WOLFSON ECONOMICS PRIZE MMXVII

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Miles Better

A distance-based charge to replace Fuel Duty and VED, collected by insurers

Gergely Raccuja

WITH THE SUPPORT OF: RAC Foundation amey

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Miles Better

Gergely Raccuja was born in Budapest, Hungary. He read Politics, Urban Planning and Italian at UCL, graduating in 2015 with First Class Honours. In January 2016, he started as a Graduate Transport Planner at Amey Consulting in Birmingham. He has a keen interest in the role that technology will have in shaping the future of transport.

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ECONOMICS PRIZE
MMXVII

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The Wolfson Economic Prize invites entrants from around the world and all sorts of backgrounds to propose original, well-argued and informed solutions to big national challenges. The aim is to bring forward fresh thinking to help people, governments and businesses develop practical policies.

This year the prize addresses an issue at the heart of every country's economic future: road infrastructure, and

how can we pay for better, safer, more reliable roads in a way that is fair to road users and good for the economy and the environment?

The way cars are powered, driven and owned is being revolutionised. Soon a world of cleaner, automated vehicles will arrive and old annual charges and petrol taxes will no longer work. A new kind of driving will take a new kind of road and a new kind of funding – ideas needed not just in Britain but around the world.

The five shortlisted submissions – of which this is one – show that it is possible to come up with potential answers that can help road users, improve safety, protect the environment, and support our economy.

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Acronyms

AV	Autonomous Vehicles
AFV	Alternative Fuel Vehicle (all vehicles that aren't petrol or diesel)
BCR	Benefit to Cost Ratio
BIBA	British Insurance Brokers Association
BTP	British Transport Police
CIHT	Chartered Institute of Highways and Transportation
COx	Carbon-oxides (mono and dioxide)
DfT	Department for Transport
DPA	Data Protection Act
DVLA	Driver and Vehicle Licensing Agency
HE	Highways England
HMRC	Her Majesty's Revenue and Customs
IPT	Insurance Premium Tax
KSI	Killed or Seriously Injured
LHA	Local Highway Authority
MaaS	Mobility as a Service
MIB	Motor Insurance Bureau
MID	Motor Insurance Database
MRN	Major Road Network
NMU	Non-motorised user
NOx	Nitrogen-oxides

ORR	Office of Rail and Road
PM	Particulate matter
RACF	RAC Foundation
SORN	Statutory Off-Road Notification
SMMT	Society of Motor Manufacturers and Traders
SRN	Strategic Road Network
ULEV	Ultra-low Emissions Vehicle
VED	Vehicle Excise Duty
VAT	Value Added Tax

Non-technical summary

The War on the Motorist might have been dreamt up as a throw-away political slogan, but many drivers see it as something very real; a battle between them and government, in which they see their pockets emptied regularly and in return they get jolted over potholes on the way to joining the next traffic tailback.

The bitter irony is that even as the number of vehicles on the roads continues to increase, and overall mileage rises, the total amount of tax received is falling rapidly in real terms. With every day passing by £2.3million is evaporating – money that was supposed to pay for a nurse, the care of our elderly, or a child's education.[1]

The number of electric cars on our roads remains small, but those that are on the road contribute nothing in terms of Fuel Duty and little, if anything, in terms of Vehicle Excise Duty (VED). Fuel efficiency of new cars has nearly doubled over the past 25 years[2], meaning that someone with a newer car could be paying half of what someone with an older car would be.

For these reasons alone it is time for a change. When it comes to taxing road users and investing in the road system we could do things Miles Better.

MILES BETTER

A distance-based charge to replace Fuel Duty and VED, collected by insurers

[1] When calculated at 2015/16 values 2010/11 revenue was £37.6bn, 2015/16 revenue was £33.54bn. Source: RACF: Road user taxation highway spending

[2] Source: SMMT: CO2 report, 2017

The proposal:

Under this proposal both Fuel Duty and VED would be abolished.

Instead there would be a single per-mile charge, the rate of which would depend on your vehicle's weight[3] (hence taking into account the damage it does to the road) and its tailpipe emissions.

The lighter and cleaner your vehicle is, the lower the per mile charge.

The heavier and dirtier your vehicle is, the higher the per mile charge.

The advantages of the new Road Tax:

1. Transparent. You know the price per mile and your in-car odometer records the miles you drive.
2. Easy to collect. Insurance companies would be paid a small fee by government to act as agents. The total cost of collection would be in line with the current cost of collecting Fuel Duty.
3. Cheap and easy to implement. The insurance industry estimates a one-off investment of around £100 million is required to adapt their systems.
4. Easy to pay. Insurance companies will issue customers with their Road Bills. Payment of these bills would be made annually or monthly, together with insurance premiums.
5. Hard to avoid. Every vehicle in the UK should have insurance and 97% currently do. Mileages will be collected by insurance companies either by drivers self-reporting or directly via telematics. Vehicle mileages will be cross referenced against MOTs.

Forward looking:

Those who purchased their vehicle prior to the new road charge would hardly be affected. Their vehicle factors would reflect the average fuel consumption of their vehicle to replicate fuel duty. By only revising the contributions for those who purchase their vehicles after the new road charge we make sure that there is no moving of the goal posts and the game is fair.

Under the new system electric and low emission cars would remain the most economical to run but would now have to contribute in line with their mileage. Diesels would be more expensive, because of their greater impact on air quality. Business fleet owners would begin switching their 96% diesel[4] fleets to electric vehicles in response making the urban air clean again.

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[3] The adjustment for weight would be determined by which category your vehicle falls into as determined by your driving licence. All cars would be classified as having the same weight.

[4] Source: RACF: Braithwaithe: The implications of the growth of internet shopping on the car and van fleet and traffic, 2017

Where the money goes:

Under the mileage-based system after every £100 of tax drivers pay, £20 would be guaranteed for road spending, putting an end to raiding the roads budget. The government would invest a further £1billion, which will relieve local governments of maintaining their most heavily trafficked and important roads making improvements come to the less well connected regions too. All of Britain's potholes will be fixed within 5 years of implementing the new Road Tax.

Over time responsibility for allocating money from the roads fund would pass to the Office of Rail and Road, working with the Transport Department and the Treasury, alongside the responsibility for developing a suite of performance measures akin to those applying to Highways England in the first RIS.

