A Feebate Scheme for the UK

Arguments in Favour

and

Suggestions for Scheme Design

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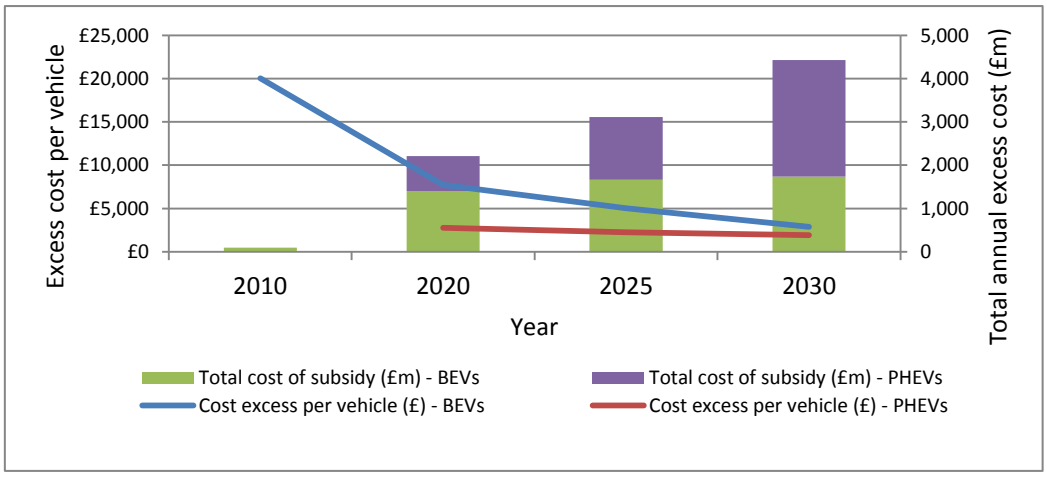
Campaign for Better Transport

Executive Summary

Evidence suggests that the UK has a good track record in using fiscal instruments to improve the environmental performance of road vehicles in recent years. This has resulted in significant improvements in the fuel efficiency of new cars. However, the challenges ahead are even greater, and further improvement will be required. This paper therefore addresses the possibility of using a feebate scheme to further improve the fuel efficiency and CO_2 performance of new cars, in particular by encouraging new vehicle technologies with very low carbon emissions.

UK government has a legally binding 2050 target to reduce emissions of all Kyoto greenhouse gases by at least 80% relative to 1990 levels, in order for the UK to meet its fair share of the burden of reduction required to avoid dangerous climate change. This in turn will require surface transport to be effectively decarbonised by that date. Owing to the relatively slow turnover of the vehicle stock, this will require immediate and continuous progress in reducing carbon dioxide emissions from conventional cars, and very significant deployment of all-electric cars by 2020. For example, the Committee on Climate Change estimates that several hundred thousand all-electric vehicles will need to enter the market in the year 2020 alone, rising to 2 million by 2030.

However, there is good evidence to show that both of these requirements (ie significantly improving conventional engine technologies and switching to alternative low carbon vehicles) will give rise to vehicles with a significant price premium relative to current conventional cars. Although some of this extra cost will be repaid through reduced fuel costs, it is clear that some form of fiscal incentive will be required to encourage the early take-up of such new technologies for some time to come. These incentives are likely to cost several billion pounds per year by 2020, and will increase through to at least 2030. The cost of such incentives for electric vehicles[1] alone are set out in the following chart.

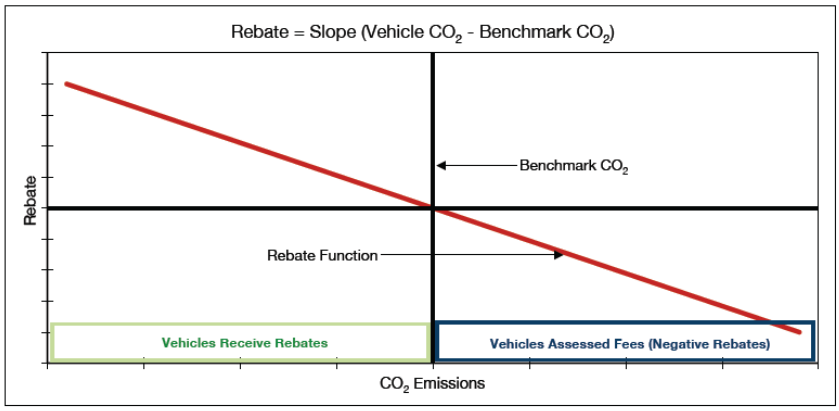


The UK already has several fiscal measures designed to encourage the uptake of low carbon cars — high fuel duties, graduated vehicle excise duty, and graduated company car taxation rules. There is good historical evidence that these taken together have had an impact on average fuel economy and CO_2 emissions. However, they are not consistent or well coordinated, and are still not sufficient to encourage the uptake of new technologies with very low carbon emissions. Nor are they capable of

[1] Currently EVs come in two main types: battery electric vehicles (BEVs) which are exclusively run on electricity, and plug-in hybrid EVs (PHEVs) which also have a small conventional engine to extend their range and flexibility, but run primarily on electricity.

providing sufficient revenue in the current economic climate to meet the need for additional incentives for such technologies on the scale indicated above.

Hence, it is argued that a new fiscal mechanism is needed, and it seems that a feebate system might be best placed to meet this need. In essence, this is a system whereby a fee is levied on the purchase of high carbon cars, and the revenue raised is then used to provide a rebate for the lowest carbon purchases. A model feebate scheme can be represented as in the following diagram:



Feebate schemes have a number of advantages relative to other more conventional tax instruments:

- in contrast to emissions standards, feebate schemes offer incentives for continuous improvement in CO_2 emissions for all new car models anywhere along the spectrum;
- they incentivise risk averse consumers to factor fuel economy more fully into their purchase decisions by amplifying the price signal upfront, rather than relying upon them to make rational and accurate forecasts of future fuel cost savings, when these are in their nature uncertain and heavily discounted;
- they develop a stronger and undistorted market for fuel economy to which all manufacturers can cater, but in addition, they establish for manufacturers a known price for CO_2 reductions, which can then be factored into their model design and marketing strategies.

Elements of such a system are already in place in several other countries, most notably France and to a lesser extent Denmark. These are summarised in the main report, as is the evidence that several of them have shown clear signs of success both in incentivising the purchase of advanced low carbon cars, and in bringing down the fleet average emissions significantly.

It is argued that such a scheme in the UK would be more effective than current arrangements, because it would operate directly at the point of sale, and would provide a mechanism to discourage the purchase of cars with very high fuel consumption and carbon dioxide emissions, and to transfer funds from the purchasers of such cars to those seeking to buy the lowest-emitting cars.

A number of aspects of policy design are discussed in the main report. These illustrate that a feebate scheme is flexible enough to be tailored to meet detailed policy goals, and to fit in effectively with other components of the UK's vehicle taxation system.

