Unknown	0	0.0	0	0.0	10.9	£8.00
Post-March 2001 Cars	424,000	63.3	5,857,000	68.7	13.8	
B(Euro 4) & A	4,500	0.7	124,000	1.5	27.3	£0.00
B (not Euro 4)	6,200	0.9	104,000	1.2	16.7	£8.00
C	76,000	11.3	754,000	8.8	9.9	£8.00
D	74,900	11.2	769,000	9.0	10.3	£8.00
E	69,300	10.3	953,000	11.2	13.7	£8.00
F	100,000	14.9	1,663,000	19.5	16.6	£8.00
G	90,400	13.5	1,448,000	17.0	16.0	£25.00
Unidentified	2,600	0.4	43,000	0.5	16.3	£8.00

Source: TfL Camera Monitoring, June 2007

Note: The results reported through Camera Monitoring change each month. The figures for June 2007 were the latest at the time of analysis but may differ with results presented in other consultation documents.

The main headlines to be taken from the camera monitoring data of cars travelling in the Congestion Charging zone are that:

- For cars registered post-March 2001
 - Almost 63% of cars registered post-March 2001. This means that cars in the Congestion Charging Zone tend to be newer than in the London market overall and the VED bands can often be identified.
 - Almost 69% of captures are of cars are registered post-March 2001. This means that newer cars are likely to use the zone more frequently.
 - However, this still means that up to 37% of cars are older cars that pre date March 2001 and so their VED band cannot be identified.

- For cars that would be entitled to the low CO2 discount because they are post-March 2001 and in VED band A or B and Euro 4 compliant
 - Only 4,500 such cars travelled in the zone over this period, 0.7% of cars in the zone. VED band A accounts for fewer than 30 cars
 - There were up to 124,000 captures for such cars. This is 1.7% of captures.
 - This demonstrates that these low CO2 emission cars are the type of car currently most likely to use the zone often with an average of 27.3 captures per car
- For cars that would be required to pay the higher charge of £25.00 because they are post-March 2001 and are VED bands G or equivalent
 - Over 90,000 such cars travelled in the zone over this period, around 13.5% of cars travelling in the zone
 - There were up to 1.45 million captures for such cars, 17% of captures
 - This demonstrates that these high CO2 emission cars are also more likely to use the zone frequently with an average of 16 captures per car
- For cars that would be required to pay the higher charge of £25.00 because they are pre-March 2001 but have engine sizes of over 3000cc
 - Almost 19,000 such cars travelled in the zone over this period, 2.8% of cars travelling in the zone
 - There were up to 270,000 captures, 3.2% of captures in the zone
 - This demonstrates that these cars are slightly more likely to use the zone with relative frequency with an average of 16 captures per car.

The Congestion Charging Zone and the London parc

Camera monitoring data also provides an indication of the postal area in which cars using the Congestion Charging Zone are registered. Of the 670,000 unique cars using the zone in June, over 54% were registered within London although many cars such as company cars that are kept and driven in London may be registered with a fleet or leasehold company located elsewhere. Figure 17.2 presents headline findings of where cars using the zone are registered.

Figure 17.2: Cars using the Congestion Charging Zone by postal region

Location	Cars % share	Captures % share	Captures per car
<i>Total</i>	<i>100</i>	<i>100</i>	<i>12.7</i>
<i>London</i>	<i>54.4</i>	<i>73.3</i>	<i>17.1</i>
Inner London	39	61	19.7
Outer London	15.6	12.7	10.5
<i>Outside of London</i>	<i>46.6</i>	<i>27.7</i>	<i>7.4</i>
South East of England	18.5	11.7	8.0
Rest of Britain	27.1	14.9	7.0

Source: TfL Camera Monitoring, May 2007

Fifty-four per cent of cars using the zone are registered in London – this accounts for 73% of captures illustrating the main market impacts of emissions related Congestion Charging would be within London. Inner London, in particular, accounts for 39% of cars but the majority, 61%, of captures. Sixteen per cent of cars are registered in outer London. However, there may also be some wider effect beyond London. Up to 19% of cars using the zone are registered in the wider south east of England, mostly in counties such as Hertfordshire, Berkshire, Essex and Surrey although these journeys are less frequent.