Implementation:

Too many good ideas fail because the difficulties of implementation are not adequately considered - they fail when the rubber meets the road. This happens for two reasons:

1. Those at the core of the proposal aren't consulted and involved. This mileage charge proposal has already benefitted from discussions with insurers to test the credibility of the proposition with encouraging feedback.
2. The implementation strategy is lacking. This mileage charge proposal includes a timeline of alpha and beta trials including by operators of fleet vehicles, after which there would be a transition period of two years during which those with telematics insurance would have the ability to opt into the scheme. Only after that would Fuel Duty and VED disappear as the new scheme was fully adopted.

The current system isn't completely broken – yet. But it is running rough and the time will come when it packs up completely.

This proposal gives a simple, technology-neutral alternative that promotes the take up of ULEVs, is prepared for autonomous vehicles and benefits all road users through increased, guaranteed investment in the road network.

To sum up, the new tax will be financially, socially, and environmentally sustainable, because it takes account of the impact any particular vehicle has on:

1. The road network – as measured by its weight
2. Congestion – as measured by the miles it drives
3. The environment – as measured by harmful emissions including CO_2, NO_x and particulate matter

Everything to do with our roads can be better.

Miles better.

1. Introduction

The prize question is seeking to find a solution to all the problems of Britain's highways and how we pay for them. Fuel Duty and Vehicle Excise Duty (VED) have served us well for many years. They reflected distance travelled, fuel efficiency and environmental impact too. However, changing technology and different motoring trends threaten to significantly distort the relationship between distance travelled and tax paid, which is unfair because these vehicles otherwise contribute to overall traffic congestion in a similar manner. Additionally, the government's tax base will become progressively eroded with severe implications for both income and expenditure. To reverse this trend, this paper recommends

1. to transition to a world without Fuel Duty and VED, where vehicles are instead paying a simple and transparent per-mile road charge via the insurance companies that insure those vehicles.
2. that the funding of the most important local authority roads (MRN)[5] be also included in the Roads Fund, and its spending be allocated according to the same criteria as Highways England's Road Investment Strategy.
3. that an additional £1bn be committed to fund the extended Roads Fund and hypothecate 20% of future Road Tax revenues for continuous and guaranteed funding of the Roads Fund.

Roads are a public good, however, unlike other public goods that have a clear system for costing every unit of consumption, roads appear to be free and unlimited to use. At the same time, road users are aware that this freedom is only an appearance and that they are taxed large sums of money for operating their vehicle, it is just difficult to pin down exactly how much they are paying and where the money goes. Improving the transparency of the system is essential for resolving the present contradiction, where people feel they are unfairly paying too much taxes and yet the government's revenues from motoring are in decline.

Before going into further details, it needs to be clarified why the present proposal will be supported by the public and why now is the right time for exploring its implementation. Between 2007 there was an attempt to reform the way we pay for roads but that proposal was not successful. It consisted of introducing a National Road Pricing scheme. The main reasons why the 2007 scheme was not successful are:

1. Fairness: Road Pricing was deemed unfair, because queueing was viewed as a fairer way of allocating road space in peak hours and congested locations. Most people felt they could not change the time and location of their journeys, and would be simply be forced to pay more under the new system[6].

[5] Quarmby D. and Carey P.: A Major Road Network for England, 2016

[6] RACF: Acceptability of Road Pricing, 2011 p 28

2. Privacy: People were concerned about the "spy in the cab". Under the proposed system the government would have been able to monitor the whereabouts of every citizen, which rightfully raised concerns.

3. Scheme Costs: Scheme implementation costs amounted up to £3bn[7] and running costs between £2-5bn[8], which were too high compared to the benefits the scheme was expected to deliver.

However, several things have changed since 2007, both in the world of transport and with the policy proposal itself. The following three changes are the main reasons why the present proposal would win the hearts of the public as the right solution for Britain's roads.

1. Fairness: the present proposal is NOT road pricing in the traditional sense. It does not discriminate between those driving in more or less congested locations. It simply proposes a new principle for calculating the fair amount of contribution that vehicle owners should pay for using the road network. In the future, when the principle of paying per mile has become established, the possibility of road pricing could be investigated.

2. Privacy: in 2007, the best selling phone was a Nokia and the first iPhone had just been released. Trading our privacy for convenience was only beginning to emerge with companies such as Google and Facebook. In 2017, people are more accustomed to waiving away their rights to privacy in exchange for various benefits. However, according to an INRIX survey from 2017, a third of people would still *not trust anyone* with their vehicle data[9]. This proposal will allow those who embrace technology to coexist with those who do not.

3. Scheme Costs: the present proposal's implementation costs are significantly lower than in 2007. Operating costs of the proposed Road Tax will match those of Fuel Duty and implementation costs are in the region of £100m rather than £4bn.[10] One insurer estimated the admin cost of implementing the proposed Road Tax to be £1.5-£1.7m for their own systems, which when multiplied by all insurance companies on the market would still be under £100m.

Having established that the present proposal is both desirable and feasible, it is important to highlight two additional reasons why now is the right time for starting the transition to a better system:

1. Ultra-low emission vehicles (ULEVs), eligible for the plug-in grants, made up only 0.26% of all cars and light goods vehicles on the road in the UK as of the end of Q1 2017.[11] Developing a payment system, where electric and other low emission vehicles must contribute too is informing people of the rules of the game in advance, rather than changes happening after purchasing a vehicle. Additionally, at present ULEVs are still more expensive and therefore it is more likely their owners are wealthier.