A feebate scheme could replace the graduated component of the current VED system. More radically, it could form a component of a more major redesign of the vehicle and fuel taxation system — a redesign which will in any case be needed in coming years as the revenue from road fuel duty declines. It is also suggested that some of the revenue from such a scheme might in the initial years be diverted to revive recent scrappage incentives, in order both to speed up the improvement in fuel efficiency across the whole fleet, and to support demand for new and more efficient cars

1 Introduction

1.1 Car Taxation and Greenhouse Gas Emissions

The UK has a good track record in using fiscal instruments to improve the environmental performance of road vehicles. This has resulted in significant improvements in the fuel efficiency of new cars. However, the challenges ahead are even greater, and further improvement will be required. This paper therefore addresses the possibility of using a feebate scheme to further improve the fuel efficiency and CO_2 performance of new cars, in particular by encouraging new vehicle technologies with very low carbon emissions.

What is a Feebate Scheme?

The word 'feebate' is a combination and contraction of the words 'fee' and 'rebate'. The idea of a feebate scheme is to levy a fee on the purchase of goods with undesirable characteristics (in this context, cars with high CO_2 emissions) and to use the revenues gained to finance a rebate to more desirable ones (ie cars with very low CO_2 emissions). The purpose of this is to give an incentive to the purchase and sale of the efficient and low-CO_2 cars and to discourage the polluting and inefficient ones. It would also serve to reduce or eliminate the higher purchase cost that is typically associated with advanced technologies and the lowest emitting vehicles.

1.2 The Challenge for Cars and Climate Change

In their 2010 progress report, the Committee on Climate Change reported that surface transport emissions fell during the recession due to the purchase of more efficient vehicles and a reduction in distance travelled. This trend continued to 2010, with surface transport CO_2 emissions falling by around 3.8% in 2009 as a result of car and HGV fuel efficiency, and preliminary figures suggesting further emissions reductions in 2010. This was however against a longer-term trend of rising emissions and growing numbers of vehicles, with increased distance travelled more than offsetting the impact of improved vehicle efficiency. Hence it is not yet assured that total CO_2 emissions from surface transport will continue on their downward trend when the economy begins to recover, although those from cars almost certainly will if new cars continue to improve at the current pace.

New car emissions fell on average from 149.5 gCO_2/km in 2009 to 144.2 gCO_2/km in 2010, which was a significant improvement and exceeded the Committee's expectations. However the target set by the Committee for 2020 is an average of 95 gCO_2/km so there is a very significant distance still to go, and the same scale of reduction will need to be maintained on average throughout the next decade if the 2020 target is to be met.

For the longer term, the Committee has recommended that the UK should set a 2050 target to reduce emissions of all Kyoto greenhouse gases by at least 80% relative to 1990 levels in order for the UK to meet its fair share of the burden of reduction required to avoid dangerous climate change. UK government has accepted this target, and it now has the status of a legal obligation. Since then, the Committee has been analysing the necessary course to meet this target, and has so far set out four carbon budgets extending out to 2027 (Committee on Climate Change, 2010b), and

governments have accepted this advice. These, the committee believes, set challenging but achievable targets but will require major changes to the technologies used in both the stationary energy sectors and in transport. In particular, this includes a long-term goal of virtually complete decarbonisation of the transport sector by the year 2050.

Clearly, the latter target will be very challenging and will require dramatic and continuous reductions in vehicle carbon dioxide emissions beyond 2020. Furthermore, given the relatively slow turnover of the overall vehicle fleet (cars are typically scrapped and replaced after about 12 years of life), that process needs to begin immediately. Working back from its 2030 and 2050 targets, the Committee has concluded that continuous improvement in the fuel efficiency of conventional cars, and early development of substantial markets for advanced low-carbon technologies, principally all-electric vehicles, are both essential. Specifically, the Committee calculates that battery electric and plug-in hybrid car penetration needs to reach 1.7 million in 2020, making up 5% of all cars on UK roads and 16% of new cars sold in that year, amounting to more than 400,000 new cars annually. This figure rises to around 2 million by 2030. Clearly this requires immediate action to prepare and transform these markets, not least by encouraging early and large scale deployment of the models already coming on to the market. This in turn implies that very significant numbers of electric vehicles should be entering the vehicle fleet in the years leading up to 2020 as well. In contrast, only 167 full electric vehicles were sold in 2010; so clearly there is a very long way to go.

What is a Low Carbon Car?

In the line of argument set out above, the Committee on Climate Change assumes that a dramatic reduction in carbon emissions will be achieved to a large extent through the introduction of all-electric cars refuelled with low-carbon electricity. At the time of writing this does appear to be the most likely option, reflecting in particular important advances in battery technology. However, limitations in the technical performance of electric vehicles (EVs) are likely to persist, so it is quite probable that many future vehicles will be hybrids of one sort or another. Currently EVs come in two main types: battery electric vehicles (BEVs) which are exclusively run on electricity, and plug-in hybrid EVs (PHEVs) which also have a small conventional engine to extend their range, but run primarily on electricity.

Also, it cannot be ruled out that a major technical breakthrough in, say, hydrogen fuel cells or advanced biofuels might tip the balance back in favour of one of the alternative technologies, but any such development of commercially viable new technologies appears still to be some way into the future at the very least.

For the purpose of this paper, however, the precise technological outcome is of secondary importance, since all advanced technologies seem likely to incur a cost premium relative to conventional internal combustion engine vehicles for the foreseeable future (see for example Element Energy, 2011). Furthermore, a recent report for the European Commission (TNO *et* al, 2011) concludes that, while recent improvements in the emissions from conventional cars have not required expensive new technologies, further significant improvements will, at an estimated average cost increase per car of around €1750. As a result, a cost-transfer mechanism such a feebate scheme is likely to be needed in all cases for the lowest-carbon cars, and for the purposes of this paper, the term ‘low carbon vehicles’ is used to denote any or all of the possible alternative technologies, including the most advanced internal combustion engines.

