HELPING PEOPLE AND BUSINESS TO MOVE TOWARDS CLEANER FORMS OF TRANSPORT

The potential role of fiscal policy

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About WPI Economics

WPI Economics is a specialist economics and public policy consultancy. We provide a range of public, private and charitable clients with research, modelling and advice to influence and deliver better outcomes through improved public policy design and delivery. We work with a range of organisations - from FTSE 100/250 companies to SMEs and charities and Central and Local Government.

About the authors

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Matthew founded WPI Economics in 2015. He is a respected economist and policy analyst, having spent well over a decade working in and around policy making in Westminster. He had previously been Chief Economist and Head of Financial Services Policy at Which?, and Head of Economics and Social Policy at the think tank Policy Exchange.

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About this report

This report was commissioned by ClientEarth and undertaken independently by WPI Economics.

Disclaimer and legal

Contents

Glossary

Carbon dioxide (CO_2): A greenhouse gas formed from the combustion of fossil fuels.

Nitrogen oxides (NO_x): A class of air pollutants formed from the combustion of fossil fuels.

Nitrogen dioxide (NO_2): A specific type of NO_x that can be emitted directly, or by the interaction of nitrogen oxide and oxygen in the atmosphere.

Particulate matter (PM): A type of pollutant made up of a mixture of extremely small particles and liquid droplets that get into the air.

Ultra-low emission vehicle (ULEV): A vehicle that emits under 75g/km of CO_2.

Plugin hybrid electric vehicle (PHEV): A vehicle with both a combustion engine and a battery that can be charged using a socket.

Zero-emission vehicle (ZEV): A vehicle that produces zero tailpipe (exhaust) emissions. Currently the overwhelming majority of these are battery-powered, although other fuels such as hydrogen fuel cells exist.

Battery electric vehicle (BEV): A ZEV powered solely by a battery in the vehicle.

Report Methodology

The analysis in this report was informed by a review of a wide range of literature and statistics on electric vehicles. We are particularly grateful to those who kindly gave their time to discuss our initial findings and thinking.

The original polling cited in this report was conducted by ComRes. ComRes interviewed 2,003 GB adults online between the 13th and 15th April 2018. Data were weighted to be demographically representative of all GB adults aged 18+. Where results refer to people 'with an opinion' or similar, this refers to the proportion of respondents excluding those answering 'don't know'. ComRes is a member of the British Polling Council and abides by its rules. Data tables are available on the ComRes website, www.comresglobal.com

The modelling approach is set out in the Annex.

Executive Summary

While historic focus has been on reducing greenhouse gases, local air pollution is now recognised as a major issue for health, productivity, and wellbeing in the UK. Poor air quality leads to the equivalent of 40,000 premature deaths each year, and costs billions of pounds in lost productivity and healthcare costs.

The need for further Government action on this issue is highlighted by several court cases brought and won against the Government's lack of action on air pollution in recent years. Government has now acknowledged the need to meet legal limits of NO_2 in the shortest time possible, which inevitably means reducing the emissions that come from the cars, vans, and lorries on UK roads. Eighty per cent of roadside NO_x, a major contributor to air pollution, comes from these emissions.

The new vehicle market is changing; in each month since December 2017, the number of new diesel cars being registered has fallen significantly year-on-year. This has not, however, been accompanied by a corresponding increase in the sales of alternatively-fuelled vehicles (AFVs). In the first three months of 2018 diesel sales fell by 33% (120,000 units) compared to the same period in 2017, while AFVs saw an increase of just 3,000 (9.8%).

This suggests that there is a place for further Government action to kick-start the clean vehicle revolution – and the public agrees. Almost three quarters (74%) of people with an opinion agreed that they were interested in reducing the impact their driving has on the local environment. Our polling also found that 79% of people with an opinion agreed that Government should play an active role in encouraging the use of electric cars.

This report sets out fiscal policy options that should be explored by Government to meet three related but distinct goals in relation to vehicles and air quality:

- In the short term, Government needs to meet legal limits of NO_2 concentration levels;
- In the medium term, Government needs to further drive the uptake of ultra-low emission vehicles (ULEVs), to set itself on the trajectory to meet its ambition of banning all sales of new petrol and diesel vehicles by no later than 2040; and
- In the long term, it needs to both achieve the ban on the sale of traditional petrol or diesel cars and vans by no later than 2040, and respond to the decline in tax revenue that would occur if we moved tomorrow to an all-ULEV fleet.

To meet these challenges, Government will need to use a suite of complementary measures that focus on a range of potential barriers. These include measures to stimulate advances in vehicle technology, improvements in public transport and electric vehicle charging infrastructure, and encouraging more environmentally-friendly driving practices such as car-sharing. In practice a holistic strategy encompassing each of these aspects is likely to be necessary.

Failing to act will force families to live, work and play in areas that are dangerous to their health and miss a vital opportunity for UK industry

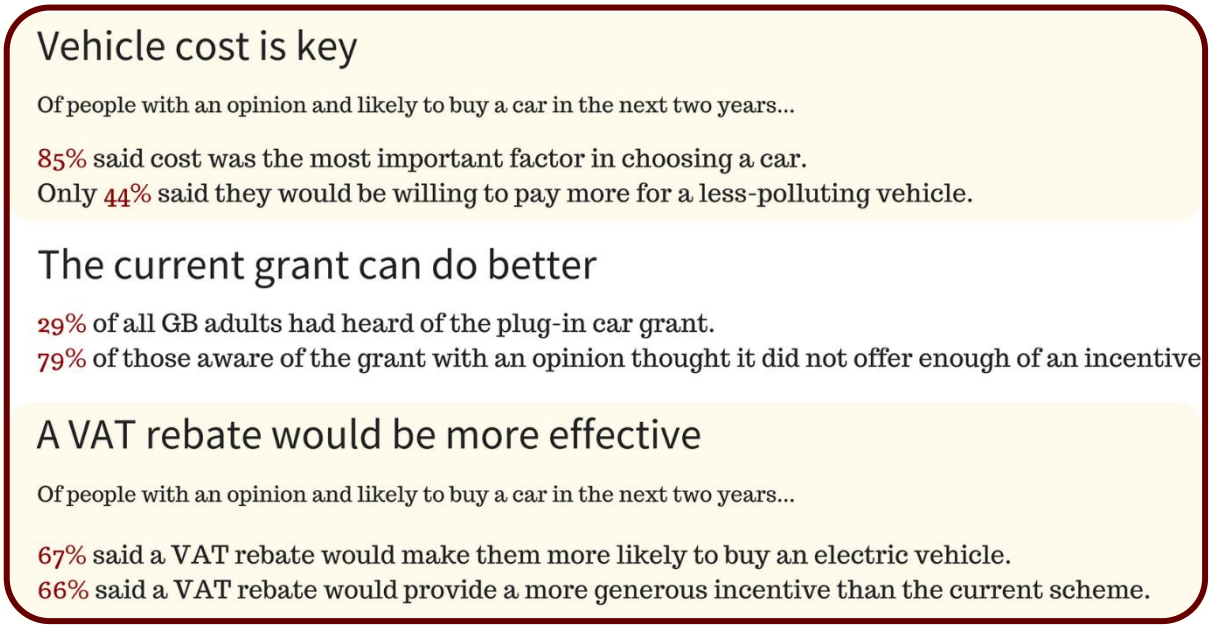
Meeting these challenges will help Government to not only meet its legal obligations relating to NO_2, but also support the UK to meet WHO guidelines for particulate matter and its own climate change targets for greenhouse gas emissions.

This report focuses primarily on fiscal policy: the levers available to Government to drive greater uptake of low-emission vehicles. In this report we set out our views on the most promising fiscal policy options, that are broadly fiscally neutral in both the short and long-term. Our key proposals are:

- Given the inherent local political challenges faced by Local Authorities, Government should mandate that all areas in excess of legal limits of NO_2 concentration levels introduce charging Clean Air Zones by 2020. Alongside this it should introduce a targeted scrappage and / or retrofitting scheme;
- The plug-in grant should be replaced by a time-limited VAT rebate for low-emissions vehicles. This would provide those purchasing a new ZEV with a 100% rebate and those purchasing other types of ULEV (such as a PHEV) a 50% rebate;
- To offset these costs we propose a small levy (£25 a year) on all non-ULEVs in the UK. Taken together, under realistic scenarios for growth in the take up of ULEVs, this approach would be revenue neutral for the Exchequer.
- A series of reforms to make the current motoring taxation system more responsive to emissions; and
- Immediate steps to begin the development of a future system of motoring taxation to replace the current tax base.

We have viewed and developed these proposals in the context of Government needing to take decisive action. Court rulings against the Government have highlighted the need for short-term action to meet legal limits and this report has shown that, without significant action, the UK Government could miss its goal of banning the sale of diesel and petrol vehicles by 2040. Even that target is unambitious when compared to other countries, including Scotland and the Netherlands, and the sooner it is met the better for all currently affected by air pollution.

Figure 1: The case for a VAT rebate to replace the plug-in car grant



There is undoubtedly growing support among policy makers, the public, and industry for measures to encourage the uptake of ULEVs. As we finalised this document, a four-committee inquiry published a

major report on improving air quality, which proposed several measures regarding ULEVs that echo our conclusions.

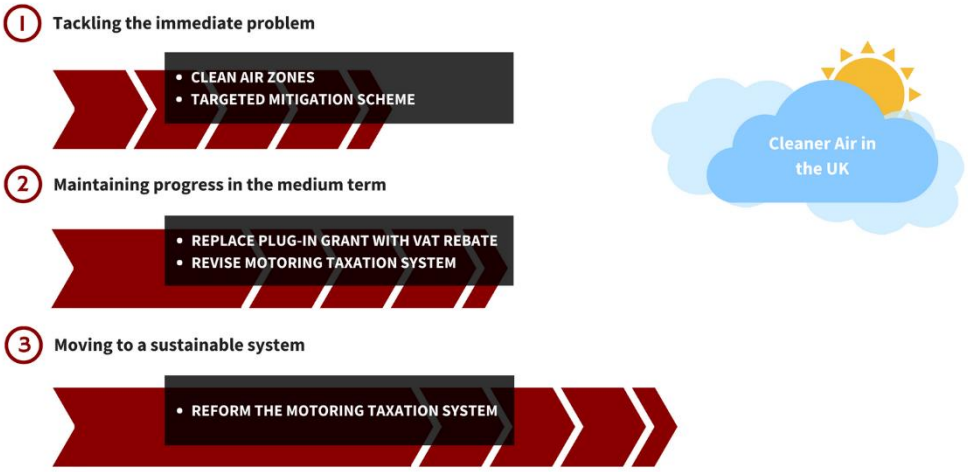
However, we also recognise that taking this action may not be easy for Government:

- While this report outlines options that are broadly revenue neutral in the short term, if take up of ULEVs increases more rapidly than expected, this could come with **direct costs to the Exchequer**, while the benefits (e.g. of improved health) are indirect and not scored by the OBR;
- Tax policymakers in HM Treasury and HM Revenue and Customs may also worry about the **level of deadweight** associated with these policies; and
- Whilst many will support the proposals, there will undoubtedly be a **minority who oppose changes** in fiscal policy that overtly favour PHEVs and BEVs over traditional diesel and petrol vehicles.

These potential objections are real, but are also far outweighed by the crucial point: failing to act will force families across the UK to continue to live, work and play in areas that are dangerous to their health – imposing health and social costs on individuals, businesses, and government.

It would also miss a vital opportunity; the Government has placed clean growth at the heart of its industrial strategy and has already taken steps to promote the uptake of ULEVs and support the development of the UK's ULEV innovation and manufacturing sector. There are also few countries that have achieved significantly greater proportions of ULEV new vehicle sales than the UK – so it is starting from a strong position. If this is to continue and the UK is to be a world leader in ULEV innovation and manufacturing, a strong home market is essential. Delivering this, and developing the home UK market for clean vehicles, will demonstrate to businesses across the world that post-Brexit Britain is the place to come to develop and manufacture ULEV technology. Ultimately, it is our view that action is not only a legal requirement, but also necessary for driving productivity, growth and living standards in post-Brexit Britain.