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[7] DfT: Feasibility Study of Road Pricing in the UK, 2004 p 27

[8] ibid

[9] INRIX, Connected & Autonomous Vehicle Consumer Survey, May 2017

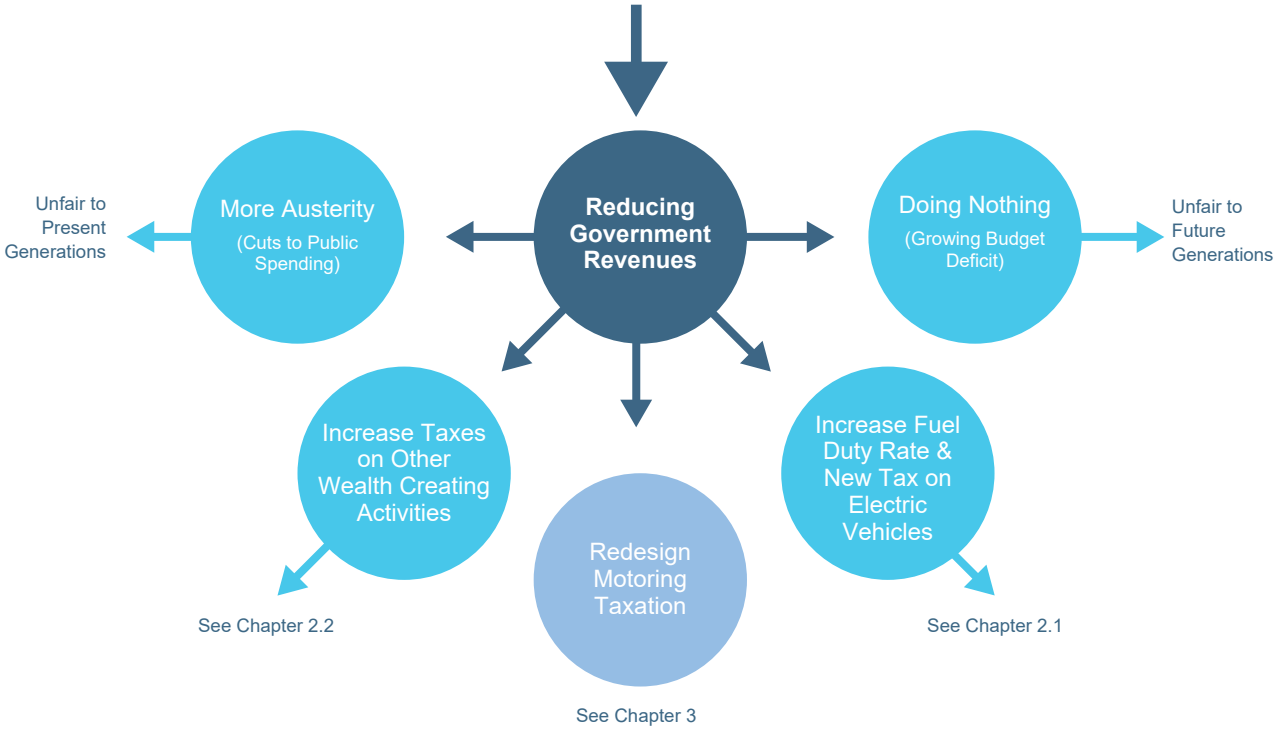
[10] Source: DfT: Feasibility study of road pricing in the UK, 2004 p 27

[11] Source: VEH0101 and RACF: Plug in grant elegible vehicles by quarter

2. Treasury revenue from VED and FD has been declining by an average of £812m in real terms every year over the past five years.[12] This decline cannot only be stopped but it can be turned around to begin rising in line with traffic levels. Within the first 5 years of implementation the new Road Tax would raise somewhere between £0.91 and £5.99bn of additional revenues on 2015 prices (section 6.1).

3. There are no viable alternatives for the government, as summarised by Figure 1. This proposal will argue in more detail in Chapter 2 why something must be done and in Chapter 3 how this proposal is the most effective way to reform Britain's road system.

Figure 1: Alternative government courses of action

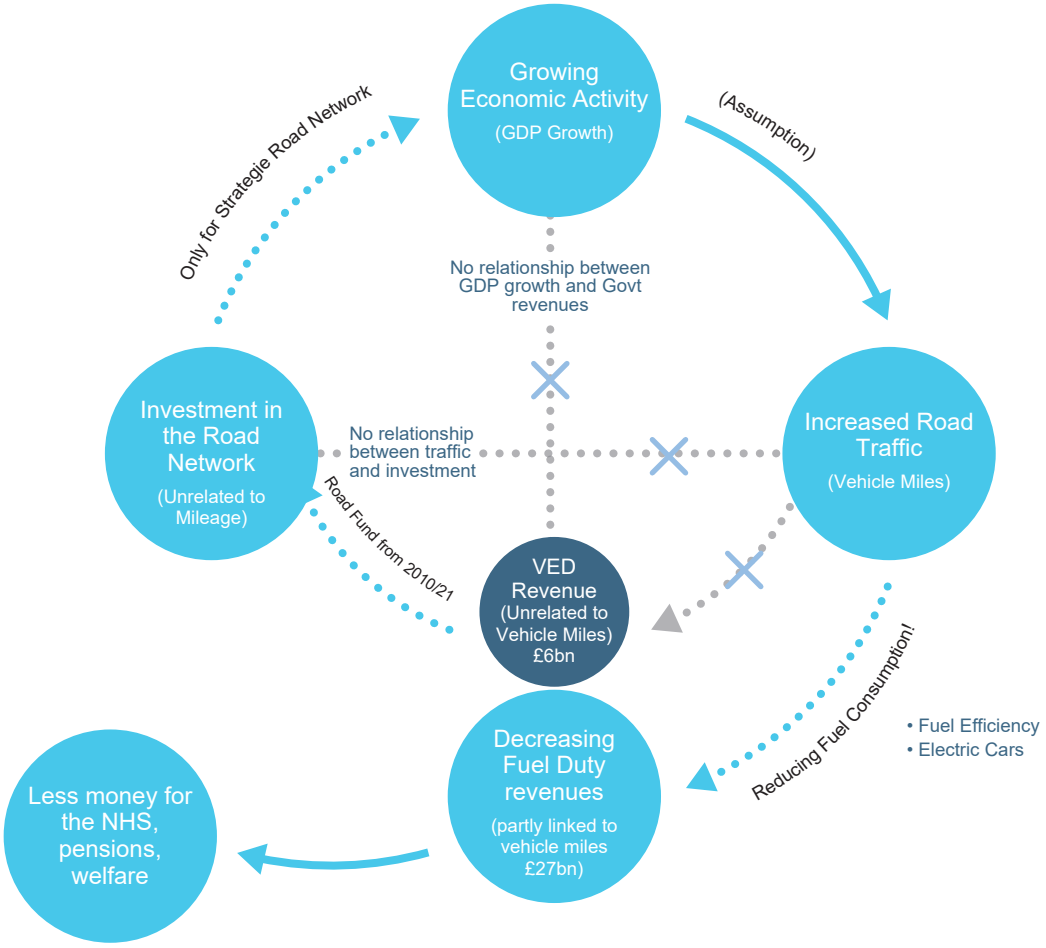


[12] When calculated at 2015/16 values 2010/11 revenue was £37.6bn, 2015/16 revenue was £33.54bn. Source: RACF: Road user taxation highway spending