18 Congestion Charging: The low CO2 discount

The low CO2 discount

The low CO2 discount would apply to cars registered post-March 2001 that are equivalent to VED bands A and B cars which emit up to 120g/km of CO2. Cars must also be compliant with the Euro 4 emissions regulations. TfL would consider that all cars registered on or after 1 January 2005 would meet the Euro 4 standard, so all new band B cars that came onto the UK market in 2006 would be considered Euro 4 compliant. Figure 18.1 shows the distribution of cars which would be entitled to this low CO2 discount.

Figure 18.1: Cars entitled for low CO2 discount

	% of cars
Congestion Charging Zone	0.9
Total London parc	0.4
London's 2006 registrations	4.5

Source: TfL Camera Monitoring; Experian from DVLA

This shows that in June, only 0.9 of cars which travelled in the Congestion Charging Zone would be entitled to the low CO2 discount. This implies there is scope for this total and share to increase significantly.

Among the total London parc of cars for 2006, some 12,000 fall into this category of being entitled to a full discount, which we estimate to be around 0.4% of the total. However, in 2006, there were up to 6,400 new registrations of these cars, which constituted 4.5% of all new registrations in London. This reflects the fact that almost all VED band B cars registered in 2006 were compliant with Euro 4.

The difference between the share of cars using the zone (and the share of new registrations in band B highlights a risk over time for emissions related Congestion Charging: it is likely to substantially increase the number of cars that would be entitled to travel in the zone without charge.

The removal of the Alternative Fuel discount

Cars which are powered by an alternative fuel and not solely by petrol or diesel are currently entitled to a full discount in using the Congestion Charge Zone. There were over 5,400 cars in June that travelled in the Congestion Charging Zone with an alternative fuel discount – around 0.8% of cars using the zone. However, the frequency of trips into the zone of alternative fuel cars is high. These account for over 172,000 captures, over 2% of total captures in the zone, and have an average capture per car of 31.6.

However, only a small share of these cars would continue to be eligible for a low CO2 discount under the new proposals. The low CO2 discount would replace the discount for alternative fuel cars. This is illustrated in figure 18.2 which shows that less than a third of alternative fuel cars using the zone during that month would retain the full discount with a change in policy:

- Some 44% of alternative fuel cars do not meet the requirements of band B. Most of these cars have CO2 emissions above 120g/km – many fall within VED bands C-F, some within band G; while others pre-date 2001.
- While 56% of alternative fuel cars fall within band B (or A); the majority of these pre-date 2006 and so are not compliant with Euro 4.
- Therefore, only 30% of alternative fuel cars that currently use the zone would be entitled to the low CO2 discount under the new proposals.

Figure 18.2: Cars with Alternative Fuel Discount by age and emissions band

	Cars % share	Captures % share	Captures per car	Proposed charge
Alternative Fuel Cars	100	100	31.6	
Pre-March 2001 Cars	5.1	4.6	28.5	£8.00
Post-March 2001 Cars	94.9	95.4	31.8	
B(Euro 4) & A	29.6	33.1	35.3	£0.00
B (not Euro 4)	25.8	23.4	28.7	£8.00
C-F	36	36	31.3	£8.00
G	3	2.7	27.8	£25.00

Source: TfL Camera Monitoring, June 2007

The likely impacts of emissions related Congestion Charging

The camera monitoring data shows that the use of cars that meet the criteria for the proposed low CO2 discount (band A and B with Euro 4) is currently low. At under 1% of cars using the zone, this is higher than the contribution of these cars to London's overall parc. However, from a relatively low base, this does offer the potential for Congestion Charging to provide incentives for development of cars in this market.

The market for these cars is at present relatively constrained. Almost all cars fall into the SMMT market segment of "basic". This is perhaps a restrictive segmentation, but it serves to show that the immediate future for cars in band A/B4 is likely to be for small city cars – not for medium, large or premium cars. However, we can consider the effect of the low CO2 discount in terms of its impact on:

- **Band A cars.** There are scarcely any cars that meet the CO2 requirements for band A which use the Congestion Charging Zone. At the time of writing, there are no cars in band A available for retail directly onto the UK market. This band effectively anticipates development based on future technological improvements in cars.
- **Band B cars that are compliant with Euro 4.** There are a growing number of cars in London that meet the criteria. TfL would consider that all cars registered on or after 1 January 2005 would meet the Euro 4 standard, so all new band B cars that came onto the UK market in 2006 would be considered Euro 4 compliant. Therefore, although these cars constitute just 0.4% of London's parc, they accounted for 4.5% of registration in 2006 and so are likely to continue to increase in coming years. The incentive of a low CO2 discount is likely to encourage this further, in particular if we consider:
 - **Band B cars that are not compliant with Euro 4.** These already account for fewer cars in London than those that meet Euro 4 at 0.4% of London's parc. There is little scope for simply displacing existing band B cars.
 - **Band C cars.** Band C cars, like those in band B, are characterised by basic and small cars. Band C cars currently represent around 8-9% of London's parc and cars using the Congestion Charging Zone. Given similar costs and

characteristics, then there is scope for substantial substitution from band C cars to band B which emissions related congestion charging could encourage.

The risk of the low CO2 discount is that it substantially broadens the number of cars that would be able to travel in the zone without additional cost. This could feasibly increase the numbers of cars using the zone. However, the withdrawal of the alternative fuels discount would partially offset this through reducing the number of cars that can travel in the zone without additional cost. Up to three quarters of alternative fuel cars would lose their discount because they would not meet the new criteria. This removes a bias which gives discounts to larger alternative fuel cars which may actually be higher in CO2 emissions and encourages the development of more fuel efficient petrol and diesel cars. TfL would keep the impacts of the low CO2 discount under review and, if necessary, bring forward changes to the scheme.

19 Congestion Charging: The higher charge for band G

The higher charge for band G cars

The higher charge would apply to cars registered post-March 2001 that are equivalent to VED band G which emit over 225g/km of CO₂. This includes cars registered between March 2001 and February 2006 which would be recorded as band F but have emissions of over 225g/km. Figure 19.1 shows the distribution of cars which would be required to pay the higher charge for band G.

Figure 19.1: Band G and equivalent cars eligible for higher charge

	% of cars
Congestion Charging Zone	13.5
Total London parc	4.8
London's 2006 registrations	10
<i>Source: TfL Camera Monitoring; Experian from DVLA</i>	

In June, some 13.5% of cars which travelled in the Congestion Charging Zone would have been required to pay the higher charge for band G. Among the total London parc of cars for 2006, some 137,000 are band G and equivalent, which we estimate to be around 4.8% of the total. In 2006, there were up to 15,000 new registrations of these cars, some 10% of all new registrations in London.

The difference between the share of cars using the zone (13.5%) and their share in London's total car registrations (4.8%) demonstrates that there is a high propensity for band G cars to be driven in the Congestion Charging Zone. This highlights an opportunity for emissions related Congestion Charging: it is likely to provide a means of targeting band G cars.

The likely impacts of emissions related Congestion Charging

The camera monitoring data shows that the use of band G and equivalent cars in the Congestion Charging Zone is high – and disproportionately larger than their share of London's parc. There is potential scope for emissions related charging to influence the market for these types of cars, particularly for those who use the zone frequently.

However, the market for these band G cars consists of several market segments which we would expect to develop and respond to Congestion Charging in different ways. The datasets we have used provided an indication of the types of market segments that characterise band G. However, we cannot identify how frequently cars within these segments travel in the Congestion Charging Zone. In broad terms we can suggest that band G consists of:

- **Executive cars and Upper Medium cars.** We estimate that around 20% of band G cars are executive cars and a further 10-15% of band G cars are upper medium. Therefore these segments represent around a third of all band G cars. Importantly, in terms of new registration over 2002-2006, this segment appears to have represented a shift away from band G – possibly influenced by reforms in company car taxations or improved fuel efficiency of these types of cars – towards bands F and E. This suggests a high degree of substitution is possible within these segments between emissions bands. A higher charge for Congestion Charging may push up the running costs for those who use

executive or upper medium cars and they may be likely to choose to substitute for a similar car with lower CO2 emissions.

- ***Sport Utility Vehicles.*** We estimate that up to 30% of band G cars are SUVs. It appears that the number of new registrations in SUVs in London peaked in 2004 and has diminished in recent years. There also appears to have been a shift in the market from SUVs in band G to band F. Band F accounts for a greater share of new registrations of SUVs than band G. Therefore, a higher level of Congestion Charging may push up the running costs for those who use SUVs in the zone frequently. In many cases, there are substitutes in band F, for example SUVs fuelled by diesel rather than petrol, and Congestion Charging may encourage this substitution. In other cases, where SUV's have become prestige high-value cars, then this segment may behave more like sports cars or luxury cars.
- ***Sport cars.*** We estimate that around 20% of band G cars are sports cars. Moreover, the majority of sports cars have band G levels of emissions and this has increased in recent years relative to the share of sports cars that are in band F. These are cars that are usually high value, retaining a high market price and high running costs. Higher Congestion Charging may not lead owners to part with these sports cars although it may affect their choice of travelling in the zone.
- ***Luxury cars.*** We estimate that around 10% of band G cars are luxury cars. These are cars that are exceptionally high value with a high market price and high running costs and so owners/drivers may be less sensitive to a change in Congestion Charging.