Figure 2: Overview of key proposals



Source: WPI Economics

Introduction

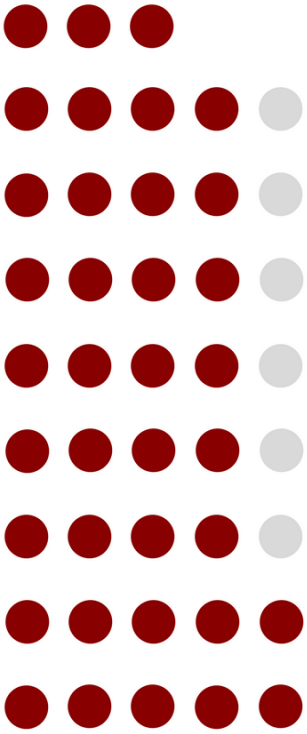
Government acknowledges air pollution as the single largest environmental risk to public health in the UK.[i] The impact of climate change from greenhouse gases such as carbon dioxide has long been an area of policy focus for UK governments, and in recent years more and more attention has also been paid to local air pollution, in particular the harm caused by nitrogen dioxide (NO_2) and particulate matter (PM).

Without further action, people in the worst-affected areas of the UK will continue to be exposed to **illegally polluted air** for years to come.

This harm is significant, to people, the natural environment, and the economy as a whole: This risk is starkly shown by a study by the Royal College of Physicians, which estimated that each year the equivalent of 40,000 premature deaths are attributable to outdoor air pollution.[ii] A 2012 study from the Department for the Environment, Farming, and Rural Affairs (DEFRA) estimated that £2.7bn was lost in productivity due to air pollution that year.[iii]

The health impacts are not just felt in shortened lives: air pollution can worsen existing medical conditions, especially respiratory and cardiovascular conditions, lowering quality of life. This may particularly be felt by children and elderly – and by those in urban areas, where traffic is greatest.[iv] There is also evidence that some types of air pollution may contribute to poor mental health.[v] These health costs are not just felt by individuals and local communities; businesses and the government are also affected through sickness absence and healthcare costs, so addressing these issues is in everyone's interest.

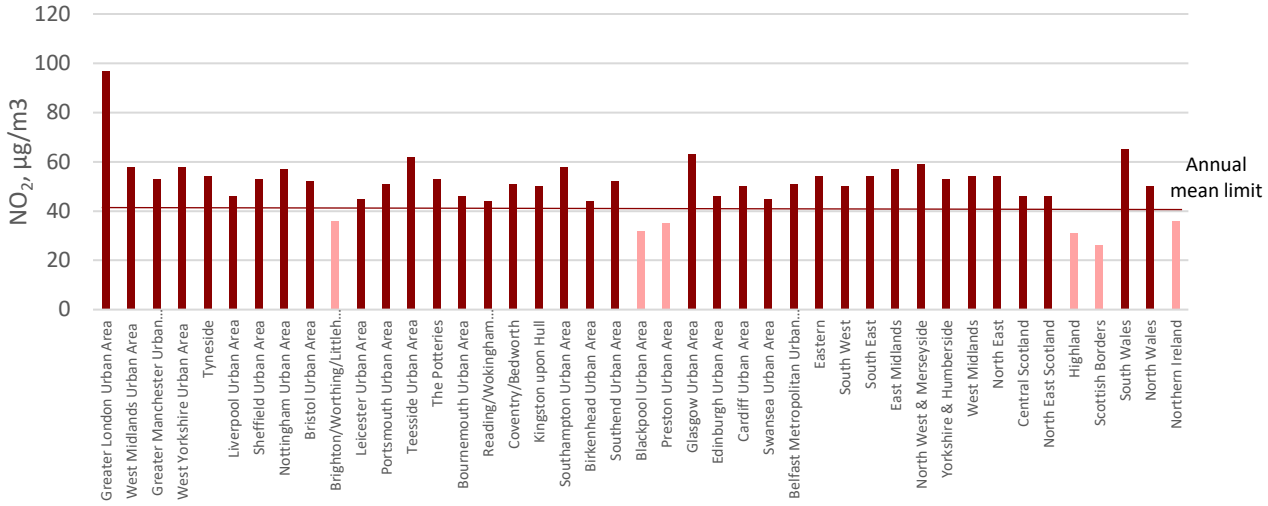
Figure 3: Proportion of UK Zones adhering to legal limits



Of the 43 Zones in the UK, only 6 are compliant with average annual legal air pollution limits

The UK should have met legal limits on concentrations of NO_2, set by the European Union and incorporated into UK law, by 2010. The government failed to meet this deadline and has a long way to go in making progress on this. This is most clearly seen by the fact that of the 43 Zones in the UK, only six are compliant with average annual legal limits (Figure 4). Without further action, the UK will not be fully compliant until 2028[vi] – meaning that those living and working in the worst-affected areas, particularly London, will continue to be exposed to illegally polluted air for years to come.

Figure 4: Highest modelled annual average NO_2 per air quality zone, 2017



Source: WPI Economics analysis of Defra modelling[vii]

ClientEarth has repeatedly brought legal action against the Government for its failure to take sufficient action to reduce air pollution. On three occasions the court has found against the Government,[viii] which highlights the need for it to do more to tackle this issue.

The Importance of Vehicle Emissions

Road traffic is the single biggest contributor to roadside NO_2, contributing 80% of these emissions. Any strategy to tackle polluted air needs to address the pollution caused by vehicles, particularly in the short term when the majority of ambient air quality reporting zones in the UK are not meeting their legal limits for NO_2 emissions. Alongside this short-term challenge, there are also medium to long-term desires of moving the whole of the UK vehicle fleet towards cleaner, less polluting (and ultimately, zero-tailpipe emission) vehicles.

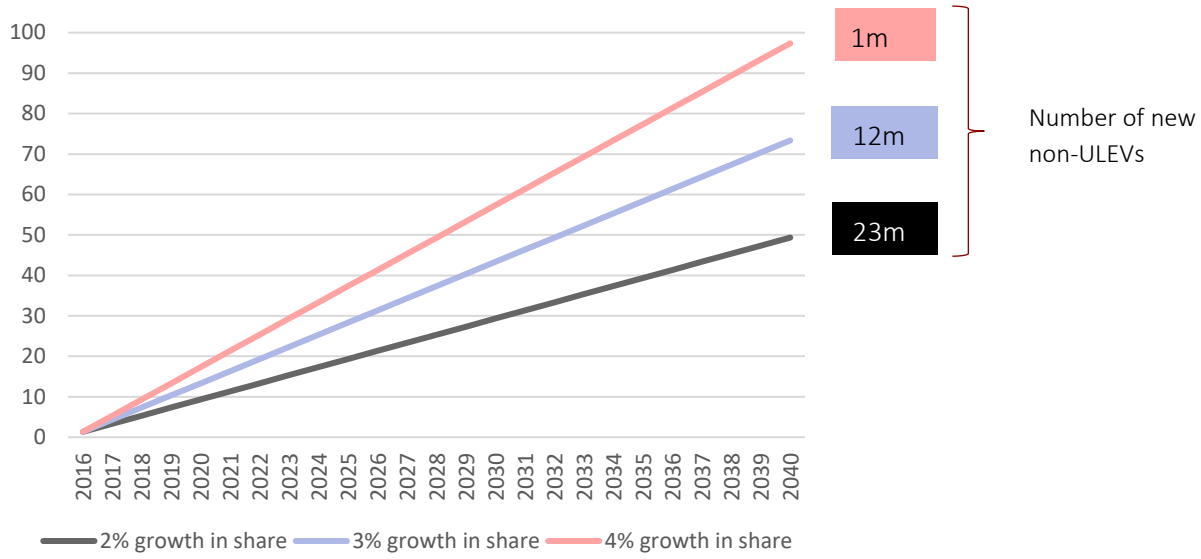
Government action

Figure 5: Government policies to incentivize ULEVs

In approaching these public policy issues, the Government has begun to take steps. Most eye-catchingly, it has committed to banning the sale of new pure internal combustion engine (ICE) cars and vans by 2040.[ix] The Industrial Strategy published in 2017 also announced a £400m Charging Infrastructure Investment Fund to accelerate the rollout of charging infrastructure, a £40m R&D fund for new charging technologies, and a commitment that by 2022 a quarter of the central government departmental fleet will be ultra-low emission.[x] A commitment to moving towards a cleaner transport future and these measures are undoubtedly positive steps, but this progress cannot be taken for granted given the current predominance of petrol and diesel vehicles in the UK fleet: ultra-low emission vehicles (ULEVs) were just 0.25% of the total UK car and van fleet in 2016.

As Figure 6 shows, to achieve this the average growth in the proportion of the car and van fleet that is ULEV will need to be significant. Even if the ULEV share of the new vehicle fleet grew by 4% each year from 2016, there would be a million new pure petrol or diesel vehicles under realistic total fleet growth projections by 2040.

Figure 6: Impact of linear growth of ULEVs as % of car and van fleet



Source: WPI Economics modelling

However, we cannot assume that merely placing a target will ensure that enough action is taken to reach these goals. Government does not publish long-term projections for ULEV uptake, but other reports, including modelling commissioned by Transport for London[xi] and independent academic studies,[xii] suggest that achieving 100% non-petrol or diesel new vehicle sales by 2040 may not be possible without significant policy action. But while a 2040 target is far from certain to be met, even this would leave us trailing other countries. In our view the UK Government should follow the lead of countries such as Scotland, the Netherlands, Germany and India in setting a more ambitious target date.[xiii, xiv, xv, xvi]

Whatever date is set as the target, there are many factors that will be necessary to achieve a new car and van market in which all sales are ULEV, and as many as possible are zero-emission. These include advances in vehicle technology, public transport and electric vehicle charging infrastructure (both at-home and on-street) and encouraging more environmentally-friendly driving practices such as car-sharing. In practice, a holistic strategy encompassing each of these aspects is likely to be necessary. This is highlighted in our polling; 75% of people who were likely to buy a car in the next two years and had an opinion felt that hybrid and fully-electric cars would be impractical for them due to the need for regular charging. Regardless of the accuracy of these concerns, this perception will need to be overcome if electric vehicles are to become a major part of the UK vehicle fleet.

Fiscal policy

This report focuses on one element of this strategy: the role that fiscal policy can play. In particular, it explores the role that taxation can play in encouraging the choice of cleaner vehicles, facilitating the shift towards clean air. We have predominantly focused our thinking and analysis on passenger cars and light goods vehicles, given that these represent more than 90% of the total vehicle fleet and are responsible for over three quarters of NO_x emissions from road transport. In considering the role that

fiscal policy can play, the report also considers the need for the Exchequer to maintain revenues from vehicle taxation as part of a well-functioning, broadly based and sustainable tax system.

Overall, this means there are three sets of ambitions for the Government:

- In the **short term**, Government needs to meet its legal limits of NO_2 concentration levels;
- In the **medium term**, Government needs to further drive the uptake of ULEVs, to set itself on the trajectory to meet its ambition of banning all sales of new petrol and diesel vehicles by 2040; and
- In the **long term**, it needs to both achieve its ambition to ban the sale of traditional petrol or diesel vehicles, and to respond to the decline in tax revenue that would occur if we moved tomorrow to an all-ULEV fleet.

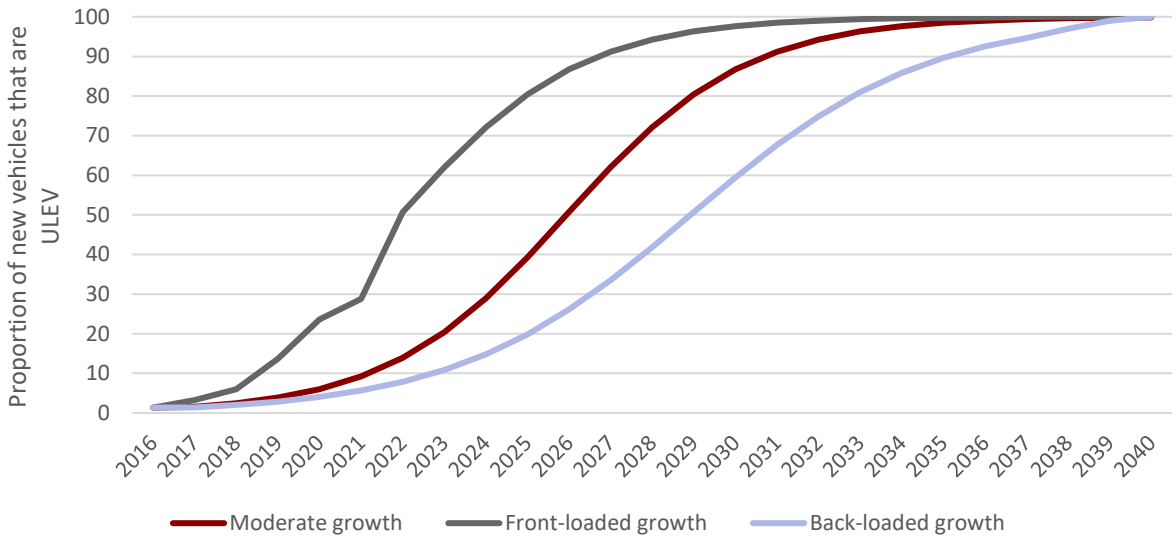
In this report we set out what we see as the most promising fiscal policy initiatives to meet these different objectives. The detailed design and implementation of such initiatives is beyond the scope of this report, but we hope that our analysis will contribute to the policy conversation that is necessary for the UK to achieve its vision for improved air quality.