2. The Problems of the current system

The first and most immediate problem is that over the past five years the treasury lost £812m in annual Fuel Duty and VED revenues in real terms, due to improvements in fuel efficiency, growing electric vehicle uptake and freezing of the duty in cash terms.[13] However, there is more to it than just a tax issue. The economic system of roads is too fragmented, as illustrated by Figure 2 because GDP growth is not proportionately captured by taxation and those taxes are not reinvested in the infrastructure that contributed to generating them. The current guarantee for hypothecating for future VED receipts will not solve this, because VED does not depend on traffic levels and therefore cannot guarantee long-term sustainability.

Figure 2: The current state of the road economic system



[13] When calculated at 2015/16 values 2010/11 revenue was £37.6bn, 2015/16 revenue was £33.54bn. Source: RACF: Road user taxation highway spending

Furthermore, users do not know how much a mile of driving or a shopping trip costs and it is difficult to see why the tax road users pay is not enough to fill the potholes outside their house. The symptoms of this ailing system are: worsening air quality, increasing congestion and too many people getting hurt on the roads. Once the economic system is harmonised and improved by appropriate policies and incentives the symptoms will eventually fade away. Finally, connected and autonomous vehicles (CAVs) and mobility as a service models are around the corner and the current road economics system will not be able to adapt to what the future will look like.

Fuel Duty is 57.95p a litre for both petrol and diesel

Fuel Duty has been frozen since MARCH 2011

2.1 Reducing government revenues

Currently motorists pay two direct taxes for road use: Fuel Duty and VED. Figure 3 shows Fuel Duty revenues adjusted for inflation against traffic levels in the UK. Until 2000 Fuel Duty revenue growth was largely in line with traffic level growths. Since then the gap has gradually diminished. This is a problem for two reasons:

- government revenues decreasing and expenditures staying the same leads to a budget deficit that is not sustainable, as concluded in Figure 1.
- higher traffic levels also require more money spent on road maintenance, which if isn't raised from road users will need to come from somewhere else.

Therefore, the government experienced pressures on its budget from both revenue and expenditure side.

The 2007 economic crisis temporarily masked this problem, as economic activity contracted and traffic levels reduced significantly. However, since 2013 the economy has been recovering and traffic levels are now exceeding pre-crisis level. The trend of growing traffic but reducing Fuel Duty revenues will continue if any of the following effects persist:

- Fuel Duty is not raised significantly above inflation levels.
- Fuel Efficiency of new vehicles keeps improving.
- The uptake of ULEVs continues to grow at a current rate.

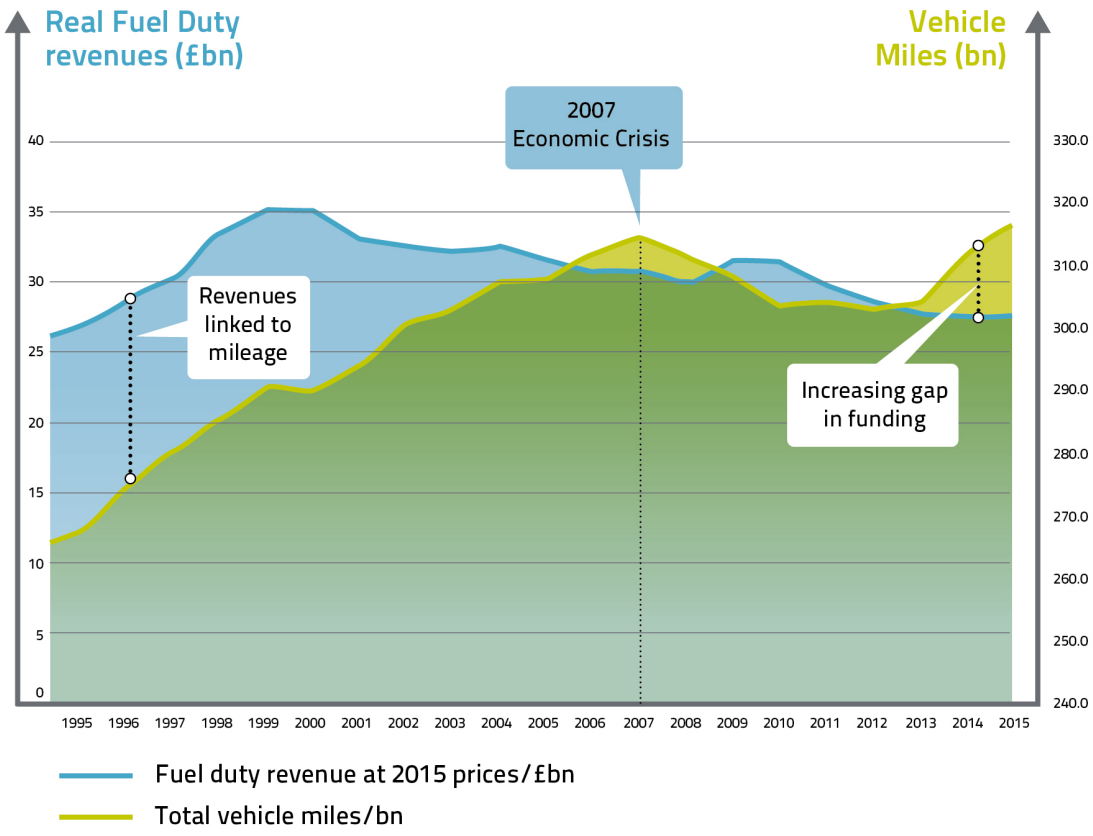
Revenues from Fuel Duty are forecast to reduce from 1.4% of GDP in 2016/17 to 1.28% by 2020/21.[15] Between 2010 and 2015 the government lost £2.3m every day in potential Fuel Duty income.[16] It has been promised that Fuel Duty revenues will be rising in line with inflation starting from 2018/19, but even this measure will not provide a sustainable long-term solution.