20 Congestion Charging: The higher charge for older large cars

The higher charge for pre-2001 cars with 3000cc engines

The higher charge would also apply to cars registered pre-March 2001 that have engine sizes above 3000cc. This engine size of 3000cc provides a logical relationship with high levels of CO2 emissions. Figure 20.1 shows the distribution of cars which would be required to pay the higher charge for older cars with engine size above 3000cc.

Figure 20.1: Pre-March 2001 >3000cc cars eligible for higher charge

	% of cars
Congestion Charging Zone	2.8
Total London parc	2.2
London's 2006 registrations	0
<i>Source: TfL Camera Monitoring; Experian from DVLA</i>	

In June, 2.8% of cars which travelled in the Congestion Charging Zone would have been required to pay the higher charge as older cars with large engines. Among the total London parc of cars for 2006, some 62,000 cars are pre-2001 and with engines above 3000cc, which we estimate to be around 2.2% of the total. The share of these cars using the zone (2.8%) and the share of the London parc (2.2%) is broadly comparable.

In 2006, there were clearly no new registrations of cars from before 2001. As there are no new cars being registered for this group then we could expect over the next few years to see a decline in number and share of older larger cars. Wear and tear means older cars continue to depreciate in value while costs of maintenance and repair increase – thereby making these less economic to run and bringing many of these cars to the end of their usable life. The DVLA data for 2006 showed that around 10% of London's parc was registered over 1993-95 and that this is markedly less than the 20% for 1996-98. This implies that 10-12 years is a reasonable life expectancy for many cars. Therefore, the years 2007-09 are likely to see a significant reduction in the size of the pre-2001 parc as cars from 1996-98 exit from London's parc.

The likely impacts of emissions related Congestion Charging

The camera monitoring data shows that the use of older larger cars, specifically pre-March 2001 cars with engine sizes of above 3000cc, is limited. Meanwhile, the passage of time means the number of these older cars on London's roads and therefore the number using the Congestion Charging Zone is likely to fall further. Emissions related Congestion Charging should be likely to accelerate the exit of these older cars from the market. Closer inspection of the pre-2001 datasets and the types of cars in London with engines greater than 3000cc indicated that these are often large cars of premium brands.

This market for older large cars also consists of several market segments which we would expect to develop and respond to Congestion Charging in different ways. It is not possible to provide precise details on these segments as there are large numbers of incomplete records for these older cars within the DVLA dataset. Neither can we identify how frequently cars within

these segments travel in the Congestion Charging Zone. However, in broad terms we can suggest that these market segments consist of:

- **Executive cars.** At least half of older cars with engines of 3000cc are types of executive cars and these cars almost entirely first registered from 1995 to 2001. It is likely that owners of these cars could soon be looking to replace them – their value is likely to have depreciated and the costs of maintenance rising. A higher charge for Congestion Charging may push up the running costs for those who use the zone frequently and they may be likely to choose to substitute for a newer executive car. Newer executive cars often have lower CO2 emissions than those produced before 2001.
- **Sport Utility Vehicles.** A large share of old cars with engines of 3000cc are SUVs and as with executive cars were mostly first registered from 1995 to 2001. Similarly, owners of these cars could soon be looking to replace them – their value is likely to have depreciated and the costs of maintenance rising. A higher charge for Congestion Charging may push up the running costs for those who use the zone frequently and affect the choice of a newer car.
- **Sports cars and Luxury cars.** We estimate that around 5-10% of older cars with engines above 3000cc are either high value sport cars or luxury cars. These are cars which often retain some of their value over time, possibly as collectable classic cars although they also require significant costs of maintenance. It is unlikely that higher Congestion Charging would lead owners to part with these cars although they may avoid travelling in the zone.