Scenarios for ULEV growth

To aid our analysis, we have mapped out three scenarios to display how the share of the new car market consisting of ULEVs reaches 100% by no later than 2040, in line with Government's policy ambition. These are not predictions of the real-world trajectory to reaching a 100% share of the new car market being ULEVs under given policy scenarios, nor are our policy proposals predicated on any of these scenarios coming to pass. The scenarios are used to give an indication of the scale of fiscal policy impacts and fiscal challenges. They are:

- **Front-loaded growth:** The share of ULEVs in the new vehicle market initially grows rapidly at the rate seen in Norway in recent years,[xvii] before growth flattens out. This is an optimistic scenario, in which the proportion of new vehicles that are ULEVs nears 100% by 2030.
- **Back-loaded growth:** This scenario is consistent with the Committee for Climate Change (CCC)'s central uptake scenario for ULEVs (which was not itself based on reaching Government's 2040 target).[xviii] In this scenario the share of new vehicles that are ULEVs reaches 60% by 2030, then continues to reach 100% by 2040.
- **Moderate growth**: The share of ULEVs in the new vehicle market follows a path between the front-loaded and back-loaded scenarios.

Figure 7: Routes to target of 100% of new vehicles being ULEV by 2040



Source: WPI Economics

The 'front-loaded' scenario is clearly the most challenging from a fiscal policy perspective, particularly in the short term. This is because any measure intended to incentivise ULEV uptake incurs higher costs as ULEVs are taken up more quickly, while the existing tax base erodes significantly quicker.

But in the long term, all of these scenarios reduce the motoring tax base – a tax base that currently provides close to 5% of government tax receipts. Regardless of the route taken to Government's target of zero new traditional petrol or diesel vehicles being sold by 2040, there will be a significant strain on public finances without reform. While this funding would not necessarily need to be recovered from motoring taxation, we also see clear economic benefits in continuing motoring taxation (particularly given externalities of congestion and accident risk, which occur as much for ULEVs as non-ULEVs), so we assume that government will continue to want to tax motoring.

Regardless of the route taken to the Government's target, there will be a significant strain on public finances

The Structure of this Report

Section 1 sets out the current situation in the UK regarding air pollution, vehicle emissions, taxation, and the fleet, as well as recent government policy measures.

Section 2 outlines a framework for understanding consumer responses to fiscal incentives, the measures that have been taken in other countries, and how the UK compares.

Section 3 demonstrates the scale of the Exchequer impact from different scenarios relating to uptake of low-emission vehicles, and offers some suggestions for the future direction of UK fiscal policy.

Section One: The Current Situation

Road Transport and Pollution

Significant improvements have already been made in reducing greenhouse gases from road transport. Since 2001 the average carbon dioxide emissions of new cars in the UK has fallen by a third,[xix] due to a combination of European requirements on manufacturers' fleet-wide average CO_2 emissions, tax incentives to move to lower-carbon emitting vehicles, the change in relative proportion of petrol and diesel vehicles, and advances in fuel efficiency and emissions technology. Ultimately it is likely to be advances in fuel efficiency and emissions technology that have had the greatest direct impact, although these advances may be stimulated by national or supranational regulatory measures.

However, as alluded to above, this reduction in CO_2 emissions has gone hand in hand with a significant increase in purchases of diesel vehicles. In part, this is likely to have been due to UK government policy that indirectly encouraged their uptake in place of petrol cars because of their greater fuel efficiency and lower CO_2 emissions. In 1994, diesel vehicles were a minority of all vehicles on British roads. However, Figure 8 shows that, since then, diesel vehicles have represented an increasing share of licensed vehicles.

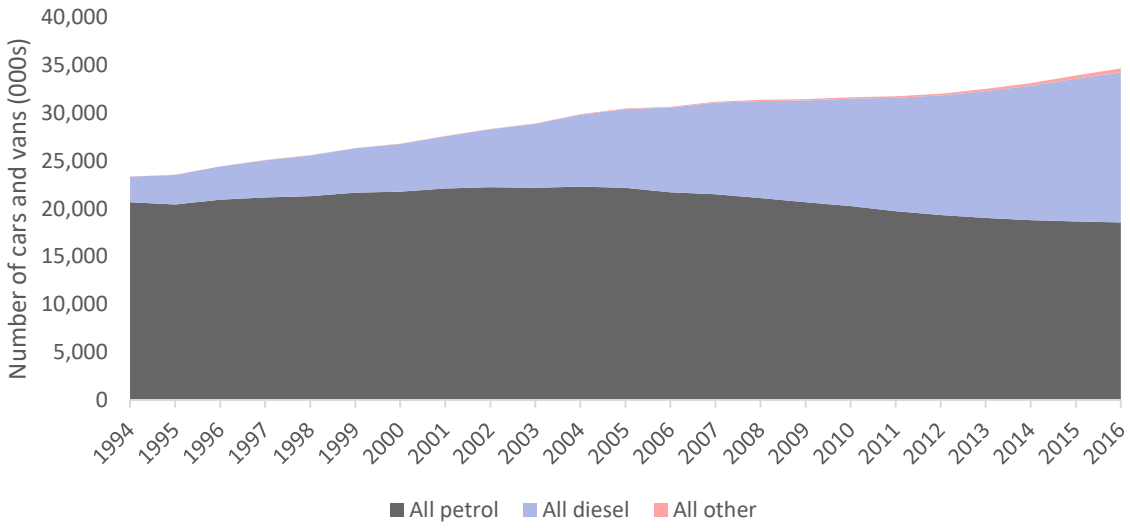
Whilst this shift towards greater diesel ownership may have played a part in the reduction of average CO_2 emissions, it has also contributed to a greater presence of NO_x and PM. This impact on local air pollution has been exacerbated by the testing regime for diesel cars, which has been exposed as inaccurate in reflecting real-world emissions. The proportion of the van fleet that is diesel is far greater than the equivalent proportion for cars, although the total number of diesel cars on the road is much larger.

Passenger cars and vans make up

75%

of all transport NO_x emissions

Figure 8: Cars and vans licensed by propulsion / fuel type, Great Britain



Source: WPI Economics analysis of Department for Transport data[xx]

Again, the overall picture of NO_x emissions is positive; in the past two and a half decades, the UK has significantly reduced the total nitrogen oxide emissions from all sectors, including transport. Altogether, road transport nitrogen dioxide emissions have fallen by 75% between 1990 and 2015 (see Table 1).

This headline fall, however, masks changes in the overall composition of the vehicle fleet and their share of NO_x emissions. The level of NO_x emissions from diesel cars has increased significantly and now accounts for 40% of total road transport NO_x emissions. There has also been only a small reduction in the NO_x emissions from vans over the same time period, meaning they now represent nearly 30% of the total.

Table 1: Change in NO_x emissions 1990-2015 by vehicle type

Vehicle type	NO_x emissions (kilotonnes) - 1990	NO_x emissions (kilotonnes) - 2015	% change	Proportion of road transport NO_x in 2015
All petrol cars	842.7	23.1	-97.3%	7.4%
All diesel cars	9.9	124.4	1156.2%	40.0%
HGVs	221.4	50.8	-77.1%	16.3%
Buses and coaches	56.3	19.4	-65.4%	6.2%
Vans	106.6	92.6	-13.1%	29.8%
Motorcycles	1.7	0.9	-44.6%	0.3%
Total	**1,238.7**	**311.4**	**-74.9%**	

Source: WPI analysis of National Atmospheric Emissions Inventory data[xxi]

Combined, NO_x emissions from passenger cars and vans make up over 75% of the total from road transport, and so encouraging the purchase of lower-emission vehicles in these categories will be critical in reducing the problem of road traffic air pollution in the future. Unless otherwise stated, the rest of this document refers to cars and vans only.

Neither petrol or diesel vehicles are truly 'clean' - thus, in our eyes, the best way to combat both CO_2 and NO_X is not by balancing petrol and diesel, but instead prioritising ULEVs which limit the emissions of both. Figure 8 above also shows that petrol and diesel vehicles continue to represent the vast majority of all cars, highlighting the scale of the challenge facing the Government.

The current UK tax system

There are several taxes in the UK that apply to motoring: the main taxes are briefly described below, as is the operation of the plug-in car and van grant.

Vehicle excise duty (VED)

Vehicle excise duty, also known as car tax or road tax, is an annual tax for owning a vehicle. It currently operates differently for cars and vans.

Since 2001, the VED for cars has been related to the car's carbon dioxide emissions: higher-emitting vehicles pay more. This was reformed in 2010 to introduce a varied first-year rate for new cars (sometimes called the 'showroom tax') and making the subsequent annual charges more sensitive to carbon dioxide emissions. A different system applies to cars registered after April 2017, which has a varied first-year rate and then a flat rate of £140 a year thereafter.

From April 2018 diesel vehicles will be moved up a VED band, so pay more than a petrol car with identical carbon dioxide emissions.[xxii]

The majority of vans pay VED at a flat rate of £240 a year – some vans compliant with certain European emissions standards and registered before certain dates pay £140 a year.[xxiii]

Company car tax

Company car tax is paid by an individual if they are able to use a car provided by their employer for personal use. The tax paid is calculated by multiplying the list price of the car by the relevant benefit in kind (BIK) rate and the individual's marginal tax rate.

BIK rates vary based on the carbon dioxide emissions of the vehicle, and there is a surcharge added for diesel vehicles. However, in the coming years the cleanest vehicles, those emitting under 50g/km of CO_2 are set to see an increase in the BIK from 9% to 16%, before it falls to 2% in 2020/21, after which it will also vary based on the electric range of the vehicle.

Until this fall occurs, the cost of operating a new low-emission vehicle will increase for business customers who use it for private as well as business travel, providing an incentive to defer purchase until 2020/21. For example, a company car driver, who is a 20% taxpayer, with a Nissan Leaf would pay £991 in BIK in 2019/20, but only £123.90 the following year. Similarly, their employer would see their Class 1A NICs fall from £684 in 2019/20 to £85 in 2020/21.[xxiv]

Fuel duty

Fuel duty is paid per litre of petrol or diesel used. Current rates are 59.75 pence per litre.[xxv] This is a significant source of revenue for Government, amounting to close to £27.9bn in 2016-17.[xxvi] Fully-electric vehicles do not pay fuel duty, and domestic electricity also benefits from a lower rate of VAT (5% rather than 20%).

However, it is also important to note that planned rises in fuel duty – the so-called 'fuel duty escalator' – have been repeatedly delayed in recent years, which suggests that any increases in this tax are likely to prove politically challenging.

The plug-in grant

Since 2011, the UK Government has offered grants to consumers purchasing new cleaner vehicles. This was initially set at up to £5,000 or 25% of the purchase price of a car,[xxvii] and reformed in 2016 to encourage purchase of the cleanest vehicles, as well as reducing the incentive offered, particularly for cars with relatively higher emissions and lower range in electric mode.[xxviii]

Since 2012, it has also been available for vans up to 3.5 tonnes,[xxix] and since October 2016 it has been available for larger vans.[xxx] However, uptake of vans using the grant has been limited, and between 2012 and October 2016 only 2,500 eligible vans had been purchased.

As of January 2018, an estimated 130,000 cars had been purchased using the scheme,[xxxi] and between its introduction in 2011 and 2016 the number of all ULEVs (not all of which will be eligible for the grant) grew from under 3,000 to 90,000.[xxxii] When the plug-in grant was extended for two years in the 2017 Budget, the Treasury estimated it would cost £50m a year, which implies between 11,000 and 20,000 vehicles a year would be purchased – either of which would be a reduction on the number of grant-eligible vehicles registered in 2016.*

* Based on 25% of each vehicle being either £2,500 for the higher number, or £4,500 for the lower.

UK tax sustainability

As well as playing a potentially important role in the Government's environmental objectives, taxes on road transport have an important revenue raising function. In 2016/17, revenue from vehicle excise duty and fuel duty represented 4.7% of central government receipts.[xxxiii] Fully-electric cars pay neither of these charges under current rules (fully-electric vans pay VED but not fuel duty, which is by far the larger contributor).