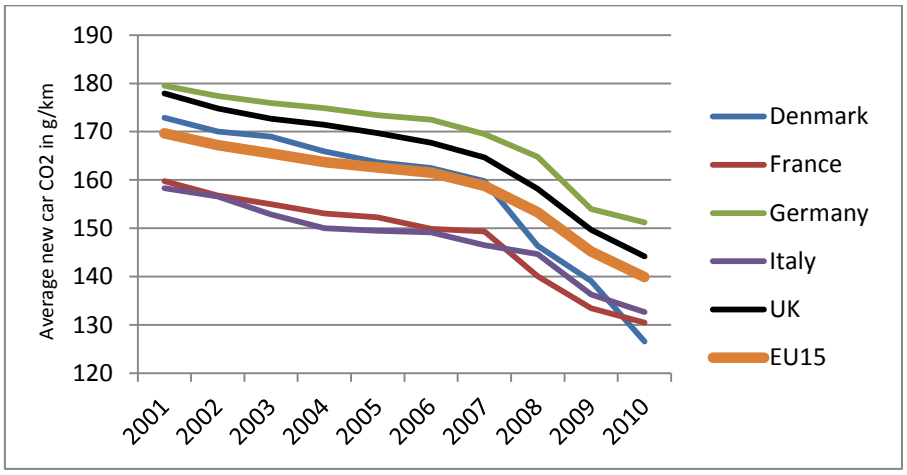
2 Incentives for Low Carbon Cars in the UK

2.1 The EU Passenger Car CO_2 Regulation

EU Regulation 443/2009 on passenger car CO_2 requires all car manufacturers in Europe to reduce the fleet average of the cars they sell to 130 gCO_2/km over the period 2012-2015. A limit value curve allows heavier cars to have higher emissions than lighter cars, such that manufacturers of large cars are still allowed higher average emissions than those of smaller cars, but the curve is designed such that the overall fleet average target should be met. A second target of 95 gCO_2/km for 2020 has been proposed by the Commission, but has not yet been translated into law.

This requirement has already had a significant effect in bringing down the average CO_2 emissions of new cars sold in Europe. The Regulation does not specify any targets for individual countries, but average new car emissions have seen downward progress in more or less all member states. Within this, however, the UK has shown better than average progress and over the past decade has moved from having amongst the highest average emissions in the EU to only marginally above the EU weighted average (144g/km as against 140g/km) in 2010.

Figure 1: Sales-weighted CO_2 Emissions from Selected EU Member States



Source: European Environment Agency

Thus the overall effect of the regulation has been to exert a significant influence on the efficiency of new car models being offered on the market; but within this the changes in consumer choice in the UK have been more marked than most. This suggests strongly that other incentives operating within the UK are also exerting an important influence in their own right.

2.2 Vehicle and Fuel Taxation

Although the Treasury does not formally consider any of the UK's transport vehicle and fuel taxes as 'green' taxes, there are a number of aspects of these taxes that can be regarded as offering some sort of encouragement to improved fuel efficiency. These are:

- road fuel taxation
- vehicle excise duty
- company car taxation

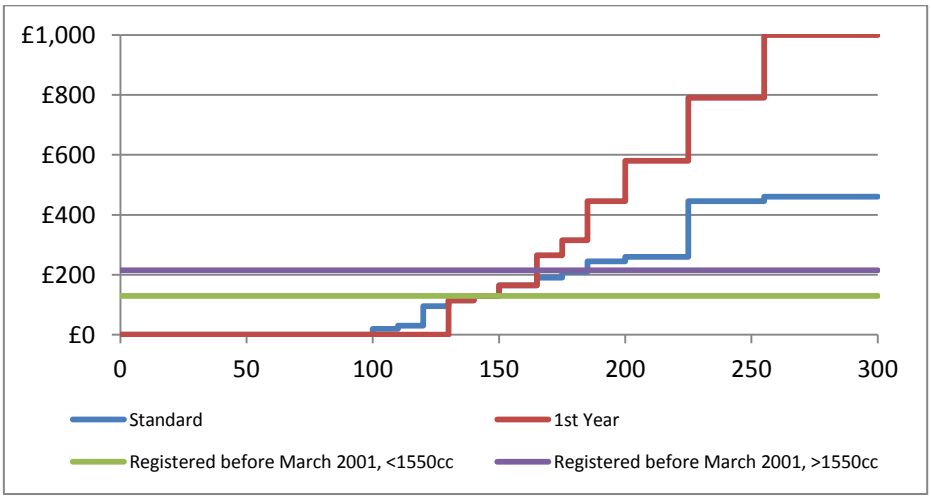
These are described briefly in the paragraphs that follow.

Road fuel taxation in the UK has historically been high by European standards. This effect has been enhanced by fuel duty escalators for significant periods over the past two decades, which had been intended to drive up the rate of duty progressively over time in order to generate a long-term price signal of rising fuel prices that will steer consumer behaviour towards better fuel economy. Successive academic studies have established that, while the short-term elasticity of demand for fuel in relation to price is quite limited, the longer term elasticity is far more significant, reflecting for example the ability of motorists to choose more economical cars in the face of rising prices. The Chancellor announced in the 2011 Budget that he planned to replace the escalator with some form of price stabilisation mechanism known as a 'fair fuel stabiliser' in an effort to smooth out the worst peaks and troughs in fuel prices. It is not yet clear precisely how this mechanism would work, and in the past similar ideas have proved impossible to implement; but with crude oil prices remaining high by historic standards in spite of the recession in world economies, it is unlikely that this new mechanism will in any case result in a significant reduction in the real price of fuels at the pump. Indeed, the Committee on Climate Change continues to emphasise the importance of maintaining high prices for conventional road fuels in order to support a continuing improvement in average CO_2 emissions.

Vehicle Excise Duty (VED) is paid annually on all registered vehicles. Since 2005 this duty has been graduated according to the CO_2 emissions of the vehicle model in question. The duty is graduated into 13 bands, with bands typically spanning an interval of 10 to 15 gCO_2/km. The rate of duty varies from zero for cars emitting less than 100 gCO_2 up to £460 for cars emitting in excess of 255 gCO_2/km. For cars emitting above 165 gCO_2/km, the duty in the first year is also significantly increased to give a stronger price signal at the point of purchase.

Even with this degree of differentiation, critics argue that this tax should have little effect over and above that of road fuel duty, as the money saved in fuel costs through switching to a car in a lower VED band is likely to greatly exceed the savings in vehicle excise duty itself. However, evidence from the Energy Saving Trust (Veitch and Underdown, 2007) did predict that graduated VED would have a disproportionate effect on car choices by raising the residual values of low carbon cars and depressing those of high carbon cars.

Figure 2: Vehicle Excise Duty rates vs gCO_2/km



A further criticism often made is that VED is largely a 'deadweight' tax, in that only the tax at point of purchase has a significant influence on vehicle choice. Once purchased, cars will remain in the fleet until they are old enough to be scrapped, irrespective of how much annual duty is paid on them. That is, owners of high-CO_2 cars continue to pay higher VED every year, even though once the car has entered the vehicle fleet nothing much can be done to improve its fuel efficiency. This is also a highly regressive tax, in that poorer motorists are steered towards older cars because these are cheaper to buy, but then pay higher tax each year because these older cars often have poor fuel economy. From then on, they also tend to suffer the higher fuel costs that are incurred by these inefficient cars, and fuel costs can constitute a very significant share of their total expenditure. A recent paper by the Office for National Statistics concluded for example that the richest quintile of households spend only about 2% of their disposable income on the taxes on road fuels, whereas for the poorest quintile the percentage rises to nearly 4% on average, even though they are less likely to own a car and will typically drive less mileage if they do.

