IPPR

REPORT

UNTYING THE KNOT

DECOUPLING OIL AND ROAD TRANSPORT

Andrew Pendleton and Laura Bradley

October 2011
© IPPR 2011

Institute for Public Policy Research

ABOUT THE AUTHORS

Andrew Pendleton is associate director for climate change, transport and energy at IPPR.

Laura Bradley is a researcher at IPPR.

ACKNOWLEDGMENTS

IPPR would like to thank Greenpeace UK for its kind support for this work and Paul Morozzo, Doug Parr, Ruth Davies, Vicky Wyatt and Charlie Kronick for their help and advice.

Glenn Gottfried and Amna Silim of IPPR developed the methodology and model for the revenue analysis; their work was indispensable. In addition, we would like to thank the interviewees listed in the methodology section who gave us their time and valuable comments, Stephen Joseph of the Campaign for Better Transport, Greg Archer at the Low Carbon Vehicle Partnership and Professor Phil Goodwin of UWE Bristol.

ABOUT IPPR

IPPR, the Institute for Public Policy Research, is the UK's leading progressive thinktank. We produce rigorous research and innovative policy ideas for a fair, democratic and sustainable world.

We are open and independent in how we work, and with offices in London and the North of England, IPPR spans a full range of local and national policy debates. Our international partnerships extend IPPR's influence and reputation across the world.

IPPR
4th Floor
14 Buckingham Street
London WC2N 6DF
T: +44 (0)20 7470 6100
E: info@ippr.org
www.ippr.org
Registered charity no. 800065

This paper was first published in October 2011. © 2011
The contents and opinions expressed in this paper are those of the author(s) only.

SMART IDEAS
for CHANGE

CONTENTS

EXECUTIVE SUMMARY

The unwritten laws of motoring, which state that people want to drive rather than use other modes of transport and that they prefer acceleration and speed to efficiency and safety, are being challenged. Not only has car use apparently peaked in the UK and other industrialised countries, with people now making fewer journeys and travelling less distance by car, but recent years have seen the biggest drop in new car CO_2 emissions on record.

The response of car buyers to rising oil prices is the strongest indication yet that the Gordian knot that has hitherto bound oil and road transport together may be inexorably loosening. Untying the knot altogether now appears feasible in a nation such as the UK, but it will take a series of bold strokes on the part of government.

Such bold 'strokes' are already envisaged in principle, as the government has chosen to adopt the Committee on Climate Change's fourth carbon budget report, which projects that hitting climate targets will require 1.7 million of the vehicles on the UK's roads to be either fully electric or plug-in hybrid by 2020. But policy is currently only piecemeal and needs to be developed into a cohesive framework.

In turn, it is important for a framework for road transport decarbonisation to be set within the context of a wider transport strategy that would see people offered every opportunity to opt for cheaper, alternative modes. This will help meet multiple public policy objectives: not only the achievement of climate targets but also connecting people to services and jobs and improving public health and localised pollution.

Both the rising price of oil and the introduction of new technology will make motoring less affordable for many households whose incomes may over the same period of time remain static. Mobility will, however, still be important to ensure people can access jobs and services and for economic growth. Therefore, while the main focus of this report is on private car use, other modes, such as walking, cycling, bus use, local and regional rail services and car-sharing, and issues such as integration and future planning, will all affect the distances people are required to travel and whether or not they can afford to do so.

The apparent 'peak car' trend suggests some fundamental shifts are taking place in transport, which date back to the 1990s. While we should not underestimate the significance of this trend, it is also important to recognise that with car use still so dominant, transport decarbonisation cannot be achieved without technological change. This report looks in detail at three key challenges faced by policymakers as they seek to untie this Gordian knot and outlines a policy framework that could help to ensure these challenges are overcome.

The first challenge is technological transformation: IPPR asks whether it is technologically feasible and desirable for the UK government to lead a Europe-wide push for tight emissions targets to drive efficiency and emissions reductions faster than otherwise might be the case. We conclude that the technology is not in itself the principle barrier – significantly, this is also the conclusion of the automotive industry. The newly formed Automotive Council has already produced a technological roadmap that identifies five technologies – hybrid engines, electric vehicles, hydrogen, improvements to the internal combustion engine, and reductions to aerodynamic drag and weight – which together are almost certainly capable of achieving a high level of decarbonisation.

To create the necessary market conditions for these technologies to flourish, government must both help spur rapid innovation to capitalise on the economic opportunities the transformation will offer and to ensure consumers are offered incentives to become early

adopters. To do this, it must develop a framework for decarbonisation which will include tough emissions regulation – below, we argue this should aim for a new fleet target of 95g/km or better by 2020 but with a review at 2015 to ensure technology is not outpacing policy – fiscal and financial incentives and a focus on attracting research and development (R&D) to the UK. The UK government should also become a vociferous cheerleader for this emissions policy to be made mandatory at the EU level, to widen the market potential.

We also conclude that being at the forefront of this technological change and championing a tough EU-wide exhaust emissions target is already in the UK's industrial and economic interests. Nissan and Toyota have chosen the UK as one of the places where they will assemble low-carbon vehicles for the European market, and Indian-owned Jaguar Land Rover, while being challenged more than many manufacturers by tough targets, has recently announced it is to manufacture its new hybrid engine in the West Midlands, creating some 750 new jobs.

But it is not so much the local assembly or manufacture of finished low-carbon vehicles by global car companies that is the most striking asset of the UK's industry. Some of the country's leading research institutes and a growing number of small and medium-sized businesses are involved in R&D that is internationally competitive. The race to develop the next generation of battery technology or to engineer the components and materials that will help vehicles operate more efficiently is ours to lose.

Through its Technology Strategy Board and a handful of other public-private institutions, the previous and current UK governments have begun the job of galvanising some of this activity, and this is to be commended. But during the course of this research, a variety of industry insiders have suggested that more needs to be done. In particular, the government and its institutions need to focus in on the key challenges with an automotive innovation strategy that seeks to identify clearly where all the best R&D is currently taking place, provide it with sufficient resource, and ensure there are links with small, medium and large enterprises in the sector to propel technologies from the laboratory bench into the marketplace.

The second challenge is renewing government revenue: IPPR uses a simple econometric model to predict the impact of UK vehicle fleet fuel efficiency improvements and emissions reductions in the next two decades on government revenue. We reach a similar conclusion as was recently reached by the independent Office for Budget Responsibility (OBR). Fuel duty, which in 2010 yielded revenues equivalent to more than 2 per cent of UK GDP, will probably more than halve in real-terms value by 2030. In addition, the VAT that is levied on fuel and fuel duty and vehicle excise duty will also fall by comparable increments.

At the same time as this fall in the revenue earned by government from the sale of fuel is taking place, North Sea oil reserves will be declining rapidly. This will not only have further revenue implications, as the royalties earned by government from the extraction of oil and gas fall, but will also – at least while the UK remains highly dependent on oil for road transport – worsen the country's balance of trade.

The best response to the UK's net importation of oil is to reduce its use, which is indeed what the fourth carbon budget envisages. Our modelling suggests that the litres of fuel consumed by cars and other road transport will fall from around 46 billion in 2011 to around 41 billion in 2020 and 27 billion in 2030. However, this has a direct effect on revenue from fuel duty and therefore suggests that, since road use carries a physical,

social and environmental cost, governments should look to shift from a levy on fuel use to a charge for road use over this same period of time.

While the Coalition Agreement explicitly rules out any move to charge motorists for their use of the roads, it does envisage introducing a road use charge for heavy goods vehicles (HGVs). During the next parliament, from 2015, the government of the day will need to extend this by increments to cars and vans. It should do so along the lines piloted successful in the US state of Oregon, where motorists in Portland were offered the option of either paying fuel duty at the pumps or through a pay-as-you-drive trial. Not only did many drivers opt in, but they also chose not to opt out again having tested the scheme.

While motorists should certainly not be asked to pay more in proportional terms, pay-as-you-drive schemes will need careful design to ensure that they don't create greater congestion by under-pricing car use. This is not only important for the obvious local and global environmental reasons, but it is also already established that congestion hampers growth.

Pay-as-you-go driving can nevertheless be designed to offer very much clearer incentives to motorists to choose more efficient and low-emissions vehicles. It can also allow motorists the option of paying less for journeys by avoiding busy roads at peak times, thereby reducing congestion. But the many and well-rehearsed arguments in favour of this approach have hitherto been outweighed by people's antipathy towards and suspicion of plans to charge for journeys.

The third challenge is ensuring a socially just transition: The energy debate has much to offer transport. The current public outcry at rising energy prices and the statistical increase in households in fuel poverty is the result of increasingly expensive fuels, inefficient housing, and incomes that are falling in real terms. 'Transport poverty' in car-owning households is to a large extent the same type of phenomenon, produced by rising fuel costs, relatively fuel inefficient vehicles and, again, a real-terms fall in income.

In the energy debate, the benefits of government policy to bring about a technological transformation often accrue to people on higher incomes, because although incentives and subsidies make – for instance – fitting solar panels more cost-effective in the long run, households are still required to raise the capital required to purchase the technology upfront. Similarly, the current grant of up to £5,000 paid to consumers who buy plug-in vehicles is unlikely to be enjoyed by households on lower incomes, as some £20,000 or more would in many cases still be needed for the upfront purchase.

However, one significant difference between fuel and transport poverty is the existence of alternative modes of transport. Current car owners who cannot afford the most efficient low-emissions technology will have to spend an increasing share of their income on petrol or diesel unless they choose to travel by alternative means. So while we conclude that some of the incentives aimed at developing the market for new automotive technology should be aimed at households on lower incomes, for instance by supporting low-carbon car sharing schemes in poorer neighbourhoods, ensuring access to affordable and integrated *public* transport will almost certainly be the most important means of keeping people mobile.

Because access to transport, services and jobs are clearly linked, we argue that a government strategy should have the explicit aim of tackling transport poverty. Such a strategy is beyond the scope of this report, but with rising motoring costs and public transport fares, access to affordable travel could quickly become as hot a political potato

as the affordability of household energy bills. In the meantime, where there are potential win-win options that serve the interests of decarbonisation and affordability, such as the use of low-carbon technology in community transport, they should be fully exploited.

A framework for vehicle decarbonisation

Based on the findings and conclusions we outline below, IPPR argues that because vehicle decarbonisation is critical to achieving the UK's carbon targets and because the automotive industry is a significant and growing employer, it is clearly in the nation's interests to develop a clear policy framework. Key aspects of our recommendations include:

- An exhaust pipe emissions standard of 95g/km or better by 2020, with a review in 2015 to examine possible tightening if technology moves faster than policy
- Strong UK government support for a mandatory standard at the European Union level
- The launch in 2013 of a new 'feebates' scheme, which would encourage consumers to buy new vehicles below a specified level of emissions and enjoy a rebate paid for out of fees charged on vehicles above the specified level
- Partnerships with the private sector to install planned public charging points in urban areas, to overcome consumer anxieties about the range of electric vehicles
- A UK automotive innovation strategy focussed on five grand technological challenges, with an increasing sum of government money invested in R&D
- The implementation of the Coalition's planned road-pricing scheme for HGVs
- Voluntary trials from 2015 onwards of revenue-neutral pay-as-you-drive schemes, offering motorists the opportunity to opt out of fuel duty and into a distance-based road-pricing scheme
- A government-led partnership initiative to bring low-carbon car-sharing schemes to communities in need of better transport interconnection.

IPPR also argues that a framework for vehicle decarbonisation should be set within a wider transport strategy that aims to address the looming travel affordability crisis, ensure deep emissions reductions, and integrate a wide variety of different modes of transport.