[14] FD revenue: CG: Current receipts: Taxes on production: Fuel Duty: £m CPNSA % ONS. TVM: TRA0101

[15] Source: OBR: Latest Forecasts

[16] Calculation is £4.06bn spread over 1826 days from 2010 to 2015.

Figure 3: Relationship between fuel duty revenues and traffic levels (1995-2015)[14]



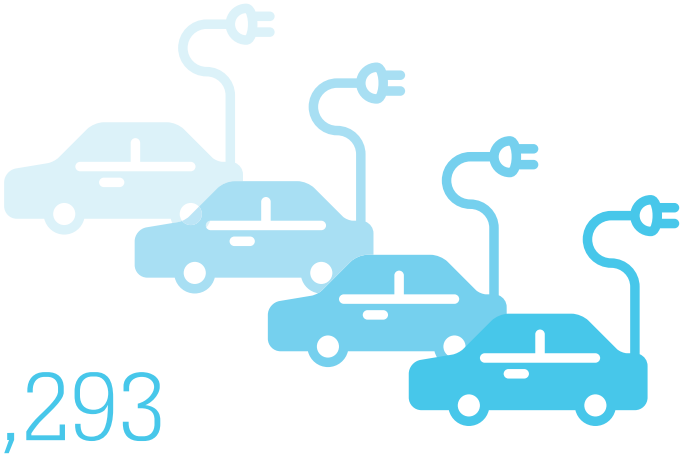
One of the government's options as suggested in the introduction is raising Fuel Duty rates and introducing a new tax on electricity used for charging electric vehicles. There are however, two main issues with this solution:

- raising Fuel Duty above the rate of inflation is regressive, making poorer people with older and less fuel-efficient cars pay more and more for every travelled mile. The IFS estimated that to return Fuel Duty revenues to the their 1997 values a raise of 24p for petrol and 18p for diesel fuels would be required.[17]
- with every new Ultra-low emission vehicle (ULEV) on the road, the number of vehicles liable to tax will be reducing, because ULEVs do not pay or pay minimal Fuel Duty. This would mean that those who pay Fuel Duty would end up paying significantly more every year.

Furthermore, Fuel Duty is an unpopular tax; raising it is politically difficult. Taxing electricity used for electric vehicles would not only pose practical challenges but is difficult to justify: why differentiate between different types of electricity use? Such a move would also add to the existing complexities of a system, which desperately needs simplification to assist people in making sustainable decisions. Therefore, this proposal argues that raising fuel duties and an electric vehicle charge is not a viable solution to the fiscal crisis towards which the government is heading and a single, transparent charge system for all vehicles is necessary.

[17] IFS, 9 Excise Duties, 2016, p201

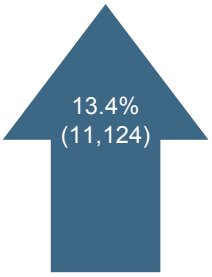
As the end of Q1 2017



94,293

plug-in grant eligible vehicles were on the road

This is



increase since the end of Q4 2016

2.2 Transparency

The purpose of collected road tax is to:

- pay for the maintenance of the road network, a public good looked after by the government, and
- pay for the negative consequences ('externalities') that vehicle use has on society.

The amount of tax should be set at a level that compensates for all these externalities. However, the real cost of driving 100km, has declined by £2 for diesels and £2.5 for petrol cars since 1997.[18] This has led to an increase in both vehicles and vehicles miles, driving up the total social (external) costs of driving and not generating sufficient revenues to mitigate them.

As mentioned in Figure 1 in the introduction, the second option that the government could do to resolve the looming tax revenue crisis, would be to increase taxes on other wealth creating activities not related to road use such as income tax or value added tax. This would not be a good idea for two reasons:

- it would mean that the social costs of driving would remain external to drivers and therefore continue to become higher.
- general taxes affect everyone and therefore It would also be unfair towards the minority of people who do not use road.

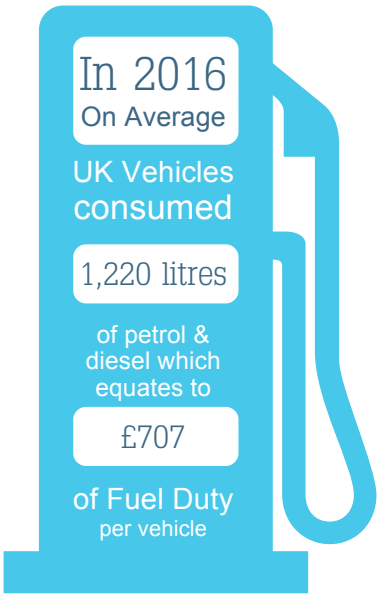
To account for all the negative consequences ('externalities') caused by an individual vehicle, it is important that these externalities are included in the cost of driving every additional mile ('the marginal cost'). For example, VED is not a marginal cost because it does not increase with vehicle use. Although it is meant to account for a vehicle's environmental impact, it is only calculated based on their "potential" per mile emissions rather than on their total emissions.

[18] IFS, 9 Excise Duties, 2016, p 217

Negative Externalities Include

Fuel Duty on the other hand is a marginal cost, because the road user needs to pay more Fuel Duty for every additional litre consumed and, in turn, miles driven. However, it is not sufficiently transparent because most road users would struggle to say how much Fuel Duty they pay over the course of a year let alone how much Fuel Duty they pay per mile. This lack of transparency leads to the current situation where road users feel that they are unfairly paying too much for road use, but are not paying enough to compensate for the externalities they generate.

For road users to be able to make informed decisions between modes of transport, the cost of driving needs to be more straightforward. This does not mean that the considerations behind the tax need to be simplistic, but that the bottom line price needs to be easily accessible to users. However, this transparency needs to be balanced with the necessity to reduce the practical burden on all road users, while presenting more upfront information to users about the cost of driving every additional mile.