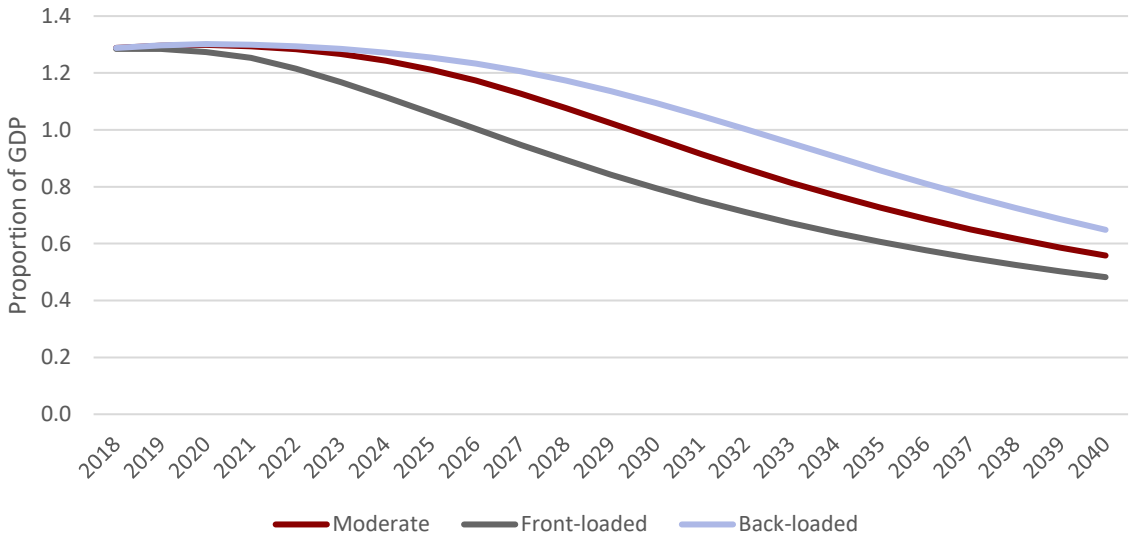
However, the great irony of such taxes based on emissions is that, if successful in incentivising households away from high-emitting vehicles, tax receipts crucial to the Treasury would inevitably decrease. Although in time moves to encourage uptake of clean vehicles will lead to a reduced burden on the NHS, and consequently lower spending as the health costs of air pollution reduce, at least in the short-term there would be significant pressure on government finances.

The importance of maintaining this tax base is likely to be a key consideration for policymakers when considering how to achieve greater penetration of ULEVs in the UK vehicle fleet. For instance, a policy that is highly-effective in driving the uptake of clean vehicles may perversely be less attractive than a more moderate policy, given the overall financial impact.

In order to demonstrate the challenges this shift will place on government finances, Figure 9 provides results of indicative modelling undertaken by WPI Economics, which shows how revenue from fuel duty could be affected by the introduction of hybrid and electric vehicles. This clearly shows the general trajectory of taxes to GDP, and highlights the need to consider alternative sources of future motoring revenue.

This model does not incorporate fuel efficiency projections for the vehicle fleet, the cost to the Exchequer of the reduction in the tax base for other motoring taxes such as VED or VAT on road fuels, or other developments such as improved public transport, which could further reduce the tax take from road duty. We have also assumed that fuel duty rises in line with inflation. In recent years fuel duty in the UK has remained flat in nominal terms (i.e. falling in real terms); clearly if fuel duty were to remain flat over this period, the Exchequer impact would be even greater than demonstrated here.

Figure 9: Projection of fuel duty from cars and vans as % of GDP under different ULEV take-up scenarios



Source: WPI Economics modelling. Note: see page 9 for scenario details.

This shows revenue from fuel duty falling rapidly as a proportion of GDP from around 2021 (front-loaded scenarios) or the mid-2020s (moderate and back-loaded scenarios) as the proportion of fully-combustion vehicles in the fleet begins to decrease. By 2040, in all scenarios, its proportion of GDP has fallen more than 50% from its peak – which cumulatively represents a fall in receipts of tens of billions of pounds.

Principles for emissions fiscal policy

Based on our assessment of the available literature, we have identified a number of principles that an effective fiscal policy for vehicle emissions should meet; an effective fiscal policy should:

- **Principle 1:** Be linked to emissions (CO_2, NO_x, and PM) in all types of vehicles, based on real-world testing;
- **Principle 2:** Consistently incentivise zero-emission vehicles over low-emission vehicles;
- **Principle 3:** Focus on up-front price parity rather than longer-term costs, given consumers' tendency to focus on headline price over running costs;
- **Principle 4:** Incentivise business and fleet as well as private ownership given that business registrations account for 50% of the new car market; and
- **Principle 5:** Be designed with long-term policy implications and sustainability in mind.

Summary of the UK tax system and air pollution

When cross-referencing the UK's current tax system to these six principles, we see some of them are adhered to. For instance, the current system does have some positive features in relation to emissions. The plug-in grant in particular appears to be a valuable incentive, particularly while the market is in its relative infancy. Further, the recent reforms to VED have also increased the up-front incentive for choosing a lower-emission new vehicle. However, there are also several features of the tax system that limit its current effectiveness. These are notably that the tax system:

- **Is not directly NO_x or PM-related:** Where taxes are linked to emissions, they are generally linked to carbon dioxide – any benefit this has on NO_x or PM emissions is indirect. There has been some movement towards a 'diesel surcharge' to reflect the air pollution impact, but this is not consistent and represents a relatively minor disincentive.
- **Is not consistent:** For some vehicle types, and some taxes, there is no link to emissions – this is particularly true for vans. The current planned near-term trajectory of company car tax rates is also not consistent with a considered long-term strategy.
- **Lacks distinction:** Some taxes do not distinguish between low-emission and no-emission vehicles (such as company car tax).
- **Ignores the second-hand market:** Each year, only around one in ten of vehicles on UK roads are new, and more than three times as many second-hand vehicles are sold as new vehicles (see Box 1). But because of the large decrease in up-front costs for second-hand vehicles compared to new, the lack of clean vehicles on the second-hand market, and the very limited incentives through VED, there is little financial incentive to purchase a cleaner vehicle on the second-hand market, which will increasingly be an issue as the number of ULEVs on the first- and subsequently second-hand markets increase.

- **Lacks long-term sustainability:** Under the existing system of motoring taxes, a significant shift to lower-emission vehicles – and particularly zero-tailpipe emissions vehicles – would lead to a corresponding reduction in government revenue from those taxes. This creates a tension between the objectives of encouraging the uptake of lower-emission vehicles and 'balancing the books'.

Box 1: Age and ownership of UK vehicle fleet

In any given year, only around 10% of vehicles in the UK were purchased in that year. Data from the Society of Motor Manufacturers and Traders (SMMT) also suggests that second-hand car sales far outstrip new car sales: in 2017 there were 2.5 million sales of new cars, compared to over 8 million on the second-hand market.

Any policy measure that is targeted at new car purchases will therefore only affect a small proportion of the fleet in any given year, and there will be a significant lag in any fleet composition effect. This is illustrated by the fact that although in 2016 1.4% of UK vehicles were ULEVs, this represented only a quarter of a percent of the fleet as a whole.

Box sources: SMMT[xxxiv, xxxv] and DfT[xxxvi]

Overall, there is clear room for improvement against several of our proposed principles, as Table 2 shows. The most crucial of these is the linking of taxes to all emissions and having a long-term strategic design.

Table 2: Assessment of UK vehicle emissions taxation

Principle	Assessment	RAG rating
1. Fiscal policy should be linked to emissions	Generally met but some omissions e.g. van VED	
2. Fiscal policy should focus on all relevant, real-world emissions	Not generally met – limited NO_x inclusion	
3. Fiscal policy should consistently incentivise zero-emission vehicles over low-emission vehicles	Partially met	
4. Fiscal policy should focus on up-front price more than longer-term costs	Partially met by plug-in grant and higher first-year VED – but in practice the impact of these is relatively small	
5. Fiscal policy should incentivise business and fleet as well as private ownership	Met – incentives available for both private and business / fleet purchasers	
6. Fiscal policy should be designed with the long-term in mind	Not met – current motoring taxation is unsustainable if environmental goals are to be achieved	

Section Two: Improving the Performance of the UK's Fiscal Policy on Vehicles

Section one highlighted that fiscal policy is one of a range of policy solutions that will be needed to tackle vehicle emissions in the UK. Alongside other policy areas, including the rollout of charging infrastructure, it could play an important role in supporting UK consumers and businesses to move towards cleaner forms of transport.

The routes through which this could happen are relatively clear. Theoretically, fiscal policy influences behaviour in a relatively straightforward way. In economic theory, consumers respond to incentives: making something more expensive (through taxation) reduces its attractiveness, and therefore reduces demand, while making something cheaper (through a subsidy) does the opposite. This means that fiscal policy could play an important part in the landscape for incentivising the take up of low-emission vehicles.

The limits of fiscal policy

However, it is also important to remember that there are limits to the extent to which fiscal policy can be used effectively. The main reasons for this are that consumers do not only respond to financial incentives and, where they do, the size of any incentives driven through the tax system are often dwarfed by the outlay for the car itself. For example, the first-year VED waiver for zero-emission vehicles is worth £200 when compared to a vehicle with 149g/km of CO_2, which compares to an average purchase price of over £25,000.

A wider set of policy measures than only fiscal policy will be needed to make widespread ULEV uptake a reality

Consumers will also be influenced by a wide range of other non-price factors. For example, when deciding whether to replace a vehicle at all, they are likely to be primarily influenced by the extent to which they feel a need to do so – for example, whether their current vehicle is in good working condition, or whether it continues to meet their needs. Even when a consumer is at the point of considering a new vehicle, whether they will choose a low-emission vehicle will depend on a wide range of factors, including practicality, aesthetics, comfort and fashion. This means that a relatively small fiscal incentive is likely to be a marginal part of the overall decision-making experience, and a wider set of policy measures than only fiscal policy will be needed to make widespread ULEV uptake a reality.

A wide body of evidence also shows that consumers are subject to behavioural biases that may further limit the extent to which they respond to price changes driven by fiscal policy. In relation to tax, a key behavioural bias is 'hyperbolic discounting', or myopia: consumers pay more attention to near-term or up-front costs than they do to the cost over several years. This suggests that, for example, measures to increase or decrease the sticker price of particular vehicles will be more effective than measures to reduce the running costs.[xxxvii,xxxviii,xxxix]

While these challenges are clear for consumers, it is worth noting that businesses may be less subject to these barriers, particularly where they employ a dedicated fleet manager who can devote more time to a purchase decision. Literature on fleet purchasing behaviour is distinctly limited, but anecdotal evidence suggests that they tend to have a longer-term view and are more inclined to consider the overall cost – and this may be particularly where vehicle costs are a significant expenditure and the sector is highly competitive. Therefore, reducing the cost of transportation, even if over several years, can help the business. ULEVs have particular advantages over petrol or diesel vehicles over the long