21 Congestion Charging: A higher charge and removing the residents' discount

The higher charge and the residents' discount

A significant change under the proposals for emissions related charging is the application of the Residents' Discount. Residents living in the Congestion Charging Zone (or in some streets neighbouring the area) are presently entitled to a 90% discount on the current Congestion Charge i.e. a weekly charge of £4. Residents with cars that would meet the requirements for the standard charge (e.g. those in VED bands C, D, E and F lower than 226g/km) would continue to pay the discounted rate of 90% and those with cars in VED bands that meet the low CO2 discount would receive the full discount. However, it is proposed that the Residents' Discount would be withdrawn for those residents continuing to use band G equivalent cars or older cars with engines above 3000cc. These residents would be required to pay the higher charge of £25.

Figure 21.1 shows the distribution of cars currently entitled to a Resident's Discount on what these would be required to pay under the proposals.

Figure 21.1: Cars with Residents' Discount by age, engine size and emissions band

	Cars	% share	Captures	% share	Captures per car	Proposed charge
Residents' discount	56,000	100.0	1,916,650	100.0	34.2	
Pre-March 2001 Cars	24,520	43.8	734,370	38.3	30.0	
Less than 2000cc	17,120	30.6	498,900	26.0	29.1	£0.80
2000cc - 2,499cc	1,830	3.3	85,590	4.5	46.7	£0.80
2500cc - 2999cc	2,670	4.8	55,590	2.9	20.8	£0.80
Over 3000cc	2,900	5.2	94,300	4.9	32.6	£25.00
Post-March 2001 Cars	31,480	56.2	1,182,280	61.7	37.6	
B(Euro 4) & A	130	0.2	6,340	0.3	47.3	£0.00
B (not Euro 4)	410	0.7	17,310	0.9	42.5	£0.80
C	3,800	6.8	127,670	6.7	33.6	£0.80
D	3,710	6.6	126,510	6.6	34.1	£0.80
E	4,260	7.6	158,300	8.3	37.2	£0.80
F	7,810	14.0	287,740	15.0	36.8	£0.80
G	11,090	19.8	450,200	23.5	40.6	£25.00
Unidentified	270	0.5	8,220	0.4		

Source: TfL Camera Monitoring, June 2007

There were almost 56,000 cars in June that travelled London's Congestion Charging Zone using the Residents' Discount. This is over 8% of the 670,000 unique cars which travelled in the zone. Residents are more frequent users. They account for over 1.9 million captures, 22% of the 8.5 million captures in the zone. However, these cars with residents' discounts are also more likely to be cars that are in higher emissions bands:

- Over 11,000 cars, around 20% of those with residents' discount, are of post-March 2001 band G and equivalent cars. This means that around 12% of the band G and equivalent cars using the zone are residents.
- Some 540,000 captures, over 23% of journeys by those with residents' discount, are with band G and equivalent cars. This is over 30% of all captures of band G cars in the zone.

Therefore, the proposals for emissions related charging may have significant implications for some residents. Up to 13,000 residents' discounts would be replaced with a requirement to pay a higher charge. These residents would see the charge change from 80p to £25.00.

The likely impacts of emissions related Congestion Charging

The camera monitoring data therefore tells us that 13,000 unique cars out of 670,000 using the zone, that is almost 2%, are residents with cars that would meet the criteria for the higher charge. These also account for 540,000 captures out of 8.5 million; that is over 5% of captures. Therefore, this indicates that this would be the most concentrated impact of emissions related Congestion Charging.

This is also illustrated by the DVLA data which records that a disproportionate share of band G and equivalent cars are concentrated in Central London postal areas that reflect the Congestion Charging Zone. For example, this indicated that in 2006, 23% of new car registrations in the Congestion Charging Zone were band G cars, compared with 10% for London's new registrations overall. It is likely that any reduction in new registrations in band G cars in this part of London would substantially affect the total overall.

The effect of the withdrawal of the residents' discounts would once again depend on the market segments in which their cars are defined. A closer inspection of the data within postal areas relating to the Congestion Charging Zone indicates that these are areas in which band G cars are more likely to be *luxury cars*, *sports cars* and *SUVs*. It is possible that owners of these cars may be less willing to substitute them for similar cars in band F or other lower bands. This may affect their behaviour, for example in reducing their travel or making journeys outside the times the Congestion Charge operates. However, the overall impact depends on the price sensitivity of different motorists within this group of residents.