2.3 Funding for local roads

Local roads bear two-thirds of motor traffic and almost all of pedestrian and cycling traffic in the UK, yet "local highways authority maintenance spending reduced by 15% between 2009/10 and 2013/14. A further 35% reduction in local highways maintenance budgets is estimated by the end of the decade."[19] and "Poor local roads cost £5bn a year to small and medium-sized enterprises in wasted staff time, fuel costs, vehicle repair costs and production."[20] The safety implications are even more severe because motorcyclists, cyclists and pedestrians are more vulnerable to poor surfaces than motorised users.

In years to come, local authorities will be under increased pressure from the rising cost of social care (among others) and the reduction in central government maintenance block grants. This will make decisions to allocate funding for road maintenance even more difficult and will leave some geographical areas hugely underfunded. Politically it is much more difficult to argue for spending on roads when there is, for instance, little money for looking after our elderly population. If investment in local roads is constantly postponed, future generations will have to pay the price of it.

[19] RACF, Condition of England's Local Roads and how they are funded, 2015, p. iv

[20] Ibid.

Underinvestment in local roads will also hold back economic growth, which seems to be shifting towards online shopping and the home delivery that is reliant on a high quality local network for access.[21]

As a measure to correct the current underinvestment in the road network, the previous Chancellor of the Exchequer has promised to hypothecate VED to investment strategic roads from 2020 onwards[22]. However, this does not resolve the chronic lack of maintenance funding for local roads that are the roads that people tend to live, shop and spend most their travel time on. Although it might seem like a local government issue the user does not distinguish between the two, they simply expect the maintenance backlog (estimated to be £8-£12bn) to be fixed[23].

2.4 Safety, Air Quality and Congestion

Safety, air quality and congestion are not distinct problems but they are the symptoms of the unhealthy state of the roads system at present. This section will look at the three features of the current system that need to be addressed by the proposed reform.

[21] RACF: RACF: Braithwaithe: The Implications of Internet shopping Growth on the Van Fleet and Traffic Activity, 2017

[22] Butcher L., VED Report, 2017

[23] Source: AIA Alarm Report, 2017

Vehicle Excise Duty (VED) from April 2017

When registering the car, the first year payment is based on CO2 emissions and powertrain type:

CO2 emissions (g/km)	Petrol and diesel cars	Alternative fuel cars
0	£0	£0
1 - 50	£10	£0
51 - 75	£25	£15
76 - 90	£100	£90
91 - 100	£120	£110
101 - 110	£140	£130
111 - 130	£160	£150
131 - 150	£200	£190
151 - 170	£500	£490
171 - 190	£800	£790
191 - 225	£1,200	£1,190
226 - 255	£1,700	£1,690
Over 255	£2,000	£1,990

After the first year, as a single payment:

Petrol & Diesel vehicles pay £140 a year

Alternative fuel vehicles (e.g hybrids) pay £130 a year

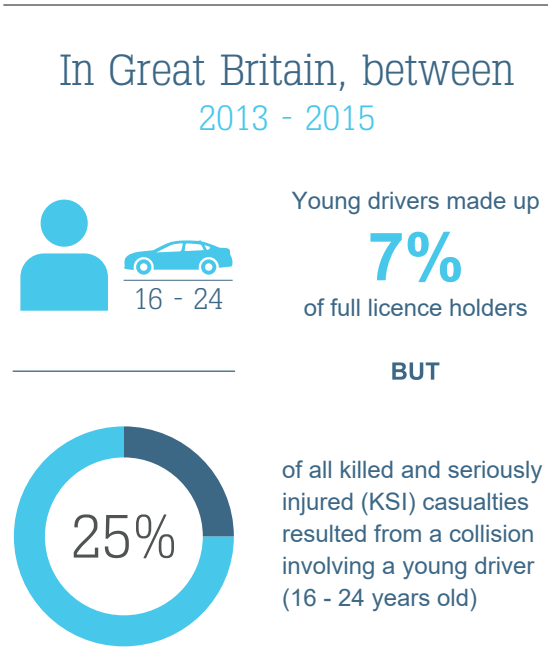
Electric vehicles pay £0

&

Vehicles with a list price of more than £40,000 pay an extra £310 a year for 5 years

2.4.1 Road Safety

Although British roads are amongst the safest in Europe, much more can be done. In 2015, there were 1,730 reported fatalities and 22,144 serious injuries.[24] Connected and autonomous vehicles are likely to dramatically improve road safety in the long term, because 94% of collisions are estimated to involve human error[25]. Nonetheless, this proposal suggests that more immediate action is required. In 2015, there were 1,281 killed or seriously injured casualties amongst young (those aged between 16-25 years) car drivers, who are disproportionately represented in collision statistics[26]. The DfT has estimated the value of preventing young car driver accidents to be £2.9bn compared to £14.7bn for all accidents.[27] Aiming to improve safety and driver behaviour of young drivers can yield big results, which is one ambition of the proposed Road Tax.



2.4.2 Air Quality and CO_2 emissions

The current road tax system is skewed in favour of diesel vehicles, which emit less CO_2/km than their petrol equivalents, and hence are more fuel efficient. Therefore, diesel vehicles pay less VED and less Fuel Duty compared to equivalent petrol vehicles. This has led to a high uptake of diesel vehicles, particularly in the light commercial vehicle sector where 96% are diesel[28]. Unfortunately, diesel engines produce increased particulate and NO_X emissions that are directly harmful to people's health and therefore have a high public health externality cost. Toxic NO_2 fumes in the UK have caused an estimated 11,940 premature deaths, the second highest in Europe.[29] Therefore, the new road tax system should have a more sophisticated approach to environmental sustainability and examine all harmful emissions that road users generate. Furthermore, average CO_2 emissions per mile have been improving but due to the increase in travelled miles the overall CO_2 emissions from transport have not decreased (Figure 4). Client Earth took the government to court again, claiming that their recently published air quality action plan does not contain sufficient actions to achieve the necessary reduction in harmful emissions.[30] It is proposed here to include in the Road Tax calculations both CO_2 and other air pollutant emissions through parameters that will reflect total emissions not just per mile figures.