Nonetheless, recent figures from the Society of Motor Manufacturers and Traders (2011) highlight the degree to which the distribution of new cars across the excise duty bands has changed over the past decade. That is, in the year 2000, there were virtually no new cars purchased in any of the lowest four VED bands, whereas now, they account for around 40% of all new cars purchased. This has been compensated by a marked and successive reduction in the numbers of new cars purchased in each of the top seven bands. As a consequence, The Committee on Climate Change (2011) is in no doubt that VED has played a significant part in the reduction in the average CO_2 emissions of new cars sold in the UK. Further differentiation of the duty bands is underway, and the Committee advocates that this process should continue.

Company Car Taxation has, since 2002, also been graduated according to the CO_2 emissions of the car. In brief, motorists who use a company-provided car for personal use must pay their marginal rate of tax on a scale charge that is intended to reflect the value of the private use of the car. This charge is a function of the price of the car, but the multiplier applied to this rises steeply with the CO_2 emissions of the car in question. As with VED, the multiplier is banded, but the banding is different in this case. That is, the lowest band apart from zero extends to 75 g CO_2, and the bands above it progress in 5 gram intervals. There are also plans to progressively reduce these thresholds in future years. Historically, company cars in the UK have tended to be larger and less fuel-efficient than their private equivalents, but these revised tax requirements have significantly improved the fuel efficiency of new company cars in recent years to the point where they rapidly overtook the efficiency of privately purchased cars (Fergusson, 2004), in spite of being traditionally larger in size and with higher engine capacities. This is a reminder that company car taxation was exerting a significant influence on the overall fleet average for some years before VED was graduated in relation to CO_2 emissions.

In summary, therefore, we can see that the UK already boasts a range of fiscal measures that are having an effect in driving down carbon dioxide emissions. Indeed, by 2030, fuel economy figures of 100mpg for both petrol and diesel cars are expected to be commonplace, so most motorists will pay £10 per week or less at current prices for fuel, and the tax take will diminish accordingly. Indeed, a recent report by IPPR (Pendleton and Bradley, 2011) calculates that fuel duty revenues will fall from above 2% of GDP to below 1.5% by 2030, or possibly even below 1%. This suggests another argument why a review of existing tax arrangements is likely to be needed.

2.3 Incentives for Low Carbon Cars

Although the Environmental Audit Committee has recently been critical of the overall design and purpose of the current fiscal incentives in the UK transport sector, there is little doubt that they have together been quite effective in improving the CO_2 performance of new cars purchased in the UK both in absolute terms and relative to other EU member states. This has been achieved through a steady improvement in average emissions right across the range of new cars on the market, boosted by some selection of the best performers in class from conventional car models, and the increasing availability of significantly more economical variants across a wide range of the car models available. By contrast there has been relatively little impact upon the size or class structure of the UK new car fleet. In terms of technologies, the vast majority of new cars purchased are still based on conventional internal combustion engines burning petrol or diesel fuel. While a small but growing share of the new car market (just passing 1% in 2010 (SMMT, 2011)) is now accounted for by hybrids, the number of full electric vehicles purchased remains negligible.

This reflects the significantly higher price and the limited range of choices available for battery electric vehicles – or indeed the various types of hybrids – and the fiscal incentives outlined above do little to overcome these barriers. As a result, a separate incentive to help overcome the price differential on the purchase of electric vehicles (EVs) has also recently been established. As of the beginning of 2011, motorists purchasing a qualifying ultra-low emission car can receive a grant of 25 per cent towards the cost of the vehicle, up to a maximum of £5,000. The 2010 Spending Review confirmed that Government has made provision to support the Plug-in Car Grant for the life of this Parliament.

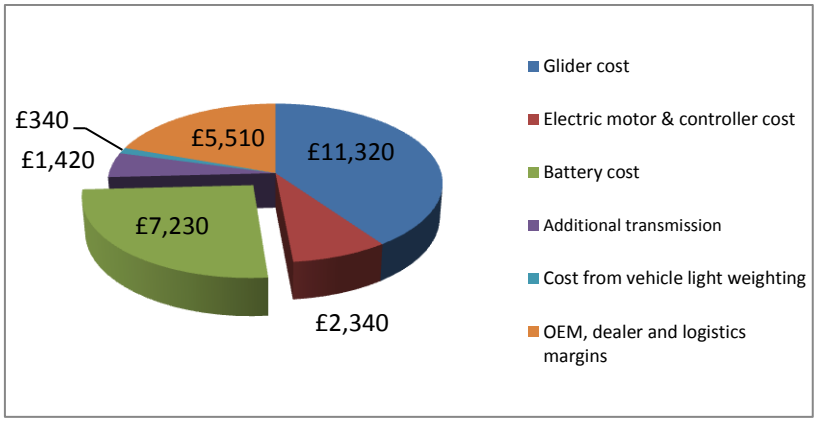
As of 30 June 2011, 680 cars had been ordered through the scheme - still a very small number in relation to the scale of the challenge set out above. Only 106 electric and plug-in cars were registered in the quarter to September 2011, making a total of less than a thousand vehicles registered in the first three quarters since the scheme began. This was well below the hoped-for target. It was envisaged that a number of new electric car models now coming on stream would significantly enhance the choice and technical qualities of the vehicles on offer, so an acceleration in uptake is expected. However, some of these new models have not come onto the market as early as was originally hoped.

The stated intention of the Plug-In Car Grant has been to help make the whole-life costs of a qualifying car more comparable with petrol or diesel equivalents in order to overcome a major barrier to their entry into the market. It is hoped that over time, as manufacturers begin to make these cars in greater volumes, the costs of production should begin to fall. This will help to make an ultra-low carbon car a realistic option for anyone looking to buy a car.

However, recent research by Element Energy for the LowCVP (2011) focuses on the total cost of ownership (TCO) of each car type over its first four years of use. The report suggests that key components of electric vehicles will fall rapidly in price as the market becomes more mature, but some will not fall far enough to eliminate the price differential between electric and internal combustion engine vehicles for some time to come. For example, the study estimates that the TCO of EVs will fall to only around £3,000 over four years above that of a conventional car by 2030, but even then, the differential in the purchase price will be around twice that level. While commercial car buyers, such as fleet managers, can be expected to take full account of the TCO of a new car, it is

likely that private buyers will continue to be discouraged by the higher up-front costs. This failure to equalise prices is accounted for largely by the costs of the batteries, which are significantly influenced by the cost of expensive raw materials, and these are not likely to fall greatly unless there is a further major breakthrough in battery technology. Insurance costs are also a major uncertainty for all car types and probably even more so for novel technologies, which could further raise the barrier to entry. Hence the higher capital cost of low carbon vehicle technologies up front is likely to continue to be a barrier to their uptake unless further action is taken.

Figure 3: Pre-tax Cost Breakdown for Mid-range EV in 2025



Source: Element Energy, 2011

Note that this conclusion holds good unless the cost of batteries for EVs falls much faster and further than most industry experts believe possible. Ironically, even a severe spike in the price of petrol and diesel is unlikely on its own to push consumers further in favour of EVs or other low carbon options, as the continuous improvements in the fuel efficiency of conventional cars will increasingly insulate their owners from price shocks caused by the high cost of oil.