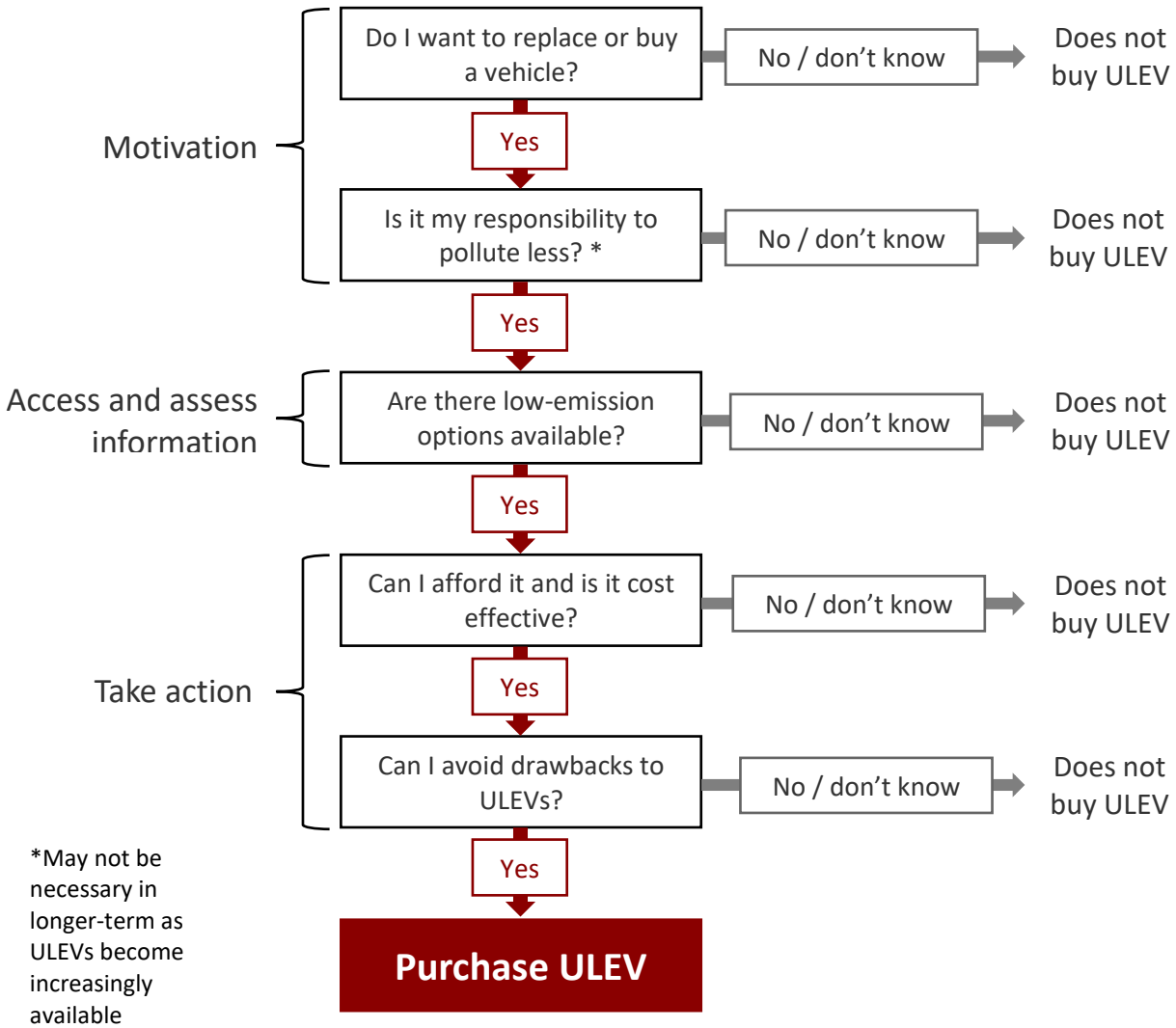
term given fuel costs and ongoing taxation benefits, and existing evidence suggests that fleet and business purchases are a significant proportion of ULEV purchases.[xl]

That is not to say that there are no barriers for fleet managers that limit the uptake of ULEVs currently. Our understanding is that these include the availability of appropriate low-emission commercial vehicles on the market, range anxiety and the need for charging infrastructure to meet the needs of commercial driving patterns, and the complexity of dealing with a variety of Clean Air Zone limits and requirements when making fleet purchase decisions. But if these barriers are overcome, fleet managers may be more responsive than consumers to long-term differences in cost.

How fiscal policy can affect consumer choice

Figure 10 builds on the analysis above to demonstrate the key stages of the consumer journey to purchasing a low-emission vehicle. It shows that, at any of these stages, a consumer may 'fall off' the journey and instead choose to purchase a vehicle with higher emissions or not purchase a new vehicle at all.

Figure 10: Example consumer journey to purchasing a low-emission vehicle



Source: WPI Economics and SMF[xli]

This suggests that a successful policy agenda will need to help consumers navigate through each of these stages, rather than being focussed purely on one or a subset of these stages. This means that to achieve its stated objectives, the Government is likely to need to employ a range of policy instruments / incentives to encourage take up of low-emission vehicles. For example, a study for the International Council on Clean Transportation (ICCT) identified four main types of incentives associated with increasing the uptake of clean vehicles:[xlii]

- Direct consumer incentives: Subsidies or tax breaks that encourage the purchase of certain vehicle types and / or discourage the purchase of other types.
- Indirect consumer incentives: Initiatives such as preferential access to low-emission zones or high-occupancy vehicle lanes, electric car sharing platforms, and introducing EVs into public fleets.
- Charging infrastructure availability: This is particularly important in reducing 'range anxiety'. In practice this is likely to require a combination of at-home charging options and public charging points.
- Policy design: This includes the provision of information on incentives and electric mobility, and an assessment of the sustainability of the incentive package to enable longer-term planning.

All of these sets of policy measures are likely to be necessary to drive uptake of cleaner vehicles. Direct consumer incentives are just one of these types, which suggests that the contribution they can make in the absence of other types of incentive will be limited.

Below we have assessed the scope for fiscal policy to answer the questions at each stage outlined above, and therefore to help 'guide' a consumer to a desired decision.

Figure 11: Outline of ways in which fiscal policy can help to answer consumer questions

Question	Relevant polling results	How can fiscal policy help?
Do I want to replace or buy a vehicle?	52% of respondents said they were likely to buy a car in the next two years	Increase cost of owning current vehicle Signal that future tax increases are coming
Is it my responsibility to pollute less?	74% of respondents with an opinion agreed that they were interested in reducing the impact their driving has on the local environment	Signal that owning a polluting vehicle is socially undesirable
Are there low-emission options available?	N/A	Not directly – but increasing motivation (see above) could increase willingness to spend time / effort researching
Can I afford it and is it cost effective?	85% of respondents who were likely to buy a car in the next two years and who had an opinion said that cost was the	Subsidies for up-front / running costs Signal that future costs will be higher for other vehicles

	most important factor when choosing a car to buy	
Can I afford drawbacks to ULEVs?	75% of people who were likely to buy a car in the next two years and had an opinion felt that an electric car would be impractical for them due to the need for regular charging.	Not directly – depends on confidence over e.g. charging infrastructure or uncertainty of range

Source: WPI Economics / ComRes

This figure shows that, while limited if used in isolation, fiscal policy relating to vehicle purchase can play a role in each of these stages, with the exception of the final question, which relates to infrastructure and technological developments such as battery life that reduce 'range anxiety'. There are two main ways through which fiscal policy can play this role:

- By increasing or decreasing the cost of an 'undesirable' vehicle compared to a 'desirable' one. This provides a financial incentive to both shop around to investigate alternative options and take the final decision to purchase the 'desirable' vehicle; and
- It can provide a signal that certain types of vehicle are undesirable, and / or that they will become more expensive in the future. In this way, taxation can be used to give information that consumers and businesses can use to guide their choices.

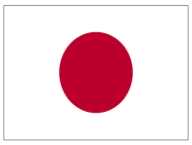
Fiscal policy is likely to be most effective when both of these effects work together. When this happens taxes can have an impact that is disproportionate to their size. A recent possible example of this was the announcement of a minor change in first-year VED for diesel vehicles in the Autumn 2017 Budget. Although this was not a large financial change, and had yet to take effect, sales of new diesel cars fell by double-digit proportions in the following months compared to the same month the previous year.[xliii] However, this has not been accompanied by a corresponding increase in the sales of alternatively-fuelled vehicles (AFVs). In the first three months of 2018 diesel sales fell by 33% (120,000 units) compared to the same period in 2017, while AFVs saw an increase of just 3,000 (9.8%).[xliv]

International examples of fiscal policy

Reducing vehicle emissions is not just an issue for the UK: many countries have introduced a range of fiscal incentives intended to drive take-up of electric vehicles. In Table 3 below we summarise the key measures that have been taken in a range of countries regarding the take-up ULEVS, as well as the extent of charging infrastructure.

Table 3: Overview of ULEV incentives in selected countries

	Plug-in ULEV share of new car market, 2016 (share of BEV)	Key fiscal incentives	Wider incentives	Public charging points per 1m people (approx.)
	28.8% (16.92%)	Car tax, registration tax, reduced car tax	Lane use, free toll road, free parking, free charging	1,550

	6.4% (0.98%)	Registration / road tax, corporate benefit tax	Free charging, reserved parking spaces	1,600
	0.6% (0.37%)	Purchase & weight-based tax reductions for next-gen vehicles and efficient ICE vehicles	N/A	150
	0.9% (0.49%)	Tax credit for purchase, various state-specific initiatives	N/A at federal level	100
	1.4% (0.39%)	Purchase grants, car tax, corporate car tax	N/A	160

Sources: IEA[xlv] ICCT[xlvi]

As this table demonstrates, Norway has by far been the most successful country in driving uptake of clean vehicles, and since 2016 (the year from which these figures date) the ULEV share of its new car market has grown further: in 2017 more than half of new cars were ULEV, and 20% were fully-electric.[xlvii] However, even in Norway fully-electric cars still only represent around 5% of the total car fleet, which shows the challenge that the rate of fleet turnover poses to moving to low-emission vehicles.[xlviii]

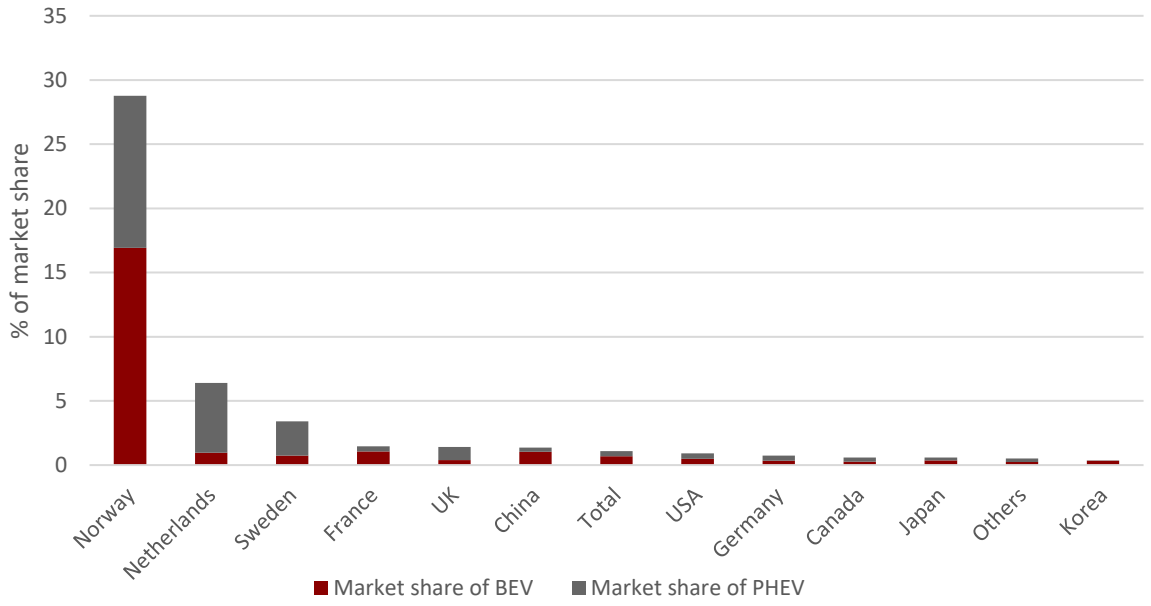
These incentives also come at a cost, however: fully-electric cars are exempt from vehicle purchase tax and VAT, which together can add up to 50% to the price of a car. As a result, comparable combustion and electric cars are similarly priced,[xlix] which is likely to have been a major factor in stimulating the market's development: one study found that of Norwegian electric vehicle owners, more than 80% cited the exemption from VAT and purchase tax as a critical factor driving their choice. Additionally, Norway has implemented a range of wider incentives to encourage adoption, including allowing fully-electric vehicles access to bus lanes and free charging, which was found to be critical for a minority of consumers.[l]

It is also telling that Norway and the Netherlands have ten times the number of public charging points per 1m people as the other countries in the sample. While there is clearly not a linear correlation between charging points and ULEV usage (if it were, Norway would not be outstripping the Netherlands in ULEV uptake), it would be surprising if a significant charging infrastructure were not a prerequisite for such market share. As a report for the International Council on Clean Transportation notes: "[N]ational vehicle markets with higher electric vehicle uptake tend to have more publicly available charging infrastructure. The basic national statistics … indicate the need to build charging stations to help meet charging demand and increase electric vehicle consumer confidence as the market develops."[li]

This reiterates the point made elsewhere in this report that, while fiscal policy will be an important factor in encouraging uptake of ULEVs, a wider set of policy measures will be needed to make this a reality.

Returning to international comparisons, aside from Norway and the Netherlands, which have particularly high shares of their new car markets from ULEVs, the UK is not unusual in ULEV penetration of the new car market. Data from the International Energy Agency also shows that the United Kingdom has a similar proportion of total ULEVs as most other countries. This means that the UK is well-positioned to learn from the success of measures in countries such as the Netherlands and Norway, and to drive growth in the ULEV market to become the 'best of the rest' in coming years.