1. CONTEXT

Both in the UK and globally, transport has a huge impact on emissions of CO_2. In 2008, 22 per cent of the UK's emissions resulted from surface transport (cars, vans, heavy goods and other road-based vehicles). It is therefore impossible to decarbonise the UK economy to the extent required in the Climate Change Act of 2008 without significantly reducing emissions from the use of the UK's roads.

Car use is still the dominant form of UK transport, with private motorised travel making up 85 per cent of the total distance covered in 2009.[1] Of total emissions from surface transport, 60 per cent is attributable to cars, 13 per cent to vans, 20 per cent to HGVs and 4 per cent to buses. The Committee on Climate Change (2010) argues that more than one-quarter of surface transport emissions can be cut by 2020.

The efficiency of road vehicles has been improving. Over the past two decades (1990 to 2008) the level of 'emissions intensity' has dropped by 16 per cent for cars, 3 per cent for vans and 14 per cent for HGVs. However, these improvements came hand-in-hand with increased distances travelled for all three forms of transport, which meant an increase in overall emissions of 7 per cent over the same period (CCC 2010: 153).

The most recent data (2004 to 2008) gives greater cause for optimism. It suggests that the tide seems to be turning in terms of surface transport emissions, as they declined in absolute terms by 1.7 per cent, by 3.5 per cent in 2008 alone and by a projected 3.9 per cent in 2009 (CCC 2010: 153).

In the meantime, the international price of oil, which has recently spiked at more than $120 per barrel and is currently averaging around $80 per barrel, is expected to increase to an average of more than $123 in 2030, providing an increasingly clear signal to consumers to decarbonise the way they travel.[2] Volatility in the oil market, rising demand in emerging economies and the potential for price shocks may also amplify this signal.

In addition, declining production of North Sea oil is leading to increased importation of oil into the UK, worsening its balance of trade. Since 74 per cent of oil consumption in 2010 was attributable to transport,[3] the impetus for a low-carbon transport system is becoming strong.

However, transport and transport fuel choices are shaped by a variety of factors. For most, access to low-carbon vehicle technology is limited and therefore even at a time of rising oil prices demand is likely to be highly elastic. Furthermore, fuel duty and VAT – together yielding £29.5 billion in 2010 – make up the lion's share of the price of a litre of fuel; this is not only politically hard to sustain, but also unfair for low-income motorists, who spend a higher proportion of their income on running their cars. Fuel duty, though adding significantly to the price of petrol and diesel, is also imprecise and inconsistent as a climate-friendly tax: it targets the fuel rather than the emissions, and is open to annual change.

In its efforts to achieve a decarbonisation of surface transport, the EU has developed a set of emissions standards for road vehicles. By 2020, when the UK and EU reach their next major emissions milestones, average emissions from new vehicles must be at or below 95gCO_2/km for cars and 135gCO_2/km for vans. The UK has already adopted these exhaust emissions standards and the EU is currently considering making them mandatory.

1 DfT, cited in http://www.centreforcities.org/assets/files/2011 Research/11-09-14_Access_all_areas.pdf

2 IPPR extrapolation from a range of data sources including International Energy Agency and DECC. The range used may under-predict the increase in oil price over the time period of the modelling, but we found that varying the oil price made only small differences to the revenue outcomes for fuel duty.

3 See http://www.decc.gov.uk/publications/Default.aspx?term=TRANSPORT&tags=&urn=&fromdate=&todate=&alpha=#result

According to the Committee on Climate Change's (CCC) fourth carbon budget, now endorsed by the Coalition government, achieving these exhaust emissions targets will require 1.7 million of the vehicles on the UK's roads to be either fully electric or plug-in hybrid by 2020 – around 5 per cent of all cars and 16 per cent of all new cars. It will also require an increase in the proportion of biofuels in the overall fuel mix to 8 per cent, a take-up of 'eco-driving' techniques[4] by 10 per cent of car and van drivers and 100 per cent of HGV drivers, stricter enforcement of the 70mph speed limit, and a levelling-off in the overall growth of traffic in the UK.

Some of these measures will be harder to achieve than others. Reaching the target level of biofuels in the fuel mix is highly questionable, due to concerns over the sustainability of production and its lifecycle emissions. Stricter enforcement of the 70mph speed limit has only recently been dealt a significant blow by the announcement of plans to raise the UK motorway speed limit to 80mph.

The emphasis in policies that aim to decarbonise road transport therefore needs to be placed on improving vehicle technology and providing alternative means for people to make journeys that are essential for their household welfare and for the economy. In this report we frame this in terms of three challenges:

1. the technological feasibility of the level of decarbonisation required to meet climate targets
2. impacts of lower emissions and fuel consumption on revenue from sales of fuel and other motoring taxes
3. likely impact of the decarbonisation process on lower-income households, for whom the availability of affordable transport is closely linked to their ability to improve their income and access services.

Methodology

The research that underpins this report involved three separate stages.

1. **Literature review:** IPPR thoroughly reviewed the literature related to low-carbon vehicle technology, policy, the impacts of deployment on government revenues, alternative means of raising revenue from road use, and the impacts of policy and revenue changes on low-income households.
2. **Modelling:** Using data from a variety of sources, we built a simple model to help us predict the government revenues impact of the level of efficiency and decarbonisation the UK government is committed to in the fourth carbon budget.
3. **Stakeholder interviews:** We interviewed a range of people (listed in table 1.1) from industry, non-governmental organisations, lobby groups, academia and government agencies in order to understand further how public policy could best support a fair transition to low-carbon road use.

4 Eco-driving courses teach drivers techniques, such as the most optimal moment to shift gears and gentler acceleration and braking, that are designed to save fuel.

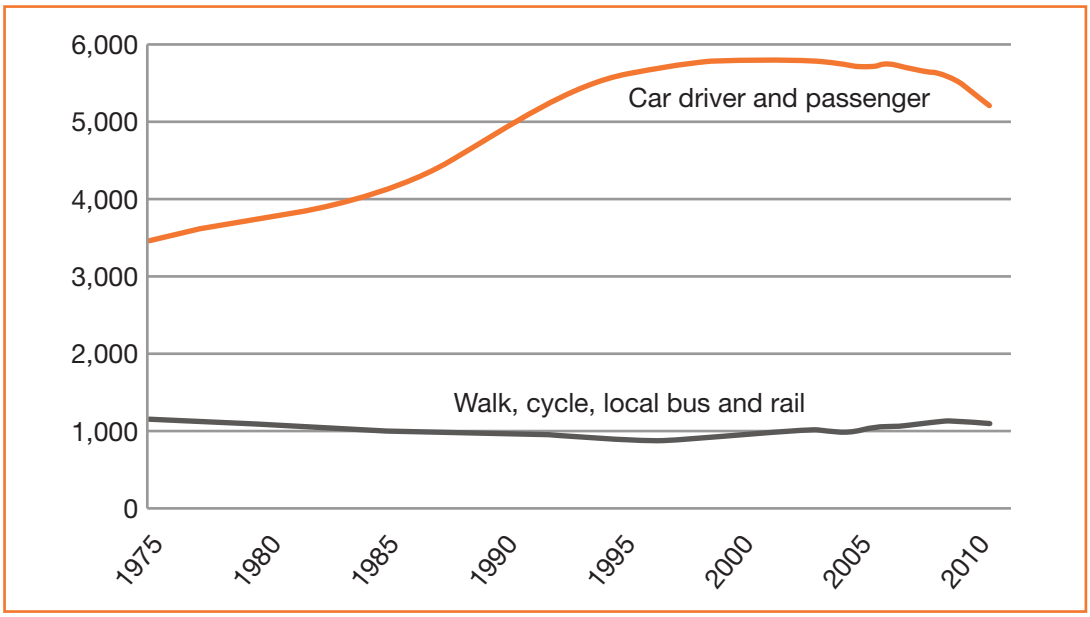
Table 1.1
Stakeholders interviewed

Name	Position	Organisation
Professor Julia King	Vice Chairperson	Aston University
Andrew Everitt	Head of Transport	Technology Strategy Board
Jonathan Murray	Deputy Director	LowCVP
Caroline Watson	Transport Strategy Manager	Energy Saving Trust
Robin Hickman	Associate Director, Transport	Halcrow
Luca Lytton	Research Analyst	RAC Foundation
Stephen Joseph	Chief Executive	Campaign for Better Transport
Jonathan Foster-Clark	Senior Management Consultant	WS Atkins
Philippa Oldham	Head of Transport and Manufacturing	Institute of Mechanical Engineers
Luc Bastard	Senior Manager of Environmental Relations	Renault
Graham Smith	Managing Director	Toyota Europe (London)
Jerry Hardcastle	Vice President, Design & Development	Nissan UK

2. THE EMISSIONS AND EFFICIENCY CHALLENGE

It is impossible to confront the challenge of reducing emissions from private transportation without considering the global context. In OECD economies, there is emerging evidence that car use is on the decline (ITF 2011, Goodwin 2012). There are many explanations for this but if the observed trend holds (see figure 2.1 below) and economies continue to grow weakly or stall, then car and fuel use and emissions predictions will require significant revision.[5] This may revolutionise transport policy and free up resources and political space for the meaningful development of a properly integrated transport system that locks out unnecessary car journeys and locks in choice over how to travel.

Figure 2.1
The apparent 'peak car' trend in the UK



Source: Reproduced from Goodwin 2012 (forthcoming)

However, the OECD peak car phenomenon is unlikely to be repeated in the short term in developing countries, whose economic growth is forecast to remain aggressive and where there are still relatively few vehicles relative to population. Of the four leading developing economies, Russia has the highest density, with 253 vehicles per 1,000 people in 2010 – China, India and Brazil have many fewer. By contrast, vehicle density in the US has fallen from a peak of 453 per 1,000 people in 2001 to 419 in 2010 (Zewatsky 2011).

The global transport efficiency and emissions challenge is therefore twofold:

- How can growing demand in developing countries for private transportation be met while reducing both fuel use and carbon emissions?
- How can public policy help drive greater efficiency and lower emissions and also temper the growth in vehicle use?

This is an important context in which to consider how policy in the UK and EU might be formulated. Increased global demand for vehicles is taking place within the context – and is a cause – of rising oil prices. It frames the challenge not only as one that must take place for environmental reasons, as argued above, but also because demand in

5 Throughout the past decade, while car use appears to have already peaked, economic growth, up until 2008, remained strong, suggesting that traffic and growth may be decoupling.

automotive markets in industrialised and developing countries is increasingly likely to be for more fuel efficient or differently fuelled vehicles.

The trend, moreover, is very clearly already heading in this direction in both industrialised and developing markets, although not at the pace required to meet either US fuel efficiency or EU carbon efficiency targets. However, there is a big difference in efficiency between countries: leading nations such as France and Italy have average new vehicle fuel efficiency standards of less than 6 litres per 100kms, whereas in the US the new vehicle fleet consumes more than 10 litres per 100kms (Eads 2011: 8).

Demand for petrol and diesel for cars and vans has hitherto been assumed to be highly elastic (that is, unresponsive to price changes, due to lack of alternatives). However, because more efficient internal combustion engine (ICE), hybrid and electric vehicles are increasingly becoming available, the link between demand for car use and the demand for fuel is being weakened, and thus that elasticity is reducing.

According to almost all of the stakeholders interviewed during the course of this research, standards will be central to meeting the challenge of accelerating the improvement in the fuel efficiency of vehicles and reducing their emissions. The moves by the US and EU to set fuel efficiency and exhaust emissions standards, and the state of California's goal of reducing vehicle emissions by 30 per cent by 2016, have begun to demonstrate this.

Key technologies

Technology is doubtless available to meet these or more ambitious standards, but manufacturers in particular fear that the introduction of the new low-emission, high-efficiency models that will help them to meet the fleet-wide standards will not be met with sufficient enthusiasm by consumers. However, all major manufacturers and some smaller ones as well have already introduced or are planning to launch low-carbon, high-efficiency vehicles, which include hybrids, such as the Toyota Prius and Honda Civic, plug-in hybrids such as the Chevrolet Volt, and full electric vehicles (EVs) such as Nissan's Leaf and Renault's Twizy.