Furthermore, the size of the current fund for new EVs is limited to £230m over the life of the current parliament, implying a capacity to support the purchase of several thousand vehicles per year over the period. This is a substantial number, but still a far cry from the hundreds of thousands of new vehicles that the Committee on Climate Change argues will be needed each year from 2020, now only a few years ahead. An indication of the sums involved is set out in the Table below.

Table 1: Projections of the Cost of Subsidising Future Low Carbon Cars

	Vehicle type	2010	2020	2025	2030
Cost difference per car vs ICE (TCO basis)	Battery-electric	£20,040	£7,730	£5,030	£2,880
	Plug-in Hybrid	n/a	£2,764	£2,272	£1,920
CCC projected registrations	Battery-electric	4,866	182,135	330,720	601,934
	Plug-in Hybrid	-	289,569	636,984	1,404,513
Total subsidy needed (£m)	Battery-electric	97.5	1407.9	1663.5	1733.6
	Plug-in Hybrid	-	800.4	1447.2	2696.7
	Total	**97.5**	**2208.3**	**3110.7**	**4430.2**

Source: Based on data from Element Energy and the Committee on Climate Change(CCC)

This analysis demonstrates that substantial financial support will be needed to encourage the uptake of electric and other new vehicle technologies well into the 2020s or even 2030s if the Committee on Climate Change's targets are to be fulfilled. And while the amount of funding needed per vehicle is likely to diminish as the TCOs of different vehicle technologies converge, an ever greater number of vehicles is likely to need this support from year to year to support the market transformation that is required. Hence we can foresee that substantial sums of money, even greater than that allocated to the current support mechanism, are likely to be needed to support the market entry and maturity of new vehicle technologies for several decades to come, and certainly at least out to 2030. As the Table illustrates, to subsidise future EVs and plug-in hybrids to the level needed to equalise the 4-year TCO with that of a conventional ICE and on the level of future purchases set out by the Committee on Climate Change would be very expensive, rising probably to over £2 billion per year in 2020, and rising year on year thereafter to more than £4 billion in 2030. The cost would be even higher if it were found to be necessary to equalise the purchase cost for private buyers rather than just equalising the TCOs.

In these austere times, it seems unlikely that a growing fund will be made available by central government from general funds to boost the market for new EVs and PHEVs to the extent indicated above. Hence this paper will now go on to argue that an alternative mechanism will be needed to help support the development of EVs, hybrids and potentially other new technologies by transferring funds from the taxation of other more conventional vehicle types to the new vehicle types that are needed. Some sort of feebate scheme might represent a promising option to achieve this, so the next section briefly summarises overseas experience with the implementation of such schemes, and discusses some key features of instrument design.

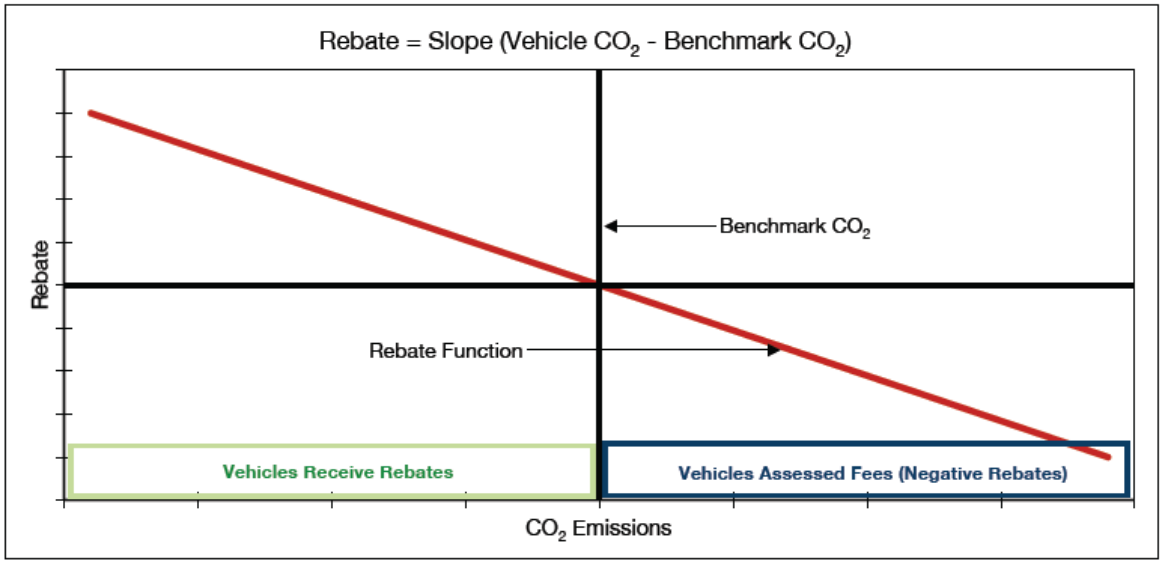
3 Feebate Schemes in Theory and Practice

Faced with the need to subsidise a very significant number of low carbon car purchases over a period of years if not decades, a new financial mechanism seems likely to be needed. In this context, some sort of feebate scheme seems a promising candidate. German and Meszler (2010) have recently set out the evidence on the effectiveness of feebate schemes in relation to CO_2 emissions from cars around the world. This Section summarises and adds to that analysis.

3.1 A Feebate Scheme in Theory

The authors set out the key features of an idealised feebate system, with reference to the following diagram.

Figure 4: Generalised Schematic of a Feebate Scheme



Source: German and Meszler (2010)

Under this idealised scheme, any new car purchased of which the CO_2 emissions exceeded the benchmark or pivot point would fall to the right half of the diagram, and would be subject to paying a fee on top of the purchase price. This fee would be directly related to the amount by which the emissions exceeded the benchmark, and with a linear scheme such as this, the fee would be a direct function (the 'rebate function' represented by the diagonal red line in the diagram) of this amount. Conversely, for new vehicles falling to the left of the centreline in the diagram, a rebate would be given, and this too would be a function of the degree to which the CO_2 emissions fell below the benchmark. The authors highlight the following principal benefits from a scheme such as this:

- in contrast to emissions standards, schemes such as this offer incentives for continuous improvement in CO_2 emissions for all new car models anywhere along the spectrum;
- it incentivises risk averse consumers to factor fuel economy more fully into their purchase decisions by amplifying the price signal upfront, rather than relying upon them to make rational and accurate forecasts of future fuel cost savings, when these are in their nature uncertain and heavily discounted;

- in this way, it develops a stronger market for fuel economy to which manufacturers can cater, but in addition, it establishes for manufacturers a known price for CO_2 reductions, which can then be factored into their model design and marketing strategies. The threat of fines under the EU Regulation also offers an implicit price of carbon, but a feebate would arguably operate more consistently across all manufacturers and models and thereby reduce market distortions.