Figure 12: New car market share of Plug-in Hybrid Electric Vehicles and Battery Electric Vehicles (2016)



Source: WPI analysis of IEA data[lii]

It is important to note here the split between Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs). The United Kingdom's new car market share is notably weighted towards PHEVs: these are capable of running either from electricity, or from a traditional combustion engine. In theory these should emit lower levels of tailpipe emissions as they will run at least for part of the time in electric mode - and they may reduce consumer fears of range anxiety if there is a more familiar engine type to fall back on in the event of a problem, acting as a 'stepping stone' to a fully-electric vehicle.

However, recent testing has suggested that plug-in hybrid vehicles may be more polluting than previously thought.[liii] This is in part due to issues with the current testing regime (which is not unique to plug-in hybrid vehicles), and in part due to consumer behaviour: put simply, drivers may drive more in 'combustion mode' than electric mode. This in turn suggests that in order to incentivise moves to 'truly' clean transport, particular attention should be paid to increasing the attractiveness of zero-emission vehicles over PHEVs, as well as to encouraging the use of PHEVs in electric mode to a greater degree.

Section Three: Potential Reforms and Impact

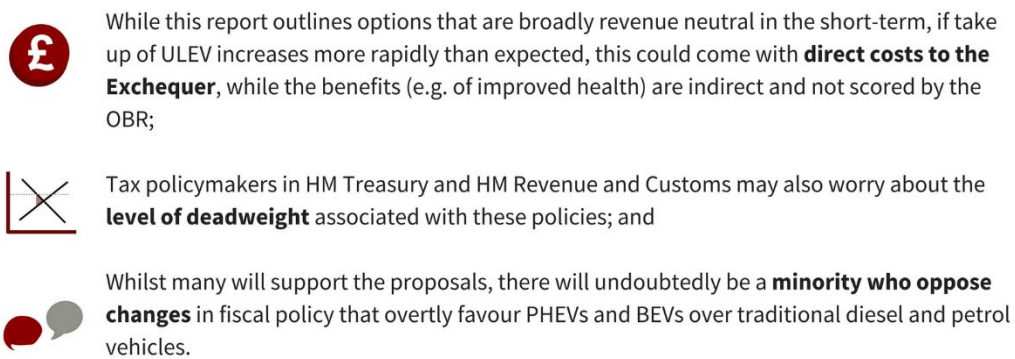
As set out above, there are short-term, medium-term, and long-term challenges for Government:

- In the short term, Government needs to meet legal limits of NO_2 concentration levels;
- In the medium term, Government needs to further drive the uptake of ultra-low emission vehicles (ULEVs), to set itself on the trajectory to meet its ambition of banning all sales of new petrol and diesel vehicles no later than 2040; and
- In the long term, it needs to both achieve the ban on the sale of traditional petrol or diesel cars and vans no later than 2040, and respond to the decline in tax revenue that would occur if we moved tomorrow to an all-ULEV fleet.

These are different challenges, which will require a set of solutions – there is no one-size fits all option available. Below we have set out our views on the most promising fiscal policy options that can be made broadly fiscally neutral in both the short and long term.

We have viewed and developed these proposals in the context of Government needing to take decisive action. Court rulings against the Government have highlighted the need for short-term action to meet legal limits and this report has shown that, without significant action, the Government could miss its goal of banning the sale of diesel and petrol vehicles by 2040. We recognise that taking this action may not be easy for Government (see Figure 9).

Figure 13: Potential difficulties in taking action



Source: WPI Economics

However, these potential objections are far outweighed by the crucial point: failing to act will force families across the UK to continue to live, work and play in areas that are dangerous to their health – imposing health and social costs on individuals, businesses, and government. It would also miss a vital opportunity; the Government has placed clean growth at the heart of its industrial strategy and has already taken steps to promote the uptake of ULEV and support the development of the UK's ULEV innovation and manufacturing sector. If this is to continue and the UK is to be a world leader in ULEV innovation and manufacturing, a strong home market is essential. Delivering this, and developing the home UK market for clean vehicles, will demonstrate to businesses across the world that post-Brexit Britain is the place to come to develop and manufacture ULEV technology. Ultimately, it is our view that action is not only a legal requirement, but also necessary for driving productivity, growth and living standards in post-Brexit Britain.

Of course, fiscal policy alone is not sufficient. These policies should also be pursued in conjunction with other measures - in particular the continued rollout of electric vehicle charging infrastructure across

the country. Our expectation is that this would need to be achieved *before*, rather than alongside, the widespread adoption of ULEVs, as the availability (or perceived availability) of charging points is likely to be a key factor that hinders uptake of ULEVs. This would not only encourage the uptake of ULEVs, but also encourage greater use of plug-in hybrid vehicles in electric mode, rather than combustion mode.

The short term

Success here will require that fewer of the most polluting vehicles (in terms of NO_x) are driving in areas where limits are currently being breached. This could be achieved either by taking these vehicles off the road completely (owners purchase a new lower-emission vehicle) or by excluding them from the area (owners keep the vehicle but no longer drive them into the area).

Our overall assessment is that there are a limited number of fiscal incentives that could play a significant role in delivering the Government's short-term objectives. There are a number of reasons for this:

- ***Size of change needed:*** Grants are already available for ULEV cars and vans, which means that purchase taxes would need to change significantly if decisions were to be influenced more than is currently the case. It is conceivable that ongoing taxes (VED) could be reformed to reflect NO_x emissions, however the scale of change would need to be large if purchase decisions were to be affected (given the difference in VED after the first year is £140 compared to an upfront cost of £31,000 for an average new ULEV).
- ***Speed of change:*** Taxes can take a long time to change, particularly when considering new taxes or large tax rises, and the required time to design, legislate for and implement the tax can be considerable. For any tax increase, there is a vocal lobby who may oppose potential changes. This makes it unlikely that changes in the tax system of a scale sufficient to change behaviour enough to meet NO_x targets will be in the near term.
- ***Overall impact:*** Given the high proportion of the vehicle fleet that is not new, it is also difficult to see how fiscal incentives on car purchase (or yearly charges like VED) can achieve significant reductions in NO_x in the short term; they would not produce a large enough change in behaviour for the entire fleet or second-hand purchases.
- ***Cost-effectiveness of the change:*** It would be hard to target a sales / ongoing tax in a way that changes behaviour of just those who are travelling in areas in breach of the legal limit – which would mean that any such tax would be likely to be complex and as a result open to potential fraud. This in turn means that the incentives would need to be targeted more broadly, implying that there would be a significant level of deadweight associated with the policy.

This suggests that in order to meet short-term goals of reducing NO_x emissions, incentives in the tax system are unlikely to have a significant impact. But there are things government can do that can work together to meet legal limits on NO_2 concentration in the shortest time possible. Our assessment suggests that the single most effective way for areas in breach of legal NO_2 limits to reduce the use of the most polluting vehicles in these areas would be to introduce Clean Air Zones where the most polluting vehicles are charged or prohibited at certain times of day.

The Government's own modelling suggests that the introduction of a network of charging Clean Air Zones would deliver significant benefits, with six additional Urban Areas meeting the legal limit in 2020, and 19 in 2021 compared to the baseline scenario,[liv] representing a benefit to hundreds of thousands, if not millions of people.

There is also notable political and public support at a national level for introducing charging Clean Air Zones. By a significant majority – 52% to 18% – the general population support the introduction of charging Clean Air Zones in the most polluted parts of towns and cities.[lv] The recent joint inquiry by four Select Committees also recommended action to make introducing charging Clean Air Zones easier for local authorities.[lvi]

But it is far from clear that this support in principle will translate into local acceptability if the decision of how to reduce air pollution is left to local authorities. Even with a supportive local authority, the opposition to a local scheme could be significant. This risk is highlighted by the recent history of local referendums in England on fiscal policy that would raise revenue:

- In 2008, voters in Manchester rejected a proposal to introduce a congestion charge;[lvii]
- A move by Bedfordshire Police and Crime Commissioner to increase council tax was rejected in a referendum in 2015;[lviii]
- A number of Mayoral Combined Authorities have been unable to secure agreement to charge a precept on council tax;[lix] and
- No local authorities have held a referendum on increasing council tax above a certain limit since the requirement was introduced in 2013[lx] – which is instructive given the significant financial pressures on local authorities in this time.

While introducing a charging Clean Air Zone would not necessarily require a referendum, it is highly likely that local political pressures would still be a significant barrier to quick action. Given this, a failure by central Government to mandate Clean Air Zones is arguably tantamount to not introducing them at all; Government needs to take bold and decisive action to mandate the rapid roll out of charging Clean Air Zones in all areas exceeding legal limits of NO_2 concentration levels – and close attention should be paid to ensuring that their design does not inadvertently increase harmful emissions.[lxi]

The primary policy concern with these zones is that such an approach would heavily penalise those individuals and businesses who were unable to or severely constrained in changing their behaviour. The obvious example would be low-income households who needed to regularly enter the Clean Air Zone. For this reason, alongside the quicker introduction of Clean Air Zones, a range of mitigation schemes should be implemented – as also recommended by the recent joint Select Committee report.[lxii]

One option that should be considered is a scrappage scheme. Previous schemes have suffered from poor design, which have led to a high 'deadweight' policy cost, as purchases that would have happened anyway are brought forward. However, a well-designed scrappage scheme, targeted at the most-polluting vehicles and those least able to afford a less-polluting vehicle (in practice small businesses and low-income consumers), should be able to mitigate these factors (see Box 2 for some suggested principles).

A similar scheme to retrofit polluting vehicles with emission-reducing technology could also have a positive impact on reducing emissions in the short-term. We propose that any such scheme follows similar principles.

Recommendation 1: Government should mandate charging Clean Air Zones in the worst-affected areas, to overcome local opposition to such schemes and deliver air quality benefits in those areas.

Recommendation 2: Government should set clear standards for the zones so they do not introduce complexity for larger fleets that might reduce the incentive to purchase cleaner vehicles. These could

include, for example, standardised emission levels and charges across zones for some types of vehicle or large fleets.

Recommendation 3: Government should introduce a targeted mitigation scheme following its consultation to ensure that a charging zone does not penalise those least able to avoid the charge.

Box 2: Designing an effective scrappage scheme

The recent UK Government consultation on a targeted scrappage scheme set out criteria for assessment of any such scheme. These were that the scheme should:

- Target support on those that need help;
- Offer value for money for taxpayer;
- Lead to minimal negative impacts on air quality or other pollutant levels;
- Not create any delays to the implementation of the NO_2 Plan;
- Be delivered with minimal risk of fraud or abuse;
- Be credible, deliverable and timely; and
- Avoid market distortion.

In our view, these are a set of sound principles for political acceptability and environmental effectiveness of a scrappage scheme. We also think that a well-designed scrappage policy can meet these criteria. We have outlined criteria that could help a scheme to meet these.

Proposed qualifying vehicles

- Existing vehicles without a Statutory Off-Road Notice (SORN), i.e. that are currently being driven; and
- Vehicles with higher NO_x emissions than permitted under, for example, Euro 3; and
- A replacement vehicle / retrofitting meeting at least, for example, Euro 5 standards on the road in real world driving conditions.

These criteria would strike a balance between ensuring that the scheme incentivised the purchase of cleaner vehicles and the removal of dirtier vehicles from the fleet, and ensuring that using the scheme was a realistic aim for those targeted: a scrappage scheme that was only redeemable against new cars would likely have low uptake given the upfront cost of a new car.

Proposed qualifying buyers

- Small businesses (based on number of employees and / or turnover) with offices within the Clean Air Zone; or
- Individuals earning below the UK average salary or in receipt of certain benefits and with vehicle registered, or place of work, within a Clean Air Zone; and
- Who were the registered owners of the vehicle before a certain date.

The criteria we suggest for qualifying vehicles and buyers are targeted in order to help those most in need and reduce the deadweight cost of the policy, but not so tight as to introduce unnecessary complexity into the system, which would inevitably increase the risk of fraud. Requiring the qualifying buyer to be the registered owner of the vehicle would also remove the risk of people taking advantage of the scheme on others' behalf.

Box source: UK government consultation[lxiii] and WPI Economics analysis

The medium term: Maintaining progress

While the immediate policy changes above can contribute to meeting legal NO_2 limits by reducing the use of the most polluting vehicles in the relevant areas, one of the key medium-term solutions is to increase the number of ULEVs on the first-hand market, which will then flow into the second-hand market over time.