A 2009 report commissioned by BERR and the Department for Transport (DfT) found that these groups of technology had the potential to reduce CO_2 emissions from transport by 40 per cent, including the emissions produced in the process of generating electricity (NAIGT 2009). Their potential was also highlighted in a recent report by the Department of Energy and Climate Change (DECC) which suggested that they represent a solution to mobility in an era of high oil prices (DECC 2009).

The advantage of hybrids – ICEs with a low-powered battery drivetrain in parallel – is that they demand very little behaviour change from drivers. However, they are not streets ahead: the best in class are merely comparable to the most carbon-efficient diesel engines. As a result, many of our interviewed stakeholders argued that meeting ambitious exhaust standards for 2020 could in theory be achieved through incremental change in diesel engine technology and vehicle design, along with some changes in the way motorists drive.

Much more significant change is likely to be triggered by the entry into vehicle fleets of plug-in hybrid vehicles. Toyota launches a plug-in version of its Prius in 2012 and is currently trialling them in a variety of European cities – it claims that this model will emit just 49g/km of CO_2 (compared with 89g/km for the current Prius). This, along with the increased market share of electric vehicles – 1.7 million in the UK by 2020 according to the CCC – would seem to mean that 95g/km is highly achievable, even if slightly under-ambitious.

Trials of hydrogen-powered vehicles are also being conducted by the Centre of Excellence for Low-Carbon and Fuel Cell Technologies (Cenex) and several vehicle manufacturers. While this technology is not expected to be available commercially until the 2020s and has significant hurdles to overcome in the meantime, such as the lifecycle emissions associated with the production of the fuel, it is expected to play a major role in surface transport in the future. In particular, hydrogen offers the chance to decarbonise larger commercial vehicles, for which the use of battery technology may be limited.

Consumers and the marketplace

A key challenge lies in the response of consumers. Efficient diesels, hybrids and electric vehicles are all more expensive to buy than petrol engine cars, hitherto the default choice. Consumers will need to be persuaded that the price of fuel will remain high and will need incentives to ensure they choose efficient vehicles, especially those with the lowest CO_2 emissions. The plug-in hybrids and EVs that offer the best opportunities to reduce emissions also require a significant shift in the way motorists use their cars.

Encouragingly, recent UK trials of EVs by Cenex suggest that behavioural barriers and preconceptions about EVs, such as 'range anxiety', may be removed once such vehicles become more familiar to consumers. For instance, 72 per cent of drivers participating in a public attitudes workshop said they would be happy to use an EV once they had test driven a vehicle, compared to 47 per cent beforehand. In EV trials, 55 per cent of journeys covered distances of less than 5km and all journeys were achievable with only a 50 per cent battery charge (data from Evans 2010).

In the Technology Strategy Board's trials of 340 ultra-low-carbon vehicles (EVs, plug-in hybrids and hydrogen fuel cells), involving both private individuals and fleet drivers, 95 per cent of participating private individuals found that the EVs in the trial were no more difficult to drive than the cars they owned. In addition, across all of the vehicles in the trials, 63 per cent of journeys covered less than 5 miles and 99 per cent less than 40 miles.

One further aspect of range anxiety is whether EVs can be driven from one European country to another and subsequently charged without adaptation. This is now the subject of an agreement between manufacturers, utilities and governments to standardise infrastructure.[6]

Beyond technological change in new vehicles, which is apparently rapid and moving inexorably in the direction of greater fuel and carbon efficiency, the pace of churn in the market in general (how quickly older vehicles are removed from the national fleet) is also a key issue. It is especially important if, as seems likely, economies in industrialised countries grow weakly or stagnate and new car purchases subsequently fall.

In 2009, largely in response to the threat recession posed to automotive industries and as a stimulus measure, several governments introduced scrappage schemes in which incentives were offered to consumers to trade in older vehicles for new ones. Some of these schemes incorporated explicit fuel economy and emissions reductions goals; the US scrappage scheme is believed to have been more successful in this regard because incentives were greater for the purchase of more highly fuel-efficient vehicles (Eads 2011).

Views on the value of scrappage schemes are mixed. Knittel (2009) argues that new cars tend to average greater annual driven distances in their first 3.5 years than older vehicles,

6 See http://www.businessgreen.com/bg/news/2111358/european-automakers-agree-standardised-ev-charging

cancelling out (or worse) the potential fuel savings from greater economy. However, the extent to which this may be the case – to which a household purchasing a new vehicle and scrapping an older one immediately increases its annual car mileage – is not clear in the literature.

Infrastructure demands

The success of low-carbon vehicles – and transport policy in general – depends not only on technology but also on having the infrastructure in place to support both the technological transition and the move to greater integration and alternative choices. Electric vehicles in particular need support in terms of recharging facilities (in the same way that the nationwide network of petrol stations supports the ICE) – having a thorough network of charging points would go some way to allaying the fears of consumers. The current debates about planning and housing need to encompass questions of transport as well, as future problems with congestion and the risk of creating communities that face exclusion from a variety of modes of transport can be 'planned out' through a strategic approach.

The Coalition government has recently produced a strategy for furthering the development of EV infrastructure. *Making the connection: The Plug in Vehicle Infrastructure Strategy* outlines plans to support recharging in the home, at work and in public spaces through a range of measures, such as reducing regulatory restrictions. It also pledges £300 million for the development of EV infrastructure during this parliament (OLEV 2011). While the strategy received criticism for abandoning the target of 9,000 public recharging points by 2013, the government argued that the home and workplace are the most appropriate place to recharge, particularly as overnight charging at home would take the pressure off the national grid and may in future provide storage for intermittent renewables.

Beyond the scope of this study, but also of high importance, is investment in a high-quality, affordable public transport network and facilities for pedestrians and cyclists. There is a wide range of literature on sustainable travel, including the evaluation of the Sustainable Travel Towns pilots in which Darlington, Peterborough and Worcester implemented packages of 'Smarter Choice' measures, with resulting increases in cycling, walking and bus use, and decreases in car use and traffic (DfT 2010).[7] Given the success of the pilots, it would seem sensible if such programmes were implemented in many similar locations.

7 See http://www2.dft.gov.uk/pgr/sustainable/smarterchoices/smarterchoiceprogrammes/index.html

An industrial opportunity for the UK?

In 1970, the UK produced more than 2 million cars and commercial vehicles. By 1982, this number had fallen to 888,000 and the industry was collapsing.[8]

The reasons for the demise of the British-owned car industry are well-rehearsed. The poorly handled amalgamations of many marques into the British Motor Corporation and then into a nationalised British Leyland created an internally competitive and fragmented company. The industry suffered famously poor labour relations, resulting in a succession of production line stoppages. Build quality of vehicles was poor. However, one overriding reason why sales plummeted and the industry declined – undoubtedly related to its other shortcomings – was a failure to innovate.

Innovation lies at the heart of growth.[9] In low-carbon vehicles, the UK has an evolving area of strength that is oriented around a series of key government-backed organisations, research institutions and companies. For instance:

- Cenex (based at Loughborough University), the Technology Strategy Board and the Low-Carbon Vehicle Partnership are working at various stages of the low-carbon vehicle innovation chain.
- Imperial College London is developing battery technologies, with companies such as Nexeon and EVO Electric spinning off.
- Zytek in Staffordshire, the sister company of a motorsports outfit, is developing a worldwide reputation for electric and hybrid drivetrains.
- Engineering company Ricardo has three technical centres in the UK developing a variety of technologies related to reducing vehicle emissions.
- Jaguar Land Rover has two engineering and design facilities in the UK and is working with WMG, a Warwick University spin-off, to develop efficient technologies. It has also recently announced it is to build a new engine plant near Wolverhampton in which up to 750 employees will manufacture its new hybrid powertrains.

Ten or more UK universities may have a leading edge in relevant technology, such as advanced lithium-ion batteries or lightweight materials. Herein lie the foundations of an innovative automotive industry – it is everything BMC and British Leyland were not. Crucially, it has been supported by collaboration between government agencies, academic institutions and the private sector.

The UK is also the location for European production of the Toyota Auris hybrid and Nissan's all-electric Leaf (whose production was secured with an £8 million government incentive, equivalent to 6 per cent of Nissan's investment costs). Indeed the automotive industry, having suffered a blip in 2009 as global demand weakened, appears very strong, employing over 180,000 people directly, 200,000 in the parts supply chain and over half a million in the sales and retail sector (BIS 2009).

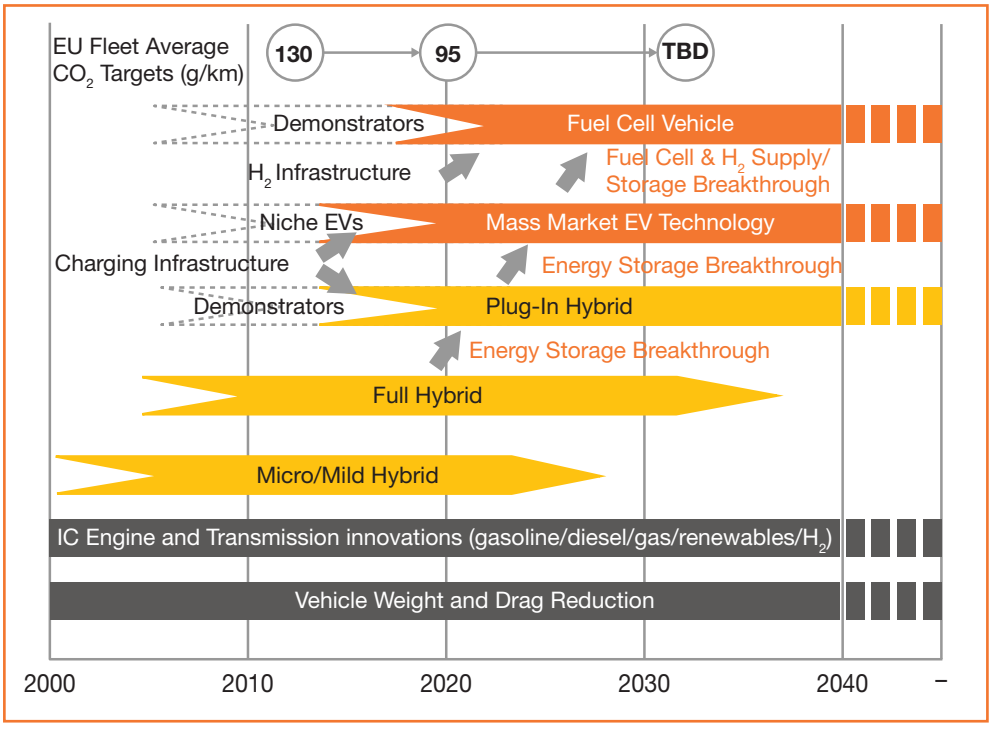
The New Automotive Innovation and Growth Team (NAIGT), an initiative of the former Department for Business, Enterprise and Regulatory Reform, produced a

8 See Ruddick 2011 and background at http://en.wikipedia.org/wiki/Automotive_industry_in_the_United_Kingdom

9 See for example Cameron 1998 or Lent and Lockwood 2010

technology road map in 2009, the implementation of which is now overseen by the Automotive Council. NAIGT's key objective was to define an industrial strategy that would deliver both economic growth and low-carbon outcomes. The team's report (NAIGT 2009) identifies a strong and innovative industry, but argues that the lack of a consistent policy framework or industrial strategy, poor orchestration of manufacturers and suppliers and a shortage of skills is hampering the industry. Figure 2.2 below illustrates NAIGT's view of the product development roadmap to 2050.