The authors argue that the pivot point for such a scheme is best set at the level at which the total income from fees broadly balances the total rebate given out, thereby creating a revenue-neutral scheme. This however is again a political judgement: revenue-neutrality is likely to greatly enhance the public acceptability of a scheme, but as against this substantial government revenues have customarily been raised from vehicle and fuel taxes in most developed countries and presumably will continue to do so, so there is no strong reason why a feebate scheme should not contribute towards this objective. In practice, furthermore, exact revenue neutrality is probably difficult to achieve, and the balance of fees and rebates will change from year to year as the scheme drives down the average CO_2 emissions. As a result, periodic revision of the pivot point is inevitable and revenue neutrality can only ever be approximate.

The summary above sets out what the authors would regard as the 'ideal' feebate system. In practice, however, none of the individual components set out above is an absolute requirement, and there may well be reasons to deviate to some extent from this model. Indeed, as outlined below, none of the existing schemes worldwide follows the idealised scheme entirely.

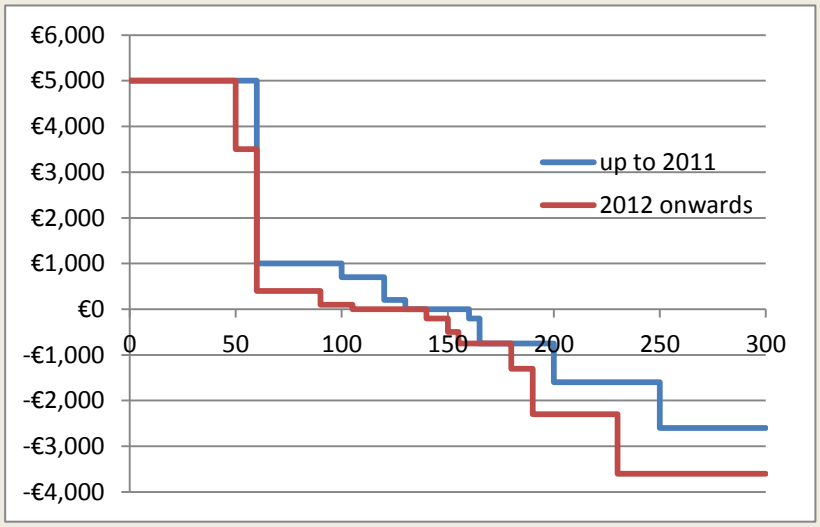
3.2 Feebate Schemes in Practice Around the World

German and Meszler go on to characterise and analyse feebate schemes and elements of feebate schemes as they have been implemented to date around the world. This covers systems in France, Ireland, Germany, the United States and Canada, although, as noted, it is only the French system which comes close to fulfilling all of the key features outlined above. For example, the Irish, German and US versions only operate a graduated tax or fee scheme, and do not incorporate rebates for the lowest emitters; the Canadian scheme does have a rebate element, but only the highest and lowest emitters are subject to a fee or rebate respectively and the majority of new cars are unaffected by either; and all of the schemes apart from the German one have a stepwise rebate function rather than the linear function of CO_2 emissions advocated by German and Meszler.

The French Feebate Programme

As noted, the French Feebate Programme implemented in January 2008 comes closest to the ideal feebate scheme as proposed by German and Meszler. The fees and rebates for new cars in euros for each CO_2 value are as summarised in the Figure below.

Figure 5: French Fee and Rebate Levels



As can be seen, a very substantial rebate (€5,000) was made available for all cars with CO_2 emissions below 60g/km, thereby fulfilling the need to subsidise such advanced technologies substantially. Above this threshold, the fee/rebate bands are much shallower but rather irregular. Neither fee nor rebate was paid for cars between 131 and 160g/km. Above this a fee was levied, rising to €2,600 for cars above 250g/km. Between 60g/km and 300g/km, a regression line suggests a slope value of approximately €18/gCO_2/km.

Historically French new car CO_2 has been well below the EU average owing to the country's high degree of dieselisation, but nonetheless the French scheme can be seen to have had a very significant effect (Figure 1). In 2008, the average French new car emissions fell by 9gCO_2/km – almost twice the reduction observed elsewhere in the EU and considerably above that in previous years in France. Sales in the 101-120g/km band, which received a €700 rebate, rose by 80%, while sales volumes fell in all bands with higher emissions. Overall, however, sales volumes also rose as the new scheme was accompanied by a scrappage incentive. Significant progress was also maintained over 2009 and 2010, with a further reduction of 10gCO_2/km.

Cuenot reports that the French scheme has been a victim of its own success in financial terms, with greater than expected reductions in emissions leading to a net outlay of €300m per annum or more. This illustrates the importance of setting the benchmark and slope carefully, and has required adjustments to be made to the French scheme effective from 2012. The largest incentives of €5,000 remain in place for vehicles below 50gCO_2/km – effectively pure electric vehicles only – while hybrids in the 50-60g/km range now qualify for a €3,500 rebate. Fees for gas guzzlers have been further increased, but the incentives for low-carbon cars above 60g/km are now significantly reduced.

Sources: German and Meszler (2010) and press reports

The authors went on to assess, to the extent possible, the effectiveness of all the schemes they analysed. As the schemes vary significantly in design, and as most are quite new or still in the course of implementation, it is difficult as yet to draw firm overall conclusions as to the effectiveness of the schemes or of the specific features of the different schemes. Nonetheless, where conclusions could be drawn, it seems that the schemes have had a significant effect in influencing the fuel consumption and CO_2 emissions of vehicles sold in those parts of the fleet which were subject to either fees or rebates, and have led to marked reductions in average emissions. Certainly the French scheme in particular appears to have had a marked impact upon the fleet average emissions from new cars when implemented in 2008, and led to an acceleration in the downward trajectory in average new car CO_2 that is clearly visible.

In relation to the possible implementation of a feebate scheme in the UK, the following two points are particularly noteworthy:

- for reference, the pivot point for the French scheme was set at approximately 140 gCO_2/km, but has since in effect be reduced somewhat;
- although the schemes vary significantly in detail, the slope of the feebate reference line or an approximation to such a line typically fell within the range of €18-€30 per gCO_2/km of the tested emissions. This is several times higher than the implied marginal rate of even the first year VED in the UK, although it is not strictly comparable as it is typically a one-off charge.

Although not addressed by German and Meszler, and not strictly a feebate scheme either, the Danish vehicle purchase tax scheme is also worthy of mention in this context. For many years the Danish government has imposed extremely high registration taxes (more than the retail pre-tax price of the car) on all new cars. Since 1997, however, discounts on this tax have been offered as a direct function of fuel economy, and these were further increased and differentiated in 2007. In essence, the very high value of the basic registration tax allows for very significant incentives for better fuel economy, applied directly at the point of purchase of a new car. As illustrated in Figure 1, Denmark has also made rapid progress in reducing its CO_2 emissions, particularly over the years since 2007, and now has the lowest sales-weighted average in Europe.