Measures to reduce the upfront cost of clean vehicles – nearing or achieving 'price parity' – are likely to be particularly important here (and would also reduce the monthly cost of a vehicle if bought on finance). In our polling, 85% of respondents who said they were likely to buy a car in the next two years and who had an opinion agreed that cost was the most important factor when choosing a car to buy, while only 44% of this group said that they would be willing be pay more for a less-polluting vehicle.

The plug-in grant has clear merit in encouraging purchases of new clean vehicles - but in our view there is scope to go further. Our polling highlighted two key reasons for this:

- Lack of awareness: Less than a third (29%) of British adults were aware of the plug-in car grant, and even among those likely to buy a new car in the next two years this was only 36%. If consumers are not aware of the grant's existence, they may be less likely to consider clean vehicles in the first place - and the grant will also have a weaker 'signalling effect'; and
- Lack of generosity: Two-thirds (68%) of people with an opinion agreed that the current scheme for buying hybrid and full-electric cars does not offer enough of an incentive. By comparison, 79% of those with an opinion who were aware of the scheme before taking the survey agreed that the incentive was insufficient.

This limited knowledge from consumers of the grant, and its perceived lack of generosity, is in turn likely to constrain demand for such vehicles, hindering the development of new models. Additionally, the upper limit on eligibility for the grant restricts the extent to which consumers who want a more expensive vehicle are incentivised to purchase lower-emission vehicles.

Given these potential limits on the effectiveness of the plug-in car grant, we propose replacing the current grant with a more effective upfront subsidy on the purchase price of new ULEVs. This would be best delivered by differentiating the VAT treatment of different types of vehicle. VAT is well-understood by consumers, and so refunding it would be a highly visible signal from government that it encourages the purchase of cleaner vehicles. The value of such signals has been demonstrated recently in the United Kingdom by the drop in new diesel car sales following a far smaller change in incentives.

Our polling found that Government paying VAT on cleaner car purchases was a more attractive proposition than the current scheme. Two in three (67%) respondents who said they were likely to buy a car in the next two years, and who had an opinion, said that if the Government paid the VAT for them, it would make them more likely to buy a hybrid or fully-electric car, higher than the proportion for the existing scheme (49%). Sixty-six per cent of respondents who said they were likely to buy a car in the next two years and with an opinion also felt that the Government paying the VAT on purchases of electric cars would provide a more generous incentive than the current scheme.

Combined with the lack of awareness of the current grant scheme, and the familiarity of VAT to UK consumers, this suggests that a VAT reduction has real potential to drive progress towards cleaner vehicles. Until the UK has left the EU, however, we are unable to remove VAT altogether from particular goods. Instead we believe there is an opportunity to offer a rebate system, whereby the Government

refunds the VAT on a qualifying purchase. By combining this with other revenue-raising measures, the approach could provide a significant boost to the financial incentives for purchasing a ULEV whilst remaining revenue neutral for the Exchequer. In practice this could be delivered as a rebate to the dealership, meaning that, at present, the consumer would see the reduction reflected in the purchase price.

This would also be in line with the approach taken in some other European countries, albeit with a different mechanism. In some European countries registration or similar taxes of varying kinds are a significant proportion of the vehicle price, and so reducing or removing them for low-emission vehicles provides a significant reduction in the up-front price – including Denmark, Norway, Austria, and the Netherlands. In the UK, the first-year rate of VED is linked to CO_2 emissions, but is a very low proportion of vehicle price: the higher first tax payment for even the most-carbon emitting vehicles would be £2,000, less than 10% of the average upfront cost (and those vehicles are likely to be larger, and therefore the £2,000 would be an even lower percentage). Evidence from Norway also demonstrates the effectiveness of a transparent, well-communicated and generous incentive scheme. [lxiv, lxv]

The familiarity of VAT to UK consumers is likely to immediately increase awareness of the scheme, but Government should also consider how its existence could be further publicized through existing routes such as Go Ultra Low.

Design and cost of a VAT rebate

In our modelling, we have assumed a full VAT rebate for zero-emission vehicles, and a 50% rebate for non-zero-emission ULEVs. We have specifically considered this as a time-limited scheme for two reasons:

- To contain the impact on the Exchequer, particularly once ULEVs become a more significant part of the UK fleet; and
- The knowledge that the scheme is time limited and the expected withdrawal of the rebate could drive quicker uptake, to take advantage of the rebate.

One potential criticism of this approach is that a reduction is available for all ULEVs, regardless of price – unlike the current plug-in grant, which cannot be applied to cars over a certain value. However, in our view this risk is not necessarily a significant one. A universal VAT reduction for vehicles meeting certain emission standards encourages *any* potential purchaser to choose a less-polluting vehicle. A consumer considering purchasing a petrol-fuelled Porsche is unlikely to instead choose a Nissan LEAF, no matter the incentives. But they might choose a Tesla Model X - which would still provide an environmental benefit relative to the alternative. Encouraging the uptake of ULEVs can also play a part in helping government to meet two of the Industrial Strategy's Grand Challenges, Clean Growth and The Future of Mobility, as well as supporting the advanced manufacturing industry in the UK more widely.

It is true, however, that at some point the cost of the VAT rebate (which rises as the cost of the vehicle rises) may become overly expensive compared to the potential environmental benefits (which may not rise as the cost of the vehicle rises). Therefore, the design of the tax rebate should consider whether a maximum available rebate should be permissible.

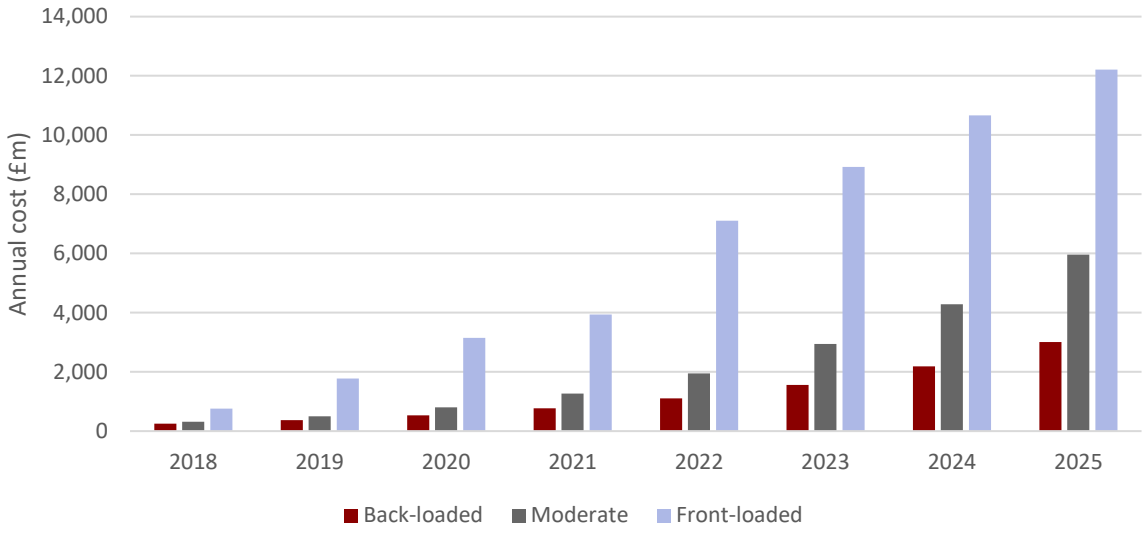
We also recognise that a VAT rebate on new vehicles will have only a marginal impact on overall fleet emissions. This is not, however, a reason not to implement it – the purpose of the rebate is to encourage the adoption of new ULEVs in the first-hand market, which in turn would speed up the supply of ULEVs on the vital second-hand market.

Once we have left the EU and are able to set our own VAT rates, if the incentive is still needed, government could turn it into a VAT reduction.

Balancing the books

The cost of the scheme under different uptake scenarios is below.

Figure 14: VAT rebate scheme cost under different scenarios



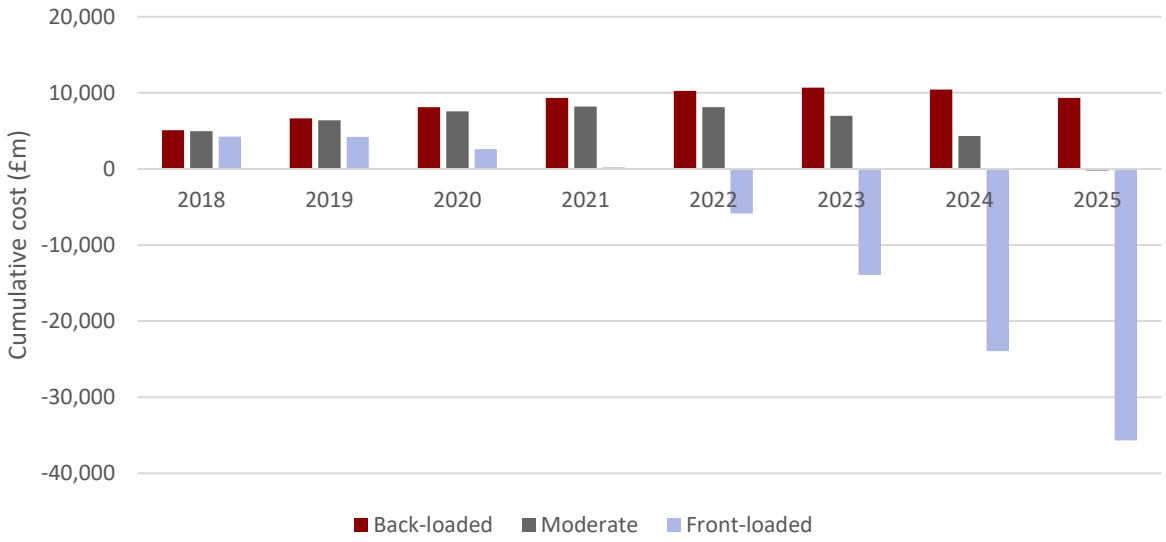
Source: WPI Economics modelling

Cumulatively, to 2025 our modelling suggests the VAT rebate would cost between £9bn and £48bn, peaking at between £3bn and £12bn a year. Ultimately, there would also be a range of tangible and intangible health, economic and wellbeing impacts associated with these costs, which should be used to justify this expenditure. However, we also recognise that these are significant sums, so we have also considered ways in which the outlay could be recovered. It is important to note that our model assumes no reduction in the real-term cost of ULEVs over time. In practice, technological advantages and economies of scale are likely to reduce the cost of ULEVs, reducing the cost to the Exchequer of a VAT rebate. So the figures in our analysis below – and the scale of measures needed to recoup that cost – are likely to be overestimates.

One option would be to introduce an additional levy on new diesel or petrol vehicles. This would follow the principle of a 'bonus/malus' or 'feebate' scheme, where a reduction in price for clean vehicles is accompanied by an increase in price for polluting vehicles.

Based on the cost of an average new non-ULEV vehicle, a 2.5% levy (around £600 in 2016 for the average new non-ULEV vehicle) would cover the cost of the VAT rebate scheme for both the moderate and back-loaded scenarios over the lifetime of the policy, and for the back-loaded scenario would in fact raise revenue. This is not true for the front-loaded scenario, which incurs significant cumulative costs by 2023, reflecting the faster growth of ULEV new vehicle market share (and corresponding decline in non-ULEV new vehicle market share on which the 2.5% levy is imposed). If the UK's ULEV market followed this trajectory, therefore, it is likely that adaptations to the policy would be needed in order to maintain the overall scheme's cost-neutrality.

Figure 15: Cumulative cost of VAT rebate and 2.5% levy on new non-ULEV vehicles



Source: WPI Economics modelling

A final option to recoup the cost of a VAT rebate scheme could be to levy a charge on all non-ULEVs, through a change to first-year and ongoing VED rates. Given the number of vehicles in the UK, this would not need to be a large amount at first, amounting to just £25 per non-ULEV under the moderate growth scenario in the first five years of the scheme. As share of ULEVs increases (and the fleet of non-ULEVs falls) increasingly large amounts would need to be charged to offset the costs of the VAT rebate scheme. For this reason, we believe that the scheme should be reviewed every three years, with parameters set for the following three years, in order to achieve a balance between balancing the books and the potential impacts on non-ULEV owners. If ULEV purchases increased more rapidly than expected, the scheme could be ended early.

Recommendation 4: Government should replace the existing plug-in grant for low-emission vehicles with a time-limited VAT rebate of 100% for new zero-emission vehicles and 50% for other ULEVs.

Recommendation 5: Government should make the VAT rebate fiscally neutral by imposing a small levy on all non-ULEV vehicles through VED.

Our assessment is that a VAT rebate scheme would be a positive medium-term step in reducing vehicle emissions in the UK. But there are also changes to the existing system of motoring taxation that could play a role, as Box 3 outlines.