Figure 2.2 Product development roadmap



Source: Reproduced with permission from NAIGT 2009

The drawback for the UK is that innovation, in terms of R&D spend, has been falling as a percentage of the industry's added value. This is largely due to the fact that while seven large, global manufacturers have significant productive capacity in the UK, most conduct R&D activities in their home markets. Ford and Jaguar Land Rover are the exceptions to this, spending close to £1 billion in Britain annually, which is around 80 per cent of the UK's total expenditure on automotive R&D (NAIGT 2009: 34).

Given the growing strength in and focus on low-carbon vehicle development in the UK and the opportunities that seem likely to develop both in Europe and in developing countries, it is in the UK's interests to develop a package of policies to consolidate and accelerate UK technological innovation and bring British-originated

BOXED TEXT CONTINUED

products to market. In this endeavour, it will help enormously if the most immediate markets for the products – the UK itself and Europe – had the tightest feasible regulations in place to lock in the technological trajectory. Indeed, industry-led NAIGT concludes: 'At present the UK industrial landscape features a limited scope for battery, hybrid, fuel-cell and hydrogen power trains, compared to countries like Germany or Japan.'

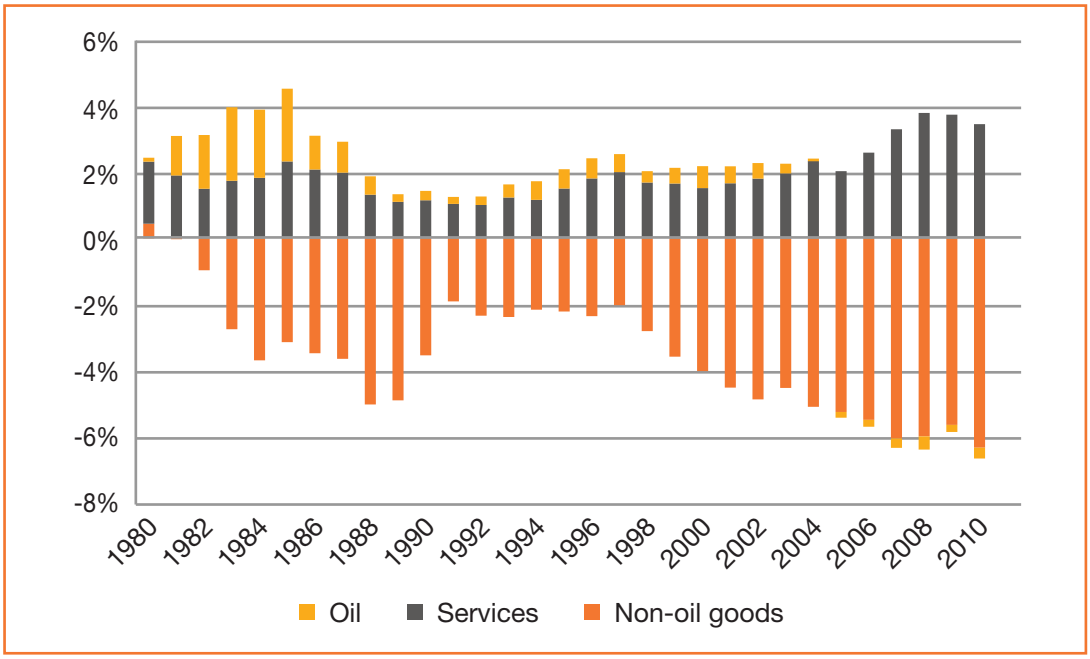
As part of the Coalition government's plan to invest in UK innovation, the Technology Strategy Board is investing £140 million over six years in the development of UK high-value manufacturing, through technology and innovation centres.[10] The high-value manufacturing centre is aimed at supporting automotive R&D, alongside other sectors such as pharmaceuticals and food and drink.

10 See http://www.innovateuk.org/content/competition-announcements/first-national-technology-innovation-centre-in-hig.ashx

3. THE FISCAL CHALLENGE

The UK raises revenue from motorists by taxing fuel, charging VAT on fuel and fuel duty, and levying an annual road use charge (vehicle excise duty or VED). As the carbon and fuel efficiency of vehicles improves, all three revenues will decline, because they are either dependent on the volume of fuel consumed or on the emissions of CO_2. In addition, declining volumes of North Sea oil production will lead to a steep drop in government royalties and a worsening balance of trade, as the UK is forced to import a greater proportion of its oil requirements, primarily for surface transport. This trend is already established (see figure 3.1 below).

Figure 3.1
Oil in the UK trade balance, 1980–2010 (% of GDP)



Source: ONS

Arguably, therefore, it is in the UK's wider economic interests to reduce the amount of oil it uses in transport, as both the balance of trade implications of the declining domestic supply and the rising global price will be punitive. The downside of this is the impact on direct treasury revenues from the sale of petrol and diesel and from annual VED. In 2010, the combined revenue from fuel duty and VAT on fuel and fuel duty was £29.5 billion. To put this in context, it is expected that expenditure on transport in 2011/12 will total £23 billion (HMT 2011).

While motorists and motoring organisations would always prefer car use to be cheaper, not only is the revenue of importance to the Treasury – especially in the current fiscal climate – but also cheaper motoring is likely to result in congestion, which will in turn be bad for growth. So while replacing the lost revenue due to greater fuel efficiency may primarily be a self-interested objective of government, it will not serve the economy or the environment well simply to allow motoring to become cheaper. An alternative means of appropriately pricing driving is therefore necessary.

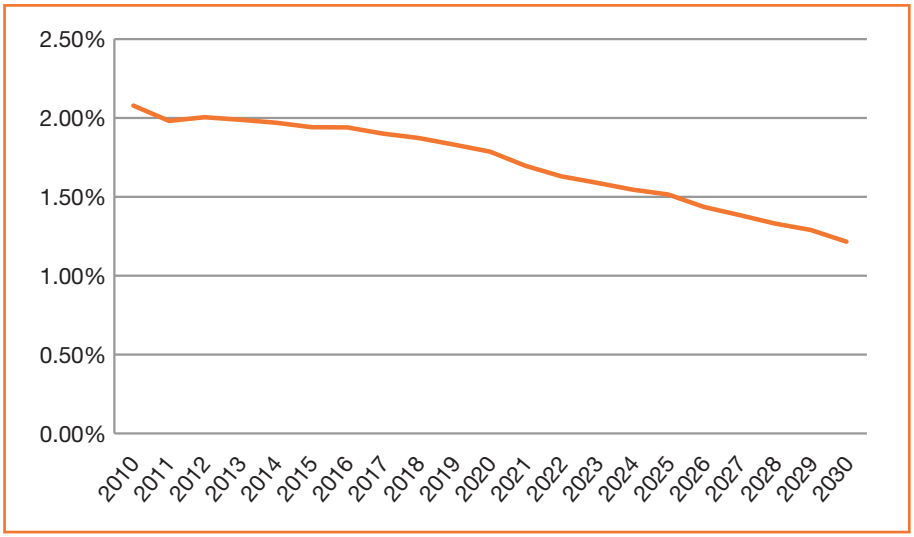
IPPR has modelled the impact on fuel duty – by far the largest source of government revenue from vehicle use – of a reduction in carbon emissions in line with the CCC's 'stretch ambition' scenario. The key assumptions are as follows:

- **Fuel duty:** In our reference scenario, fuel duty increases by RPI using OBR projections to 2015 and then 3.2 per cent per annum to 2030
- **Oil price:** We use the IEA's reference scenario, which starts at $78 in 2010 and increases to $123 in 2030
- **GDP:** Assumed to grow according to ONS projections to 2015 and then by 2.2 per cent per annum to 2030
- **Exchange rate:** Calculated at $1.55345 throughout
- **Fuel efficiency:** Calculated by applying to fuel the factors of decrease in carbon efficiency given by the CCC's projections
- **Distance travelled:** A dependent variable in the model, but since this appears to over-predict we have also manually adjusted to reflect DfT projections.

The parameters that we vary to produce a variety of results are fuel duty rate, since to rates are adjusted annually in the UK budget and are subject to a great deal of discourse and political pressure, and distance travelled, since this is the focus of some controversy in the literature. However, the projections from the DfT and other official sources do not take account of the already observed drop in per-capita car use and the hypothesis that the UK may have reached 'peak car' (see figure 1.1).

IPPR's reference scenario for fuel duty (represented in real terms as a percentage of GDP) assumes governments achieve an annual increase in fuel duty in line with inflation (which notably has not happened in the past decade) and that traffic grows in line with DfT projections (see figure 3.2 below). In this scenario, fuel duty drops from around 2 per cent of GDP in 2011 to around 1.75 per cent of GDP in 2020 and to around 1.2 per cent in 2030.

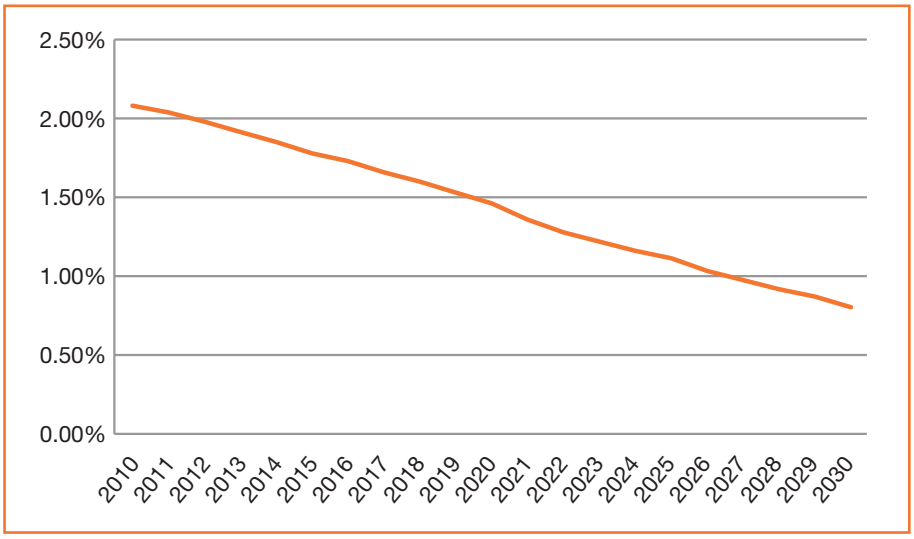
Figure 3.2
Fuel duty, IPPR reference scenario (% of GDP)



Source: IPPR model

This reference scenario may be optimistic because, judging by the past decade, it seems unlikely that governments will manage to keep increases in fuel duty in line with inflation, especially as consumer petrol and diesel prices will be increasing due to the rising global oil price. Figure 3.3 below uses an annual fuel duty increase of only 1 per cent, which is in line with the average achieved in the past 15 years. In this 'political reality' case, fuel duty yields less than 1.5 per cent of GDP by 2020 and significantly less than 1 per cent by 2030.