4 A Feebate Scheme for the UK

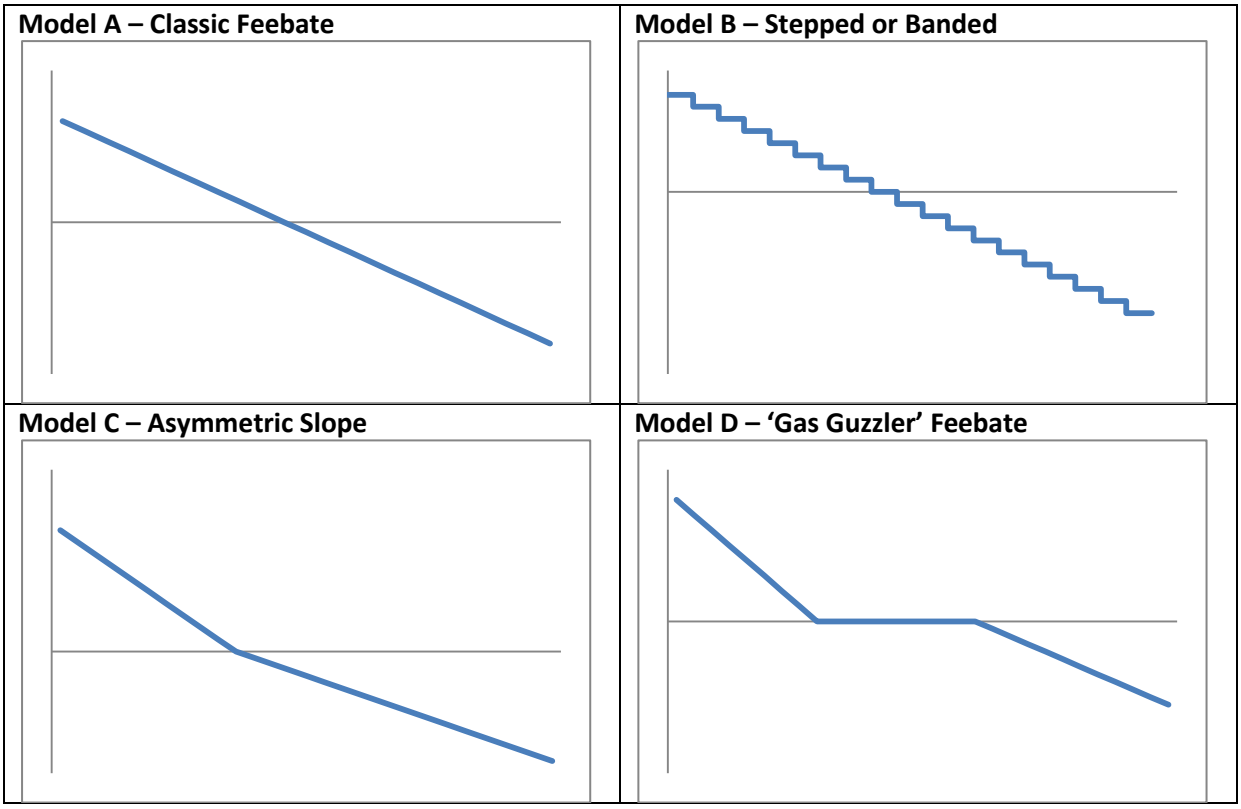
4.1 Defining Features of a Feebate Scheme for the UK

In most of the cases studied by German and Metzler, the feebate scheme in question was the principal or only mechanism designed to bring down CO_2 emissions in the country concerned. In the UK, in contrast, we have seen in Section 2 that there are already a number of mechanisms in place to achieve this goal, and that in general progress on new car CO_2 reduction is good. However, it should be stressed that the rate of progress across Europe as a whole is less good; that the UK performance is rather flattered by an unusually high starting point; and that future progress could be less rapid as targets become more demanding. Furthermore, the specific argument set out here is that a feebate mechanism is the best available means to transfer funds from high emitting car purchases to those of very low emitting vehicles which will not be purchased in significant numbers without some sort of additional fiscal intervention.

As a result, the best practice principles established by German and Metzler do not necessarily apply in the UK case. For example, it would not be necessary to establish a pivot point for the feebate function that delivers fiscal neutrality. On the contrary, it might make more sense to establish the upper threshold for rebates at a point which reflects the crossover between conventional and very low carbon cars. Where precisely this point would be set will depend upon future changes to the European test cycle which will reflect the life-cycle emissions of electric vehicles. However, this point should be close to or below the point which can be achieved in theory by conventional internal combustion engine vehicles. The French scheme in effect sets this threshold figure at 60g/km, for example.

As a corollary to this, there would be no requirement for the feebate function above this point (ie determining the fee to be paid on conventionally-fuelled vehicles) to be either continuous or linear. Provided that sufficient funds would be raised by the charge to fund the rebates on the all-electric vehicles, a number of options are available and the choice is purely a matter of public policy and the likely impact upon conventional vehicle sales. For example, the levy could be a flat rate on all conventional vehicle sales (although this would be regressive); it could be an *ad valorem* tax based on vehicle price; or (better still from the environmental perspective) it could be some function of the vehicle's CO_2 emissions.

4.2 Variants on the Design of a Feebate 'Curve'



Above are illustrated four possible main variants of an idealised feebate scheme 'curve' illustrating the variation of fee or rebate as a function of CO_2 emissions. This is not an exhaustive list but an illustrative one. Also, aspects of more than one variant could in some cases be combined. The table below briefly characterises each variant and outlines the main strengths or weaknesses.

Characterisation of Variant	Strengths	Weaknesses
Model A – Classic Slope is straight and continuous around a single benchmark point.	Establishes a consistent price for CO_2 reductions at all points on the line and hence a consistent incentive for CO_2 reductions	Difficult to establish a clear fee/rebate differential between improved conventional and unconventional engine technologies Difficult to set slope and benchmark accurately to achieve desired level of revenues received or paid out
Model B – Stepped Curve is divided into a number of discrete steps or bands. Steps may all be equal in size or asymmetric.	Easy to communicate accurately, eg in a table; Banded taxes and duties generally favoured by finance ministries; Flexibility over size of steps to calibrate the income and expenditure desired, and to tailor the outcomes	The value of a small change in CO_2 emissions is not consistent: near the boundary of two bands it is large, but elsewhere it is zero and hence reduces the overall incentive and cost-effectiveness
Model C – Asymmetric Slope Curve is still straight with a single benchmark, but slope of curve differs above and below the benchmark.	Easy to establish a clear fee/rebate differential between improved conventional and unconventional engine technologies Can accommodate a large difference in the population of vehicles to the left and right of the benchmark More flexibility to vary slope and/or benchmark to adjust revenues received or paid out	The value of CO_2 savings differs on either side of the benchmark
Model D – 'Gas Guzzler' Feebate Curve is straight but has 2 benchmark points; curve is flat and normally set at zero between the two	New purchases of 'average' cars are largely unaffected by the scheme* Easy to establish a clear fee/rebate differential between improved conventional and unconventional engine technologies Greater flexibility over which cars are subject to fees in order to finance the rebates	Has little impact on the overall average CO_2 emissions of new car purchases as a whole*