Box 3: Other fiscal incentives that could form part of a medium-term strategy

There are other aspects of fiscal policy that can play a role here as well. Government should make a public commitment that cleaner vehicles will be consistently taxed less than more polluting vehicles, and that the cleanest (zero-tailpipe emissions) vehicles will be taxed the least. There are also obvious aspects of the current system that are ripe for reform, including:

- VED for vans should not be flat-rate, but linked to emissions;
- Company Car Tax should consistently distinguish between zero-emission and low-emission vehicles, and the 2% BIK rate should be brought forward to 2019/20;
- Government should consider increasing VED on second-hand diesel vehicle purchases in areas with particularly high NO_x; and
- Government should consider linking all emission-based taxation to real-world NO_x and PM emissions as well as CO_2.

Recommendation 6: Government should consider ways to make the current motoring taxation system more responsive to emissions in the medium-term, and to meet a clear set of principles.

The long-term: Replacing revenue

In the medium to long term, there will be a need to replace the revenue that currently comes from taxation of motor vehicles, particularly fuel duty. It is essential to do this without reducing the incentives for purchasing cleaner cars.

The need to replace this is clear – it has been estimated that a cumulative £60-£170bn could be lost in fuel duty by 2030 compared to OBR projections if the UK were to achieve the carbon trajectory suggested by the Committee for Climate Change.[lxvi] The scale of the impact is uncertain, but the conclusion is inescapable: the current motoring tax base, of which fuel duty is a major part, will be eroded and require reform, as our modelling shows (see Figure 9).

The most commonly proposed reform is a form of road user charge, which would require both significant infrastructure development and political will. This is a major challenge and amounts to an overhaul of motoring taxation. However, there is increasing recognition that this is the likely long-term destination of motoring taxation in the UK given the near-inevitable reduction of the existing tax base and the opportunities for reform it offers.[lxvii,lxviii] Therefore we urge government policymakers, civil society (including groups that represent motorists), and the car industry to work together to begin considering how such a scheme could operate and be implemented. Part of this should include establishing a prize fund, available to Combined Authorities, to pilot such a scheme. The competitive prize fund should be large enough to:

- Cover the costs of designing and implementing a scheme; and
- Include a premium to ensure that any 'first-mover disadvantage' a Combined Authority faces from piloting a scheme is outweighed (this premium could be spent, for example, on improving local infrastructure beyond that needed for the road user charge scheme).

Such a scheme could also be designed in such a way as to complement environmental objectives, by levying higher charges on more polluting vehicles. This would ensure that environmental incentives,

covering carbon dioxide and NO_x and based on real-world emission profiles, are built into the system from the start, rather than added and modified piecemeal as has been the case in the UK. In time this could be extended to, for example, the emissions produced in the manufacture of a vehicle, to incentivise the use of cleaner manufacturing technologies further up the value chain, although consideration of emissions from manufacture are outside the scope of this report.

Recommendation 7: Government should convene a working group of stakeholders including the vehicle manufacturing industry, environmental groups, haulage and fleet operators, motorist representative bodies, and tax policy design experts to develop a consensus on a sustainable, environmentally-friendly, long-term future for motoring taxation in the UK.

Recommendation 8: Government should establish a competitive prize fund, available to Combined Authorities, to pilot such a scheme. This fund should cover the costs of designing and implementing a scheme, as well as a premium to the winning authority.

Conclusion and priorities for fiscal policy

The challenge of air pollution in the UK is real. Every year, tens of thousands of lives are cut short by dirty air, and countless others suffer ill health as a result of local air pollution from vehicle emissions.

There is a need for immediate action, and a pressing case for more fundamental reforms in the medium to long term:

- In the short term, government should mandate the introduction of Charging Clean Air Zones and introduce a targeted scrappage and retrofit scheme. These are the policies with the greatest potential to deliver improvements to air quality in the coming years.
- In the medium term, government should continue with its policy direction, but re-market and redesign the plug-in grant as a time-limited VAT rebate.
- In the long term, a move to road user charging looks inevitable if the tax base from motoring taxation is not to be eroded. Given the scale of change this would represent, government and other stakeholders should start planning and piloting this now.

Overall, our recommendations are as follows:

Recommendation 1: Government should mandate charging Clean Air Zones in all areas exceeding legal NO_2 concentration limits. This would overcome local opposition to such schemes and deliver air quality benefits in those areas.

Recommendation 2: Government should set clear standards for the zones so they do not introduce complexity for larger fleets that might reduce the incentive to purchase cleaner vehicles. These could include, for example, standardised emission levels and charges across zones for some types of vehicle or large fleets.

Recommendation 3: Government should introduce a targeted mitigation scheme following its consultation to ensure that a charging zone does not penalise those least able to avoid the charge.

Recommendation 4: Government should replace the existing plug-in grant for low-emission vehicles with a time-limited VAT rebate of 100% for new zero-emission vehicles and 50% for other ULEVs.

Recommendation 5: Government should make the VAT rebate fiscally neutral by imposing a small levy on all non-ULEV vehicles through VED.

Recommendation 6: Government should consider ways to make the current motoring taxation system more responsive to emissions in the medium-term, and to meet a clear set of principles.

Recommendation 7: Government should convene a working group of stakeholders including the vehicle manufacturing industry, environmental groups, haulage and fleet operators, motorist representative bodies, and tax policy design experts to develop a consensus on a sustainable, environmentally-friendly, long-term future for motoring taxation in the UK.

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Annex: Overview of Modelling Assumptions and Approach

Modelling new fleet composition and cumulative number of ULEVs

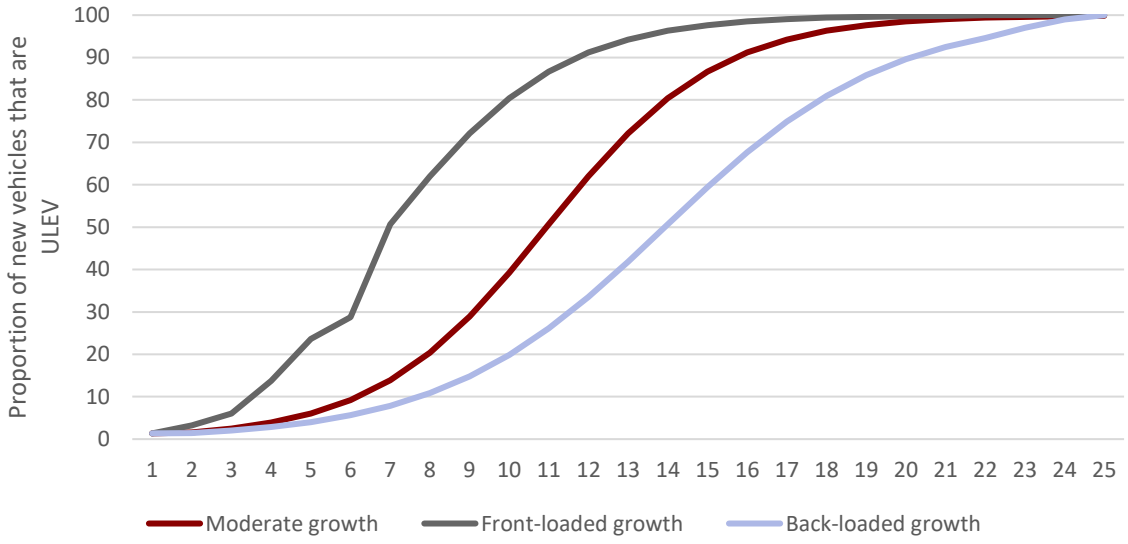
We take data from 2016 and previous years' fleets from the Department for Transport.

Assumptions:

- The total new fleet grows by the average annual growth (2001-2016)
- The proportion of new fleet that is ULEVs reaches 100% by 2040, in line with government policy ambition, in three ways:
    - **Front-loaded growth:** The share of ULEVs in the new vehicle market initially grows rapidly at the rate seen in Norway in recent years,[lxix] before growth flattens out. This is an optimistic scenario, in which the proportion of new vehicles that are ULEVs nears 100% by 2030.
    - **Back-loaded growth:** This scenario is consistent with the Committee for Climate Change (CCC)'s central uptake scenario for ULEVs (which was not itself based on reaching Government's 2040 target).[lxx] In this scenario the share of new vehicles that are ULEV reaches 60% by 2030, then continues to reach 100% by 2040.
    - **Moderate growth**: The share of ULEVs in the new vehicle market follows a path between the front-loaded and back-loaded scenarios.

The three growth scenarios are shown below:

Figure 16: Routes to target of 100% of new vehicles being ULEV by 2040



- Each year, one in 14 of the previous year's stock of ULEVs is scrapped (in line with the average age of a car at scrappage).

- New zero-emission vehicles represent 50% of new ULEVs, broadly consistent with modelling undertaken by Element Energy for the Committee for Climate Change.[2]

Modelling total fleet projections

To model the total size of the fleet, we first take the new vehicle stock using the approach outlined above.

Assumptions:

- Each year, one in 14 of the previous year's stock is scrapped

This approach provides us with a projection of 45m cars and vans in the UK by 2040. This is consistent with other projections we are aware of:

- The Low Carbon Vehicle Partnership projects 41m vehicles in the UK in 2030, and 47m in 2050[3]
- The Department for Transport projects between 31m and 35m cars in England in 2040.[4] Assuming the proportion of cars in England compared to the UK remains the same, this provides an estimate of between 38m and 41m cars in England in 2040. There are currently 3.9m vans in the UK, which would suggest a total of between 42m and 45m vehicles, or a little higher if the number of vans in the UK grows over time.

Modelling impact on VAT

Assumptions:

- The average cost of a new ULEV vehicle in 2016 is £31,000.[5]
- The average cost of a new non-ULEV vehicle in 2016 is £24,000.[6]
- Inflation is 2% (the Bank of England's target inflation rate).

Policy assumptions:

- Zero-emission vehicles receive a full VAT rebate, while non-zero emission ULEVs receive a 50% rebate.
- A 2.5% levy on the purchase price applies to all non-ULEVs.
- Both the VAT rebate and the levy end in 2025.

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[2] Pathways to high penetration of electric vehicles. Available here: https://www.theccc.org.uk/wp-content/uploads/2013/12/CCC-EV-pathways_FINAL-REPORT_17-12-13-Final.pdf

[3] Transport Energy Infrastructure Roadmap to 2050. Available here: https://www.lowcvp.org.uk/assets/reports/20150307_LowCVP%20Infrastructure%20Roadmap_ELECTRICITY_Final%20(with%20graphics).pdf

[4] Road Traffic Forecasts 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf

[5] WPI Economics analysis of common ULEVs by price and sale volume. WPI Economics analysis of Go Ultra Low Standard ULEV car listings (https://www.goultralow.com/choosing/electric-car-selector/) and weighted by vehicle stock in 2017 (https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01#table-veh0120)

[6] WPI Economics of the most popular new cars in 2017 - £24,000 is also the starting sale price of a new Ford Transit, the most popular type of light commercial vehicle.

Modelling impact on fuel duty

Up until 2022, we take nominal GDP projections and real GDP growth from the Office for Budget Responsibility.

Assumptions:

- Cars and vans combined pay total fuel duty proportional to their share of the vehicle fleet in 2016.
- Non-zero emission ULEVs pay 50% of the fuel duty (i.e. use 50% of the fuel) of traditional petrol and diesel vehicles. There is no clear evidence of the extent to which hybrid ULEVs are driven in electric or combustion mode - nor the proportion by which this might change in the future. Studies have found varying proportions for different vehicles, ranging from under 25% to 75% running in electric mode.[7] We have therefore taken 50% as a midpoint.
- After 2022, GDP grows by 1.5% a year in real terms. This is consistent with the OBR's medium-term projections in the November 2017 Economic and Fiscal Outlook.[8]

Policy assumptions:

- Fuel duty remains flat in real terms.

[lxix] International Energy Agency (2017). *Global EV Outlook 2017*. Available here: https://www.iea.org/publications/freepublications/publication/GlobalEVOutlook2017.pdf

[lxx] Committee for Climate Change (2015). *Sectoral scenarios for the Fifth Carbon Budget: Technical Report*. Available here: https://www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf

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[7] See for example Nicholas et al (2017), which finds between 23% and 74% of miles being travelled in electric mode; Carlson (2015) which finds a maximum of 33%; and Tal et al (2014), which found between 16% and 68%

[8] OBR, Economic and Fiscal Outlook November 2017 http://obr.uk/efo/economic-fiscal-outlook-november-2017/