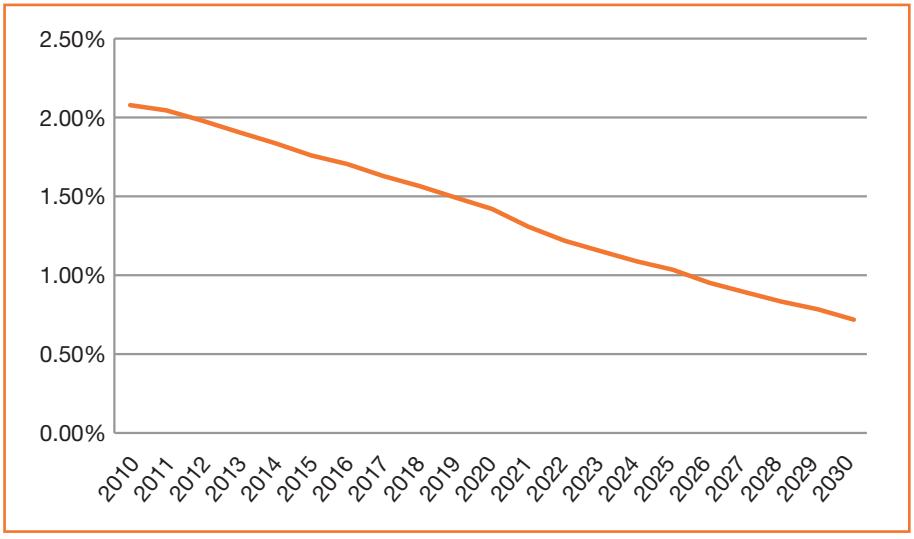
Figure 3.3
Fuel duty, IPPR 'political reality' case (% of GDP)



Source: IPPR model

In a third 'peak car' scenario, we assume that demand does not grow and remains at its 2010 level until 2030. Given the peak car hypothesis, this may not be an unlikely scenario and is therefore of real interest, as it helps us to examine the impact that reduced demand might have on fuel duty revenues. In figure 3.4 below, the peak car demand scenario is combined with the political reality fuel duty rate scenario (used in figure 3.3) – this is in effect the worst case for revenues.

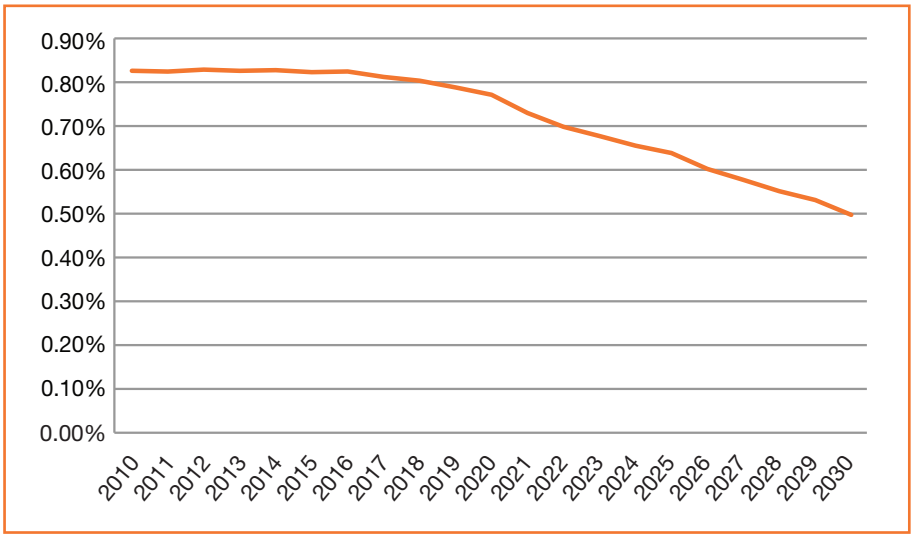
Figure 3.4
Fuel duty, 'political reality' combined with 'peak car'



Source: IPPR model

Whichever scenario is chosen, VAT, which is charged on both fuel and the fuel duty also declines significantly. In IPPR's reference scenario (see figure 3.5 below) VAT revenues almost halve in real terms.

Figure 3.5
VAT revenues, IPPR reference scenario



Source: IPPR model

IPPR's model shows similar results to the Office for Budget Responsibility in its recent Fiscal Sustainability report (OBR 2011). OBR also models the impact of greater vehicle efficiency on VED (figure 3.6) and the revenue impacts of the expected decline in North Sea oil production (figure 3.7).

Figure 3.6
VED receipts

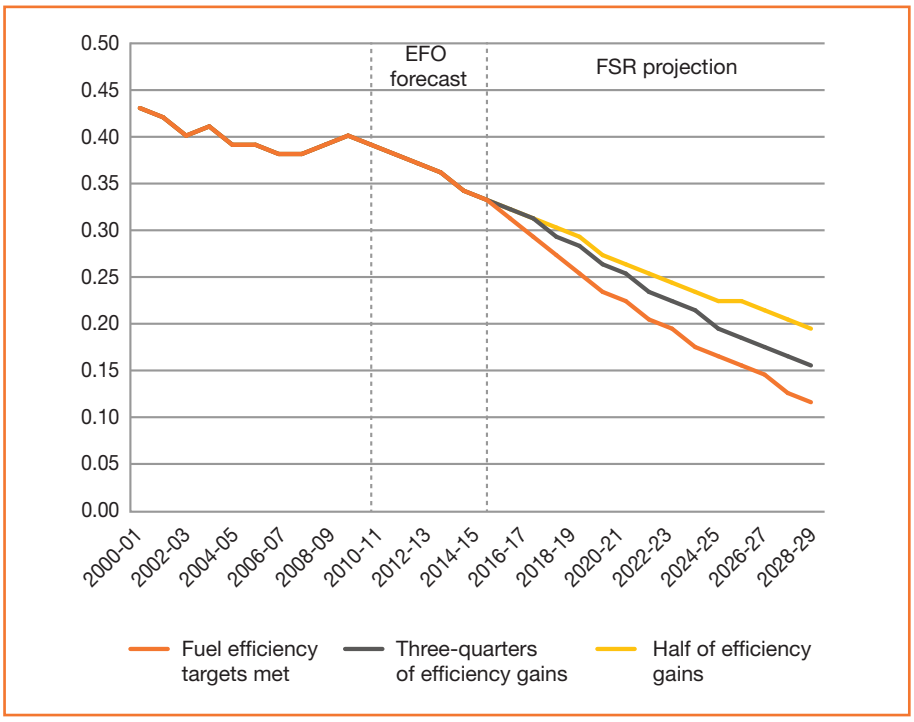
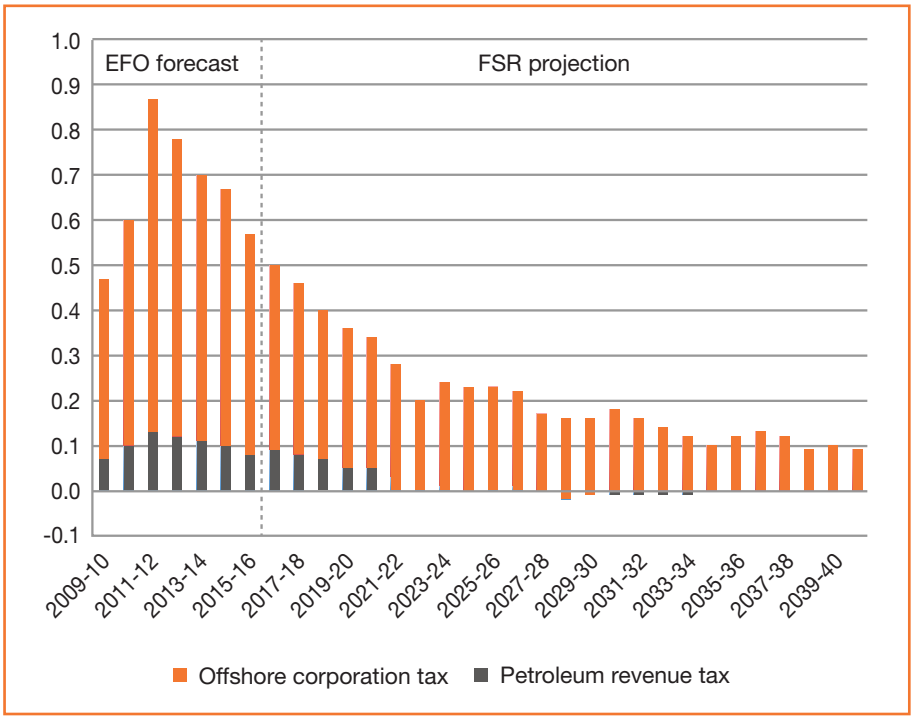


Figure 3.7
UK oil and gas revenues



Source: Reproduced from OBR 2011

The impacts of greater vehicle efficiency on revenues related to fuel use are quickly becoming the subject of scrutiny. Recent reports from the OECD's International Transport Forum (Van Dender and Crist 2011) and Sir James Mirrlees' review of the UK tax-base confirm that significant decline is to be expected. The latter argues that fuel duty should be replaced with congestion or road-user charging (IFS 2011).

Fiscal incentives to influence vehicle ownership can also have a significant impact on the kinds of cars people drive. VED in the UK is banded according to a vehicle's CO_2 emissions. Since April 2010, as a further incentive, new cars emitting less than 130g/km incur zero VED in their year of registration. However, perhaps the best example of a tax-based incentive intended to influence vehicle ownership is a 'feebate' scheme, in which less fuel-efficient and more polluting vehicles incur a charge and more efficient and less polluting vehicles earn a rebate.

France introduced a feebates scheme for vehicle purchase in 2008. Table 3.1 below shows how its charges and rebates work. While it has drawn criticism for offering overly generous rebates and not charging high enough fees, its emissions-related benefits appear to have been significant, with the French fleet average falling by 11 per cent between 2007 and 2009 (that is, since the scheme's introduction).[11]

11 See http://www.greencarcongress.com/2008/08/french-governme.html

Table 3.1
Fees and rebates in France's Bonus-Malus scheme

Fee (Malus)	Emissions (gCO_2/km)	Rebate (Bonus)
–	< 60	€5,000
–	< 100	€1,000
–	101–120	€700
–	121–130	€200
€0	131–160	€0
€200	161–165	–
€750	166–200	–
€1,600	201–250	–
€2,600	> 250	–

Pay-as-you-go

A thorough review of the literature concerning the raising of revenues from private vehicle use has failed to identify a viable alternative to taxing fuel other than charging users of roads on a pay-as-you-drive basis. As the US Transport Research Board's 2006 study puts it: '… travellers and the public would benefit greatly from a transition to a fee structure that more directly charged vehicle operators for their actual use of roads' (TRB 2006).

In the extensive stakeholder interviews that underpin IPPR's research, the issue of road-user charges as a replacement for fuel duty and as a fairer and more environmentally savvy means by which to tax vehicle use was raised very frequently, with an overwhelming majority of people supporting a shift in this direction. However, most of our interviewees also drew our attention to the difficult politics of road-user charges.

Currently, aside from various tolls for specific roads, the only UK examples of more comprehensive schemes are in London – where the area covered (charged for) has recently been reduced – and in Durham.[12] Proposed schemes in Edinburgh and Manchester were put to local referenda and fell foul of public attitudes. Three-quarters of voters in Edinburgh in 2005 opposed the introduction of charging.

The arguments in favour of charging road users according to the roads they use are compelling. The Eddington Transport Review found that 'a 5 per cent reduction in travel time for all business travel on the roads could generate around £2.5 billion of cost savings – some 0.2 per cent of GDP' (DfT 2006). Banks et al (2007) estimated that a national scheme costing £4.5 billion per year to run would generate £25–£30 billion per year in revenue. In 2009/10, fuel duty and VAT raised £29.5 billion.

Rural road users, who often have few alternatives to car use and therefore a highly elastic demand for roads, are likely to benefit in a scheme that is revenue neutral (in which fuel duty is replaced and not supplemented by charges for road use) because uncongested rural roads would require minimal charges, probably related to vehicle emissions only.

From the perspective of fuel efficiency and CO_2 emissions, road-user charges can provide a much keener incentive than fuel duty, which is at best blunt. The London congestion charge is waived for electric, hybrid and plug-in hybrid vehicles, as well as conventional ICE vehicles with emissions of less than 100g/km of CO_2. The impact such schemes

12 See http://www.tfl.gov.uk/roadusers/congestioncharging/ and http://www.durham.gov.uk/pages/Service.aspx?ServiceId=6370

are also intended to have on congestion should improve fuel efficiency regardless of the vehicle (DfT 2006).

One of the criticisms of fuel duty is that it is regressive. Road-user charging, while unlikely to be progressive, may not be as regressive, although the evidence is mixed.