* NB this might be a strength or a weakness, depending on the precise objectives of the scheme

4.3 Integrating a Feebate Scheme into the UK Tax System

As noted, overseas examples of feebate schemes based around CO_2 emissions are typically the main mechanism intended to drive down fleet average emissions, and in several cases, have replaced an existing vehicle purchase tax scheme. In the UK, the situation would be very different in that there is no existing purchase tax and we already have a number of fiscal mechanisms in place to incentivise a reduction in the average carbon dioxide emissions for the new vehicle fleet. Indeed, the proliferation and diversity of existing 'green' taxes on vehicles has recently been criticised by the Environmental Audit Committee (2011).

Hence, it would be necessary to consider how a proposed feebate scheme would fit in with the current mechanisms without adding to the existing complexity and overlap. In addition, the Coalition Government has established a 'one in one out' rule to limit the amount of legislation that consumers and industry face, so it is unlikely that a new feebate system would be accepted without some corresponding simplification of the existing fiscal mechanisms applied to cars.

A Standalone Feebate Scheme

For example, a flat rate registration fee of £55 is already levied on the first registration of a new vehicle. Currently this is designed purely to reflect the administrative cost of registering and logging the vehicle, but could arguably be fairly simply modified to incorporate the new car CO_2 tax on conventionally fuelled car purchases by graduating the fee according to some function of CO_2 emissions. At the very least, this could also reduce the complexity of VED by removing the requirement to have separate rates of VED for the first year of ownership as outlined in Section 2 or indeed to graduate it at all, while at the same time strengthening and clarifying the purchase price signal in relation to CO_2 emissions.

This alone would greatly reduce the regressiveness and deadweight losses inherent in the current arrangements. Where the fee element of the feebate scheme were incurred, this would fall solely on the original purchaser of the car, and these tend to be either companies or wealthier individuals. Most of this cost would be absorbed by the first owner of the car, and little if any would be passed on to secondhand car buyers. As intended, a feebate scheme would also shift the cost burden towards those purchasing the most polluting cars, while reducing the cost to those who made cleaner choices.

Feebates as part of a Redesigned Vehicle Tax System

More radically, this might be an opportunity to begin to reduce the rates of the existing VED system. As noted above, VED is largely a deadweight annual tax that does little to improve the emissions performance of the vehicle fleet once a new vehicle has been purchased and entered the fleet, and disadvantages the poorest motorists the most. Historically, it was established as a road fund tax designed specifically to fund the maintenance and building of roads, and although it is still commonly referred to as 'road tax' this hypothecation has long since ended. It has also served an important administrative purpose in that the annual renewal of the tax disc provided an occasion to carry out a paper check that all motorists also had valid insurance and an MoT certificate for their vehicle. Now, however, automated databases can perform the latter functions, such that when a tax disc is applied for online or by telephone, the vehicle's insurance is automatically checked

electronically with the Motor Insurance Database (MID), and MoT Certificates and GVT Certificates are also checked electronically with the MoT Database.

As a result, VED now serves increasingly little purpose apart from revenue raising, and its possible replacement by a feebate system centred on the car purchase choice would not only serve to improve the environmental performance of the vehicle fleet and bring about the introduction of important new vehicle technologies at scale, but would at the same time facilitate a simplification of the vehicle tax system and a reduction in administrative costs. This is an historic opportunity at a critical juncture in the future of the national vehicle fleet where radical change is needed in order to meet our future greenhouse gas reduction targets. As noted by IPPR (Pendleton and Bradley, 2011), a radical restructuring of the vehicle and fuel tax system will in any case be required as the tax take from fuel tax in particular is eroded. This would have the effect of reducing the tax burden on the poorest motorists and those who drive least, while shifting the burden towards wealthier motorists who use more fuel and drive more miles.

Note that decisions made about the other fiscal mechanisms would also influence the choice of which variant of feebate to adopt. For example, a 'gas guzzler' type feebate might be very effective at encouraging new technology if used alongside a version of the existing graduated VED; but if it were to partially replace graduated VED, it would likely be ineffective at driving down average fleet emissions.

An additional possibility would be to apply some of the income from a feebate system to a renewed scrappage incentive, in order both to help accelerate the switch to a low carbon fleet by removing old gas-guzzlers, and to buoy up demand for new car purchases.

5 Summary of Key Findings

To summarise, this report has set out the following main lines of argument:

- UK government has a legally binding 2050 target to reduce emissions of all Kyoto greenhouse gases by at least 80% relative to 1990 levels, in order for the UK to meet its fair share of the burden of reduction required to avoid dangerous climate change. This in turn will require surface transport to be effectively decarbonised by that date. Owing to the relatively slow turnover of the vehicle stock, this will require immediate and continuous progress in reducing carbon dioxide emissions from conventional cars, and very significant deployment of all-electric cars by 2020.
- However, there is good evidence to show that both of these requirements will give rise to vehicles with a significant price premium relative to current conventional cars. Although some of this extra cost will be repaid through reduced fuel costs, it is clear that some form of fiscal incentive will be required to encourage the early take-up of such new technologies for some time to come. These incentives are likely to cost several billion pounds per year by 2020, and will increase through to at least 2030.
- The UK already has several fiscal measures designed to encourage the uptake of low carbon cars — high fuel duties, graduated vehicle excise duty, and graduated company car taxation rules. However, these incentives are still not sufficient to encourage the uptake of new technologies with very low carbon emissions, and nor are they capable of providing sufficient revenue in the current economic climate to meet the need for additional incentives for such technologies.
- Hence, it is argued that a new fiscal mechanism is needed, and it seems that a feebate system might be best placed to meet this need. In essence, this is a system whereby a fee is levied on the purchase of high carbon cars, and the revenue raised is then used to provide a rebate for the lowest carbon purchases. Elements of such a system are already in place in several other countries, most notably France, and have shown clear signs of success both in incentivising the purchase of advanced low carbon cars, and in bringing down the fleet average emissions significantly.
- Such a scheme in the UK would be more effective than current arrangements, because it would operate directly at the point of sale, and would provide a mechanism to discourage the purchase of cars with very high fuel consumption and carbon dioxide emissions, and to transfer funds from the purchasers of such cars to those seeking to buy the lowest-emitting cars. It could replace the graduated component of the current VED system. More radically, it could form a component of a more major redesign of the vehicle and fuel taxation system — a redesign which will in any case be needed in coming years as the revenue from road fuel duty declines.

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