[24] Source: DfT: RRCGB: 2015

[25] Source: DfT: Pathways to Driverless Cars, 2015

[26] Source: DfT: Road Traffic Estimates, 2017

[27] Source: DfT: Young Car Driver data, 2015

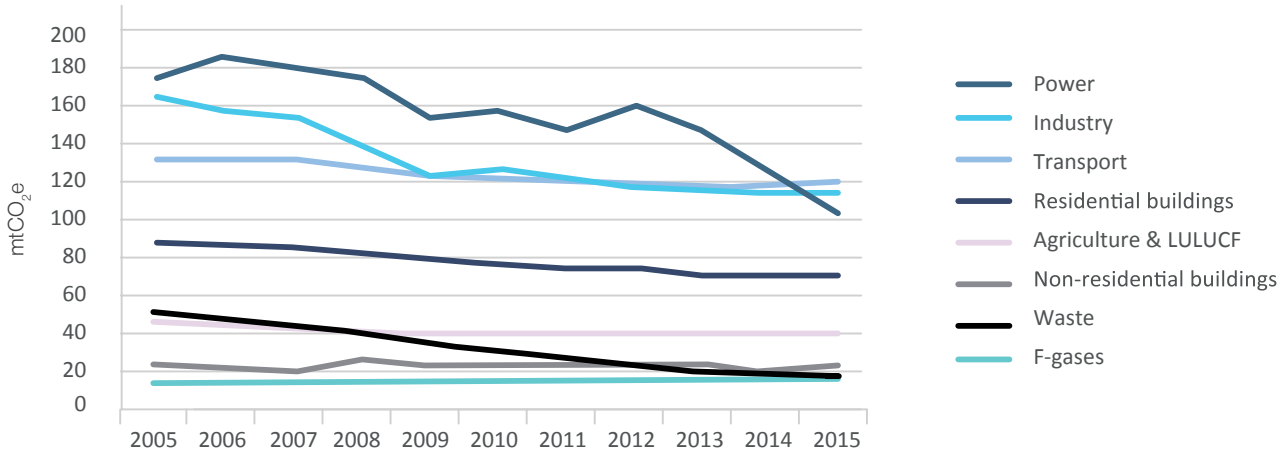
[28] Source: RACF: RACF: Braithwaithe: The implications of the growth of internet shopping on the car and van fleet and traffic, 2017

[29] Source: EEA: Air Quality in Europe, 2016, p. 60

[30] ClientEarth: press release, May 2017

Figure 4: Overall CO_2 emissions from transport are increasing[31]

Source: DECC (2016) Provisional GHG statistics for 2015; DECC (2016) Final GHG statistics for 1990-2014; CCC analysis.
Notes: Chart shows temperature-adjusted emissions in power, residential and non-residential buildings. This smooths out the large changes in heating emissions between years with mild and cold winters to give a clearer impression of genuine progress.



2.4.3 Congestion

Congestion is caused by increasing traffic levels and the concentration of traffic in time and place. As showed on Figure 3, traffic levels in Great Britain are growing and there are more and more vehicles on the road network[32]. In the current system, road space is allocated to users on a first come, first served basis – queueing occurs. As the estimated cost of congestion keeps growing and is currently estimated to be £30bn[33], most transport economists have been advocating the introduction of road pricing. Traditionally, this has involved charging higher prices for using roads in congested locations and time periods.

[31] CCC, 2016 Progress Report

[32] Source: TRA0101 – for vehicle miles and VEH0101 – for licensed vehicles

[33] INRIX (2017). Traffic congestion cost UK motorists more than £30 billion in 2016. Press release, 20 February. Retrieved 20 March 2017 from http://inrix.com/press-releases/traffic-congestion-cost-uk-motorists-more- than-30-billion-in-2016/

This paper appreciates the benefits of the traditional approach to road pricing but believes that at present in the UK such a scheme would not be feasible. Public perception of road pricing is not favourable because the majority of people feel that the time and place of their car use is not voluntary but a consequence of external factors such as the need to arrive or leave work at a certain time or the lack of better alternatives to driving.[34] Additionally without fully appreciating the impact of technology we risk creating solutions that by the time they are implemented become obsolete due to future changes to how much and on what mode we will travel.

2.5 Disruptive technologies

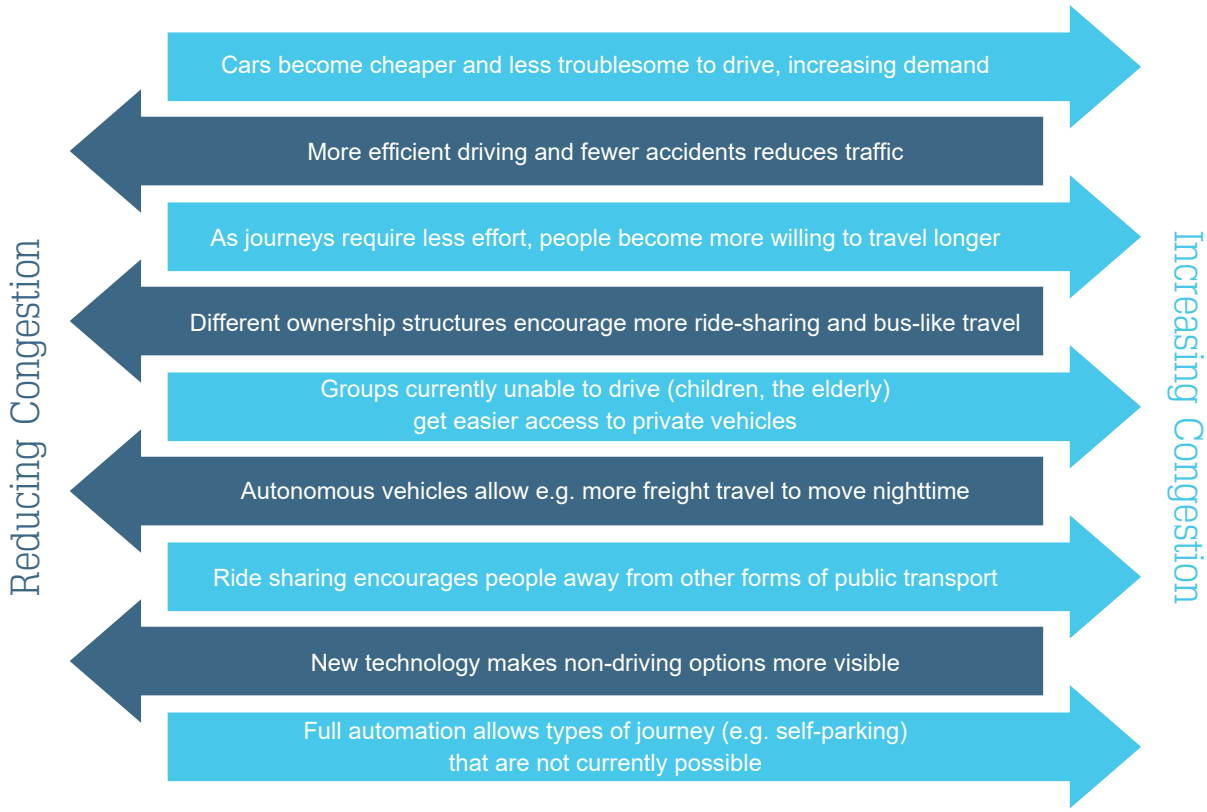
ULEVs and electric vehicles are not viewed as unexpectedly disruptive technologies in this paper since they merely replace one type of fuel with a different type. They are necessary in reducing the environmental externalities of road transport and their uptake needs to be encouraged but will not fundamentally change travel patterns.