In Edinburgh, Cain and Jones (2008) found that 10 per cent of the lowest-income quintile could be negatively affected by the city's proposed charge. In Oregon, where road-user charging has been piloted on a voluntary basis, the $0.12 per mile standard charge did not have any negative impact on the cost to rural or lower-income households. Schweitzer and Taylor (2008) concluded that such charges may be regressive but would replace a more regressive system. They found that transport road tax was twice as unfair as tolls in California.

The IFS's 2000 study of the distributional impacts of the proposed London congestion charge – and additional levy – found:

> **'Households close to the bottom of the income distribution would pay very little on average, and households right at the top would pay around £5 per week on average. This pattern is mainly driven by the tendency of both vehicle ownership rates and vehicle utilisation rates to increase with household income.'**
> Crawford 2000

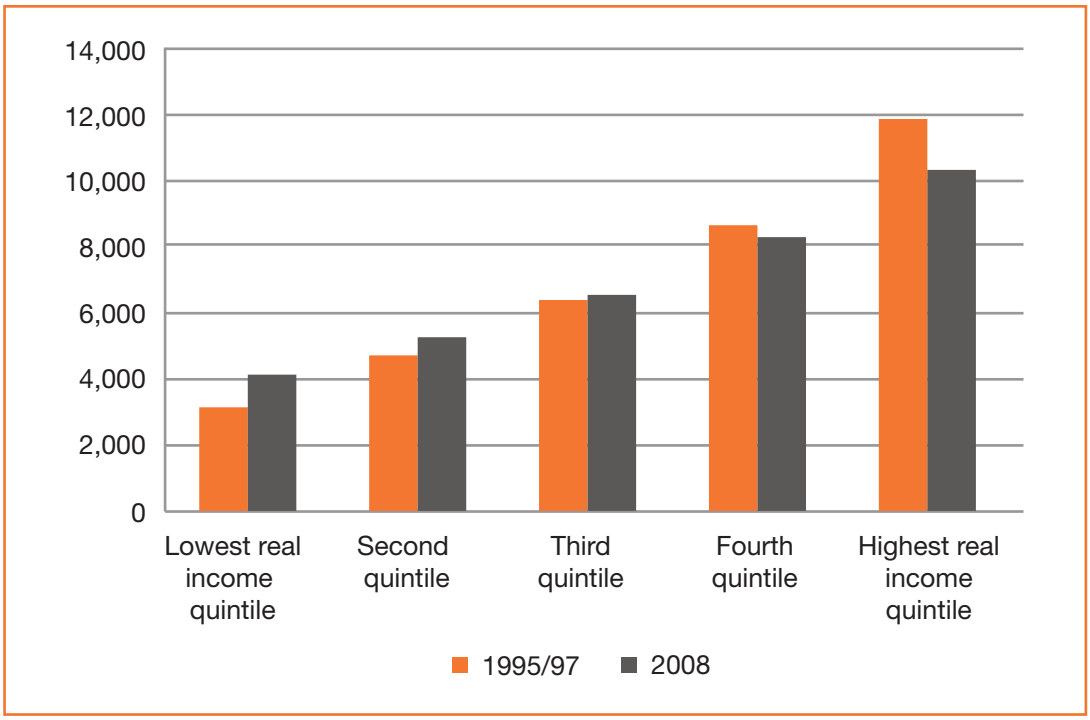
How revenues are spent is a key issue in determining whether or not the outcome of road-user charging is fair. For instance, the vast majority of the revenues from the London charge – which totalled £137 million in 2007/08 – are invested in improving bus services, which should reduce the elasticity of demand for road use by private vehicles. Fuel duty is a source of general revenue, and so revenue from a scheme at the national level that sought to replace it would be unlikely to hypothecated in the way the London charge is.

4. THE SOCIAL JUSTICE CHALLENGE

The challenge of providing affordable transport to ensure people on lower incomes can travel and, importantly, seek higher wages is significant. As a broad, if only indicative, illustration of the link between access to transport and employment, the Office for National Statistics (ONS)recently found that individuals commuting into London who spend over an hour travelling earn an average wage of £18.80 per hour, whereas those travelling for 15 minutes or less earn on average £9.60. Outside London, the figures decrease to £14.30 and £8.30 per hour, but the trend remains the same (ONS 2011).

As Brendan Barber from the TUC has put it: 'The link between long commute times and high earnings suggests that transport costs are a huge barrier to people looking for work outside their local area.' This view is further supported by data on travel in different income groups. Figure 4.1 below shows the average miles per year travelled broken down by household income quintile in 1995–97 and 2008. It highlights that distance travelled is negatively related to income, but also that distance travelled for the three lower quintiles is increasing while it decreases for the top two quintiles.

Figure 4.1
Average annual distance travelled by income quintile, 1995–97 and 2008 (miles per year)



Source: IPPR using DfT data

Given that the costs of transport fall regressively (and regressiveness is increasing due to rising motoring costs and increasing fares for public transport), this data appears to suggest that there is a case for improving access to personal transport as well as investing more in public transport aimed at lower-income groups.

In addition, households with lower incomes tend to have greater difficulty accessing services, both because they lack access to transport and because they live in areas of higher deprivation. A Joseph Rowntree Foundation study (Lucas et al 2001) concluded that low-income households' lack of access to transport added to economic and social exclusion in deprived communities. Since those same communities typically suffered from

poor local service provision, those who most need access to transport are often those who are least able to afford it.

Interventions aimed at using public expenditure to increase the availability of affordable, low-carbon travel should follow a hierarchy, according to Phil Goodwin (2010). In particular, he notes:

> **'It is very apparent that the very best value for money at present is coming from spending on a large number of small, relatively cheap projects aimed at local safety schemes, smarter choices, cycle improvements and some quality improvements to bus services.'**

One important conclusion that can be drawn from the above is that investments in public transport to connect areas of deprivation to services and jobs markets are likely to be more directly effective than investments in motoring. The Sustainable Development Commission notes that, due to expenditure on roads, 'the richest 10 per cent of the population effectively receive four times as much public spending on transport as the poorest 10 per cent' (SDC 2011).

Therefore, it remains inescapably the case that investing in public transport to increase access to travel is the most important priority in tackling 'transport poverty'. This is especially important as planned cuts in government subsidies, the removal of the cap on rail fares, increases in fuel costs and the high rate of inflation have precipitated significant increases in prices.

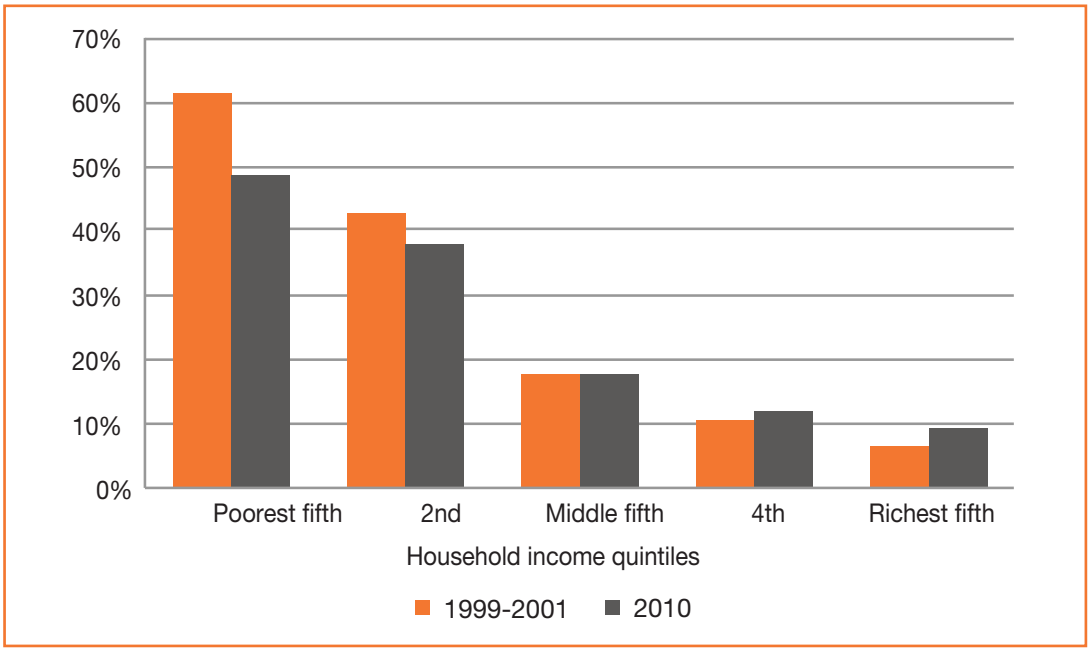
Part of the challenge of providing better and more affordable mobility to people on average to low incomes is to ensure in future planning decisions that demand for travel is lower because workplaces, housing and services are within easy reach of one another (Taylor and Sloman 2008). This approach is gaining credibility, especially in urban areas, is reinforced by the apparent peak car trend, and demands greater attention from policymakers.

However, public transport and planning policy is not within the scope of this study; suffice it to say that for people on lower and moderate incomes, an approach that seeks to ensure affordability and integration of different modes and plans in less travel is of high importance.

However, a common assumption is that households on lower incomes rely mostly on public transport and therefore that the costs of owning and using a car will be less important than the costs of using public transport. In fact, car ownership has increased among the poorest fifth of households from less than 40 per cent in 2001 to more than 50 per cent in 2010 (see figure 4.2).

The additional costs of the transition to a low-carbon transport system therefore pose further social justice challenges (beyond the impending increases in the costs of public transport). For instance, in energy policy, the feed-in tariff (or FiT) for renewable electricity, which is designed to provide incentives for incrementally more expensive forms of generation, has been criticised not only because it is funded regressively by utility bill-payers but also because its benefits are enjoyed by better-off households that can afford the upfront costs of installing the technology (NEA 2011).

Figure 4.2
Proportion of households without a car by income quintile



Source: Reproduced from The Poverty Website, http://www.poverty.org.uk/75/index.shtml (data from National Travel Survey, DfT)

There is not a feed-in tariff style incentive for electric vehicles (although in the event of a smart grid that carried a large proportion of renewably generated electricity it is conceivable that EV owners could be incentivised to use their vehicles' batteries to store electricity overnight). But offering a per-vehicle incentive to early adopters will inevitably favour people with high incomes. For instance, even including the current electric car grant of £5,000, a Nissan Leaf, which incurs very low running costs and zero VED, costs almost £24,000.

Consequently, as motoring costs rise, due both to higher fuel prices and to a variety of taxes and incentives aimed at persuading consumers to purchase more fuel and carbon efficient vehicles, there is a risk of exacerbating transport poverty, in the same way that fuel poverty has increased on the back of rising energy prices. According to the Joseph Rowntree Foundation study, households in the poorest fifth of the population can spend up to 24 per cent of their income running a car (Lucas et al 2001).

Furthermore, in the same way that people on lower incomes tend to occupy less thermally efficient housing, those who own cars also tend to drive less fuel-efficient and more polluting vehicles. To these households, the residual value of a 10-year-old vehicle, which may be one-third or less of the original purchase price when new, is not a trivial matter. Thus, improving efficiency and emissions across the whole of the UK's fleet carries a social as well as economic cost.

In the case of fuel poverty – in the context of a potentially costly transition to a low-carbon energy system – it has been proposed (Ekins and Lockwood 2011) that a three-pronged approach be adopted that:

1. Helps households on lower incomes to install measures to improve insulation
2. Provides advice on energy-saving approaches
3. Offers rebates on the costs of energy conditional on the first two.

In addition, it has been shown that households on lower incomes can enjoy the benefits of climate policy in the energy sector if a community-wide approach is taken and strong community actors draw in resources in order to help combat fuel poverty and build infrastructure (ibid).

A not-dissimilar[13] approach might be adopted to assist motorists on lower incomes or to allow communities that face economic and social exclusion to reduce their vehicle emissions (if they are car owners) and to enjoy a variety of affordable transport choices. The travel equivalent to the three-pronged approach might be to:

1. Increase access to low-carbon travel by targeting transport spending at low-income households, especially those in areas of deprivation
2. Ensure low-income households have access to good information about reducing emissions through making sustainable choices in transport
3. Compensate low-income households for increased costs during the transition to a low-carbon transport system through cross-subsidy within any new method of taxing travel (such as road-user charges).

We make some proposals for policies in these areas in the following section.

13 As government and welfare spending is cut, there is likely to be a debate about entitlement, and it will be easier to reach agreement about people's entitlement to household warmth than to affordable mobility and, in particular, motoring.

5. CONCLUSIONS

The Gordian knot that binds oil, private transport and government revenues is loosening. If current, agreed climate targets remain in place and government policy is introduced to support their achievement, then within a decade this knot – or perhaps noose – will have begun to unravel; within two, it will be untied completely.

The automotive industry has also been given a wake-up call. The biggest drop in new car CO_2 on record – 3.6 per cent in the second quarter of 2008 and then 5.5 per cent in 2009 (SMMT 2011) – came not because of climate targets or policy but because of the rise in oil prices and the recession. Because the rise in the price of oil is forecast to continue between now and 2020, efficiency will be the watchword for motor manufacturers, creating extremely positive conditions in which governments might impel more ambitious CO_2 reductions.

Several already-ongoing events will determine whether or not the UK is a pioneer in this regard.

- First, car use is already levelling off and perhaps even reducing. This may be by dint of the tough economic times in which the UK finds itself, but the trend appears in fact to have begun long before the recent recession. The inexorable rise in the price of oil and the relative reduction in real terms incomes may accelerate the observed trend, but other factors such as transport policies in cities and the increased use of information technology are also important factors in reducing car use.
- Second, the UK is shifting from its position of having been a net oil exporter to being an importer of oil. As its price rises, large import volumes of more expensive oil will prove punitive to the UK's balance of trade and its economy.
- Third, driven not only by the oil price signal but also by the UK's explicit aim to reduce its emissions, vehicle technology is responding quickly, promising not only a rapid exit from high oil dependency and emissions, but also some significant opportunities for UK industrial development in a new, clean automotive sector.
- Fourth, as a result of the changes in car use, the rising price of oil and the increased efficiency of the UK vehicle fleet, the government's hitherto healthy revenue from taxation of petrol and diesel can be expected to fall dramatically as fuel sales fall from 45 billion litres this year to around 41 billion in 2020 and 27 billion in 2030.
- Fifth, households with lower incomes will face rising travel costs, whether they run cars or not. The policy approach to decarbonisation of road transport must therefore be set within the context of a wider strategy for sustainable, affordable (and possibly less need to) travel, something which has been a long time coming from successive UK administrations.

This government and the next will therefore be required to design policy to meet three concurrent challenges: leading a transformation in automotive technology to reduce oil dependency and emissions, replacing revenue lost as a result of the fall in fuel consumption, and widening access to transport during the transition.

1. Transforming automotive technology

This study has found that the new car emissions target already adopted by the UK, requiring a reduction to 95g/km by 2020 – at least in effect through the adoption of the fourth carbon budget – is technologically feasible. Indeed, some think it may be possible to reduce exhaust emissions in cars even further by 2020. For instance, AEA's study for the European Commission (AEA 2010) suggests that a combination of known technologies, such as downsizing and turbocharging ICEs and extensive use of hybrids, if applied consistently, could *technologically* render 85gCO_2/km by 2020 feasible.

However, the challenge of achieving the target is twofold. First, having adopted the target in the UK, the Coalition government must become vocal and forceful champions for its adoption across Europe. The UK alone is not a large enough market to hasten the pace of innovation and reduce the costs of more efficient and low-emissions vehicles. Second, ensuring that people will not only change their purchasing behaviour but also make different travel choices will require sustained government strategy.

In addition, therefore, to setting and reviewing progress towards an exhaust emissions standard of 95g/km by 2020 *or better*, the UK needs a wider road transport decarbonisation framework that locks in a set of objectives over the next two parliaments alongside a national transport strategy which aims to ensure that the travelling public is offered a range of options and that people – especially those on low incomes – are not forced to be car dependent.

Part of this approach should focus on the industrial opportunities the shift away from oil-based technology presents through a strategy to intensify, accelerate and commercialise UK innovation in vehicle design, engine efficiency and decarbonisation, and the use of lightweight materials for efficiency. This study also finds that the UK is extremely well positioned to benefit from a low-carbon vehicle revolution and that it is therefore in the nation's interests to ensure that an emissions standard of 95g/km or better is not only the UK's aim, but also Europe's.

The UK has three choices with regard to the future of its approach to the automotive industry: to import vehicles into the UK, to manufacture and export vehicles, or to develop technology, manufacture and export. Since the decline of the automotive sector in the 1980s, the UK has been highly successful in attracting inward investment, especially from the three large Japanese manufacturers. However, these and other manufacturers will be open to making greater investments if the UK can provide better incentives for and better coordinate its already impressive R&D activities.

Through the Technology Strategy Board and with input and collaboration from the Automotive Council and its members, through the Low-Carbon Vehicle Partnership and the Energy Technologies Institute, this process is underway. The sums of money – £140 million over six years – are comparatively small and will need to be increased. But in addition, some of the stakeholders consulted during this research have argued that funding is being spread too thinly, across too many initiatives and institutes and in too diffuse a fashion, partly due to a fear of government being seen to pick winners.[14]

As well as increasing over time the pot of money available for UK automotive R&D, the government should focus its efforts more clearly on technologies in which we have world-leading research. Two that were mentioned frequently in our interviews are battery chemistry and lightweight materials. Stakeholders also spoke of the risks of not backing potential market leaders: other countries, such as the US and Germany, will do so and the UK will fail to capitalise on its promise.

The flipside of building on the UK's expertise and enterprise is the threat to existing jobs in the automotive sector if the UK both fails to maintain its efforts to lead transport decarbonisation and fails to encourage innovation. The shocks that reverberated through the automotive industry after the oil price spike and recession of 2008–09 have clearly

14 Although, to confuse matters, others have argued the opposite; that funding is focused on too few technologies and that picking winners is not the government's job.

signalled a move towards greater vehicle efficiency. Safeguarding the jobs of those already employed in the manufacturing, supply of components for and selling of vehicles in the UK requires a long-term vision that puts British innovation at leading edge of the global industry.

2. Renewing government revenue

Because of the inexorable trend towards greater vehicle efficiency, even using the most optimistic projections for year-on-year fuel duty increases and growth in traffic, fuel duty is likely to fall significantly in real terms. IPPR's modelling, using DfT's traffic growth scenario and with annual duty rate increases to keep pace with inflation, suggests that fuel duty will still decline from around 2 per cent of GDP in 2010 to around 1.75 per cent of GDP in 2020 and around 1.2 per cent in 2030.

If governments fail to make the annual increases in fuel duty necessary to keep pace with inflation and instead, for example, manage an average increase of only 1 per cent per annum (similar to the average increase actually achieved in the past decade) then the decline in revenues is steeper, to less than 1.5 per cent of GDP by 2020 and less than 1 per cent of GDP by 2030. Even so, this 'political reality' scenario is perhaps still overly optimistic, if the apparent peak car phenomenon is borne out in future traffic trends. In a zero-traffic-growth 'peak car' scenario, the value of the fuel duty declines to less than 0.7 per cent of GDP by 2030.

VAT, which is levied on sales of fuel and fuel duty, inevitably declines too, as does VED. In 2010, fuel duty and VAT, VED and revenues from North Sea oil amounted to more than 4 per cent of GDP. Oil and UK government revenues are currently bound together, but the ties are certain to loosen. The downside to this inevitable decline in revenues related to the production or use in transport of oil will be experienced by HM Treasury and are part of a wider pattern of declining revenues from conventional sources.

Rather than tax motorists, future governments may opt to find entirely alternative sources of revenue. The Green Fiscal Commission (2009) envisaged a shift from traditional forms of taxation to environmental taxes aimed at behaviour change. But fuel duty, the biggest single revenue-raising instrument in the transport sector, is not an especially effective environmental tax and impacts regressively on motorists with lower incomes.

Charging motorists for their use of the road is the only viable alternative to taxing fuel. IPPR has reviewed the extensive literature on road pricing and concludes that it can help government stabilise revenues from motorists as it replaces fuel duty and VAT, can offer environmental gains over fuel duty, is somewhat fairer, can reduce congestion, and offers motorists opportunities to reduce costs. It is hard to see an alternative, and yet the politics of pricing road use remain intractable: it is explicitly ruled out in the agreement between the parties in the current Coalition government and will be tough to introduce even after 2015.

The politics are made tougher by the need for government to reinforce a message that a shift to a different form of revenue-raising should not mean cheaper driving, as this will lead to greater congestion and harm economic growth, as Eddington (DfT 2006) and others have shown.

Nevertheless, we conclude that the next government will have to grasp the issue of replacing the existing revenue sources as they decline and that phasing in charges for road use as a means to do this in a consensual and revenue-neutral way may be not only unavoidable but also desirable.

3. Achieving a fair transition

As has been observed in the energy sector, the costs to the economy of decarbonisation fall more heavily on the shoulders of people in lower income households. In addition, the removal of bus subsidies and the cap on rail fares and rising fuel costs will soon drive up prices in the public transport sector.

While more households in the lowest-earning income quintile are car owners than was the case a decade ago, there may be reasons why this statistic does not fairly represent vehicle ownership in the UK's poorer neighbourhoods. For instance, relatively high levels of car ownership among the UK's student population may distort the picture.

We therefore conclude that, ultimately, only a properly integrated transport strategy – about which there is no shortage of literature – will provide households currently experiencing social and economic exclusion with access to better and more affordable travel options. We also conclude – although here the literature is less comprehensive – that access to a variety of affordable modes of transport will in turn play an important part in ensuring lower-income households have access to better employment opportunities, higher wages and a wider range of services. An integrated, sustainable transport strategy should therefore be seen as the cornerstone of an equitable approach to UK jobs and growth.

As we argue in the section above, wherever opportunities arise to ensure that the benefits of government policy can accrue to people in lower-income households, this should be a priority. For instance, vehicle charging infrastructure could be targeted at lower-income neighbourhoods in which community or shared EV use was also being supported by local authorities or other agencies.

As the wider literature on transport shows, while changes in policy, fuel prices and behaviour by no means threaten the dominance of the car, a more balanced approach to transport would see a greater proportion of the current UK government transport budget – around £23 billion in 2011/12 – spent on securing people's access to safe, affordable and sustainable mobility.

This does not mean that vehicle decarbonisation is any less important, but it does mean that easing car dependency – which is especially punitive for people with limited income but a major burden for many others – by reinforcing the apparent 'peak car' trend, if accompanied by support for alternative modes, is likely to have a good social justice outcome.

A framework for vehicle decarbonisation

The above conclusions suggest government should develop a clear framework to drive the decarbonisation of vehicles in the UK and to help shape a market in Europe that is in its own industry's interests. Currently there is policy, but it is piecemeal. The framework should have four key elements.

1. Developing the market

Under current fiscal constraints, government is unlikely to be able to make any significant differences to the scale of the UK market for low-carbon vehicles through large-scale deployment incentives. It is critical, therefore, that it sets long-term policies to determine a clear direction of travel for the automotive sector. These should include:

- Locking in exhaust emissions standards for 2020 and beyond. As per the CCC's fourth carbon budget, the mandatory target should be 95g/km or better, with an opportunity to review and tighten at 2015 should fuel prices continue to rise and technology and behaviour change outpace ambition.

- Actively supporting the agreement of a Europe-wide target of 95g/km by 2020.
- Extending the current £5,000 plug-in vehicle grant to the end of the current spending review period (to 2015) with a budget of £230 million as originally proposed.
- Introducing revenue-neutral 'feebates' for new vehicle registration from 2013 onwards, at first to overlap with the grant and then to replace it. The feebate 'pivot point' (the g/km emissions rate at which rebate becomes fee) should be reduced in line with progress against the 2020 target and reviewed alongside the target itself.
- Revising VED banding and charges to ensure that motorists have clear incentives to increase efficiency and reduce emissions that are in line with technological progress.
- Working with urban local authorities, energy utilities and large employers to invest in charging points; the aim should be for all towns and cities to match London's ambition (1,300 charging points by 2012) to ensure 'range anxiety' is addressed.
- Promoting eco-driving extensively as a means to help motorists save money as fuel prices increase and ensuring all professional and business drivers have access to eco-driving courses. The CCC suggests that 10 per cent of car drivers and 100 per cent of HGV drivers will need to be trained in eco-driving by 2020.
- Enforcing effectively rather than increasing the 70mph motorway speed limit, which the CCC suggests will save 1.3 $MtCO_2$ by 2020.

2. Backing British innovation

The necessary institutions – the Technology Strategy Board in particular – are already in place and actively supporting the innovation process with significant amounts of funding. There is a surprising amount already happening in automotive R&D in the UK and so the government's job must be to further support, orchestrate and promote the commercialisation of the emerging technologies. It should do this by:

- Explicitly backing five grand vehicle technology challenges – fuel cell, electric, hybrid, ICE efficiency, and vehicle design and weight – with a bespoke innovation strategy for the automotive industry.
- Forming networks of researchers around each grand challenge and providing a clear route to commercialisation through industry partnerships, including SMEs, financiers (including representatives of the Green Investment Bank once operational) and business development specialists, as well as larger companies.
- Being willing to spend larger sums of money on single challenges rather than spreading finance thinly across a wide range of institutes and technologies.

An automotive innovation strategy will almost inevitably require finance over and above the current £140 million being invested by government in the high-value manufacturing technology and innovation centre, but additional funds are unlikely to be forthcoming before 2015. In the longer term, the government should increase R&D support; this should be offset by cost reduction at the deployment end and by job creation.

The UK Innovation Investment Fund, which has 'clean' technologies in its portfolio and uses public money to draw in private capital, should be scaled up towards the originally proposed level of £1 billion within the next five years in order to help development among SMEs in particular.

NAIGT (2009) identifies a range of skills shortages faced by the automotive industry. While some of these are likely to be addressed in the focus on STEM skills, a sector strategy is needed to ensure that innovation doesn't migrate overseas for lack of skilled workers and that investors choose the UK as an R&D base.

3. Moving beyond fuel duty

Fuel duty is in decline and post-2020 the real-terms fall in revenue will be significant. With this in mind, and so as to replace lost revenue in order to reinforce the shift towards efficient, low-carbon vehicle use, governments should begin to develop strategies for introducing pay-as-you-drive schemes.

- The Coalition should implement its promised HGV road-user charging scheme with the explicit aim of reducing HGV emissions and using revenues for, among other UK-haulier-related purposes, assisting companies to improve HGV fleet efficiency, scrapping older vehicles and paying for eco-driving training (see above).15
- From 2015, the next government should begin voluntary trials of road-user charges for cars and vans in which participants are given fuel duty relief, so that they do not have to pay twice to use the roads.
- At the same time, the government of the day should look to build out from these trials, gradually offering more UK motorists the opportunity to 'pay-as-you-drive', with variable charges according to vehicle CO_2 emissions and the distance and time of the journey.

4. Tackling 'transport poverty'

People on lower incomes are facing escalating travel costs as public transport fares and fuel costs rise and will only benefit in the margins from policies to encourage the development of low-carbon vehicles. The elements of the framework for decarbonising vehicles outlined above should fit into a wider transport strategy that prioritises sustainable and affordable mobility.

- The model of ownership of vehicles is likely to shift as vehicles change, introducing greater opportunities for car-sharing and community ownership of ultra-low-carbon vehicles, especially in urban areas. The government should draw on the multitude of existing schemes to understand the role that the new generation of vehicles can play in affordable mobility.
- In the meantime, in light of the apparent consumer shift away from car use – again, especially in urban areas – and the affordability and environmental benefits of that shift, the government should develop a strategy for transport with an emphasis on the smart integration of public and private modes and with an explicit goal to tackle growing transport poverty.
- Reducing travel dependency through smarter planning will also be important for people on lower incomes. This suggests that attempts to rebalance the UK economy should go hand-in-hand with careful spatial planning that increases people's opportunities to live, work and access services within the same locality and ultimately without the need for car use.

15 For more details see Campaign for Better Transport 2010

References

AEA (2009) *Assessment with Respect to Long-Term CO_2 Emission Targets for Passenger Cars and Vans*, European Commission. http://ec.europa.eu/clima/policies/transport/vehicles/docs/2009_co2_car_vans_en.pdf

Banks N, Bayliss D and Glaister S (2007) *Motoring Towards 2050: Roads and Reality: Technical Report*, London: RAC Foundation/Arup

Cain A and Jones PM (2008) 'Does Urban Road Pricing Cause Hardship to Low-income Car drivers? An Affordability-Based Approach', transport research record (2067), 47-55 2067-06

Cameron G (1998) 'Innovation and Growth: A survey of the empirical evidence', unpublished. http://www.nuff.ox.ac.uk/users/cameron/papers/empiric.pdf

Committee on Climate Change [CCC] (2010) *The Fourth Carbon Budget – Reducing emissions through the 2020s*, London: CCC. http://www.theccc.org.uk/reports/fourth-carbon-budget

Crawford I (2000) *The Distributional Effects of the Proposed London Congestion Charging Scheme*, London: IFS. http://www.ifs.org.uk/publications/1765

Department for Business Innovation and Skills [BIS] (2009) *Government's response to the Business & Enterprise Select Committee's 'The Automotive Industry in the UK' report*. http://www.bis.gov.uk/files/file52905.pdf

Department for Energy and Climate Change [DECC] (2009) *The UK Low Carbon Transition Plan*. http://www.decc.gov.uk/assets/decc/white%20papers/uk%20low%20carbon%20transition%20plan%20wp09/1_20090724153238_e_@@_lowcarbontransitionplan.pdf

Department for Energy and Climate Change [DECC] (2011) 'Transport Energy Consumption in the UK since 1970', statistical release, 27 July 2011. http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-consumption/2325-factsheet-transport-energy-consumption.pdf

Department for Transport [DfT] (2006) *The Case for Action: The Eddington Transport Review*. http://www.inference.phy.cam.ac.uk/sustainable/refs/transport/Eddington.pdf

Department for Transport [DfT] (2010) *The Effects of Smarter Choice Programmes in the Sustainable Travel Towns: Full Report*, London: DfT. http://www.dft.gov.uk/publications/the-effects-of-smarter-choice-programmes-in-the-sustainable-travel-towns-full-report/#

Eads G (2011) *50by50: Prospects and Progress*, London: Global Fuel Economy Initiative. http://www.globalfueleconomy.org/publications/Pages/PublicationsHome.aspx

Ekins P and Lockwood M (2011 forthcoming) *Tackling fuel poverty during the transition to a low-carbon economy*, York: Joseph Rowntree Foundation

Evans R (2010) 'Electric vehicles', presentation, 15 July 2010. http://www.lowcvp.org.uk/assets/presentations/Robert%20Evans%20-%20Cenex%20LCVP%20conf%20RE.pdf

Goodwin P (2010) *Opportunities for improving transport and getting better value for money by changing the allocation of public expenditure to transport*, London: Commission for Integrated Transport

Goodwin P (2012 forthcoming) 'Three Views on Peak Car', *Local Transport Today*

Green Fiscal Commission (2009) *Green Fiscal Reform: A Green Tax Shift*. http://www.greenfiscalcommission.org.uk/index.php/site/about/final_report/

HM Treasury [HMT] (2011) *Budget 2011*. http://cdn.hm-treasury.gov.uk/2011budget_complete.pdf

Institute for Fiscal Studies [IFS] (2011) *Tax by Design: The Report of the Mirrlees Review*. http://www.ifs.org.uk/mirrleesReview/design

International Transport Forum [ITF] (2011) *Transport Outlook: Meeting the Needs of 9 Billion People 2011*, Paris: OECD/ITF. http://www.internationaltransportforum.org/Pub/pdf/11Outlook.pdf

Knittel C (2009) *The Implied Cost of Carbon Dioxide Under the Cash for Clunkers Program*, working paper 189, Berkeley: Center for the Study of Energy Markets, University of California Berkeley. http://www.ucei.berkeley.edu/PDF/csemwp189.pdf

Lent A and Lockwood M (2010) *Creative Destruction: Placing Innovation at the Heart of Progressive Economics*, London: IPPR. http://www.ippr.org/publications/55/1815/creative-destruction-placing-innovation-at-the-heart-of-progressive-economics

Lucas K, Grosvenor T and Simpson R (2001) *Transport, the environment and social exclusion*. http://www.jrf.org.uk/sites/files/jrf/1859352936.pdf

National Energy Action [NEA] (2011 forthcoming) *How, and to what extent, can UK energy and fuel poverty policy contribute to a socially just transition to a low carbon society?* York: Joseph Rowntree Foundation

New Automotive Innovation and Growth Team [NAIGT] (2009) *An Independent Report on the Future of the Automotive Industry in the UK*, London: Department for Business Enterprise and Regulatory Reform. http://www.bis.gov.uk/files/file51139.pdf

Office for Budget Responsibility [OBR] (2011) *Fiscal Sustainability Report 2011*. http://budgetresponsibility.independent.gov.uk/wordpress/docs/FSR2011.pdf

Office for Low Emissions Vehicles [OLEV] (2011) *Making the Connection: The Plug in Vehicle Infrastructure Strategy*, London: Department for Transport. http://assets.dft.gov.uk/publications/making-the-connection-the-plug-in-vehicle-infrastructure-strategy/plug-in-vehicle-infrastructure-strategy.pdf

Office for National Statistics [ONS] (2011) *Commuting to Work 2011*. http://www.ons.gov.uk/ons/rel/lmac/commuting-to-work/2011/index.html

Schweitzer L and Taylor BD (2008) 'Just pricing: the distributional effects of congestion pricing and sales taxes', *Transportation* 35: 797–812

Society of Motor Manufacturers and Traders [SMMT] (2011) *New Car CO_2 Report 2011*. https://www.smmt.co.uk/shop/new-car-co2-report-mar-2011/

Sustainable Development Commission [SDC] (2011) *Fairness in a Car Dependent Society.* http://www.sd-commission.org.uk/data/files/publications/fairness_car_dependant.pdf

Taylor I and Sloman L (2008) *Masterplanning Checklist for Sustainable Transport in New Developments*, London: Campaign for Better Transport. http://www.bettertransport.org.uk/system/files/Masterplanning_Checklist_executive_summary.pdf

Transport Research Board [TRB] (2006) *The Fuel Tax and Alternatives for Transportation Funding*. http://onlinepubs.trb.org/onlinepubs/sr/sr285.pdf

Van Dender K and Crist P (2011) *What does improved fuel economy cost consumers and what does it cost taxpayers?* discussion paper 2011-16, Paris: OECD/ITF. http://www.internationaltransportforum.org/jtrc/DiscussionPapers/DP201116.pdf

Zewatsky M (2011) 'Vehicle Density in Emerging Markets', Polk blog, 29 April 2011. http://blog.polk.com/blog/blog-posts-by-margaret-zewatsky/vehicle-denisity-in-emerging-markets