Mobility as a Service (MaaS) is a business model that is already beginning to emerge in some cities and is being trialled in Birmingham. It provides mobility solutions combining all possible modes of transport for a monthly subscription fee. MaaS focuses on user experience and removes pain points, such as interchange penalties, and seeks to anticipate delays to offer the fastest route to users. It is thought further real benefits will be unlocked by the introduction of autonomous vehicles because the two systems together could render car ownership superfluous by providing cheap on demand vehicles at users' fingertips.

Connected and autonomous vehicles (CAVs) are most likely going to change road transport. They have the potential to fundamentally transform car use into a public form of transport. For a host of consequences see Figure 5, which describes the two opposite directions in which technology can impact traffic levels and congestion. It is impossible to tell whether traffic levels will rise or fall but what is important is that the proposed tax system can adapt to the changes.

[34] RACF: Acceptability of Road Pricing, 2011, p 31

Figure 5: Potential effects of technology on road traffic and congestion[35]



If the proposed road tax system is able to adapt to both traffic scenarios it is worth implementing it now, to give the government time and revenues to prepare for the changes and keep the network functional. If on the other hand, traffic levels reduce significantly then significantly less road maintenance and investment will be required and collecting less revenues is entirely justified.

This paper assumes that fully autonomous vehicles will be available between 2025 and 2030 therefore the future-proofing of roads is an urgent matter.[36] While the availability of autonomous vehicles is still uncertain, many safety related connected vehicle features are already available such as automated breakdown call, road incident alerts and re-routing, and emergency services automatic response.[37] For the majority of these safety features to be fully functional there is a need for the appropriate levels of digital 5G infrastructure, which is estimated to cost £4.5bn to deploy on all UK roads.[38] To be able to pay for all the necessary upgrades there needs to be a more sustainable solution for the government and a fairer way to motorists.

[35] Michael Dnes: Roads to Tomorrow, Wolfson Prize submission, 2017, p. 22

[36] Although much more ambitious targets have been set by some commercial companies. Source: www.driverless-future.com

[37] INRIX: Connected and Autonomous Vehicle Customer Survey, May 2017, p. 25

[38] Oughton E. J. & Frias Z.: Exploring the Cost, Coverage and Rollout Implications of 5G in Britain, 2016 p. 57

3. The proposed Road Tax

This chapter will explain why mileage, emissions and vehicle category make the proposed Road Tax fairer than the system of Fuel Duty and VED, which it will replace[39]. It will point out that inviting insurers to collect the tax benefits everyone: the government, road users and insurance companies too, through low collection costs, a transparent and seamless payment system and a small margin too. It will present user experience when paying tax through Figure 6 and show how a no-tech and a high-tech solution can coexist under the same principles. It will point out that using insurance companies will allow the system to preserve one of Fuel Duty's core strengths, its low collection costs. Finally, mileage validation will be addressed which is the proposal's greatest challenge.

3.1 Principles behind the Road Tax

Since most people already call VED their "road tax", and because part of the revenues will be reinvested back into roads, in makes sense to call the new tax system the new "Road Tax". It will be financially, socially, and environmentally sustainable as the following inputs will determine the new Road Tax (for the exact formula see 80):

- a vehicle's impact on traffic and congestion (miles driven),
- a vehicle's impact on the road surface (vehicle weight measured through vehicle category), and
- a vehicle's impact on the environment and our health (measured through Euro standards)

These considerations will make the tax regime fairer for all road users because of the tax burden's proportionality to both vehicle category and road usage thus charging vehicles more if they do more damage to roads and the environment than those that do less damage. The new Road Tax will also be good for the environment and people's health as it would discourage people using polluting vehicles by calculating their total harmful emissions both CO2 and other harmful pollutants. The new Road Tax would be good for the economy, because increasing revenues would fund an extended Roads Fund that would target all the economically vital roads of the UK (see Chapter 7). By internalising all negative externalities the new Road Tax will provide a fair comparison between different vehicles within the system too.

[39] Only the "showroom tax", the first year VED rate would be kept, which influences the types of new vehicles entering the market. This is a negligible proportion of VED revenues, which is why it isn't mentioned

3.2 The role of insurers

Crucially, the proposed Road Tax would be collected through private motor insurance companies, since they already have all the personal and vehicular details that are required for calculating the amount of tax owed by each individual car owner. In the future, whenever someone's insurance is due for renewal, they will receive their road tax bill together with their new insurance quote (see Figure 6). The Road Tax bill would be the same regardless of the insurance provider and could be paid in all the ways that insurance can be paid. This clarity would have a positive behavioural impact because it will help motorists understand the environmental and social impact of their driving; much like water metering did for water use.

One major insurance company estimated the costs of implementing the system to be between £1.5-£1.7m, due to the fact that they already collect Insurance Premium Tax (IPT) on insurance policies, which is passed on to the government. Insurance companies would also be paid a handling fee (0.01% of total revenues), which are the same as current Fuel Duty collection costs. This which would incentivise insurers to find the best way of administering the system. Operational cost estimates are in section 6.2.1.

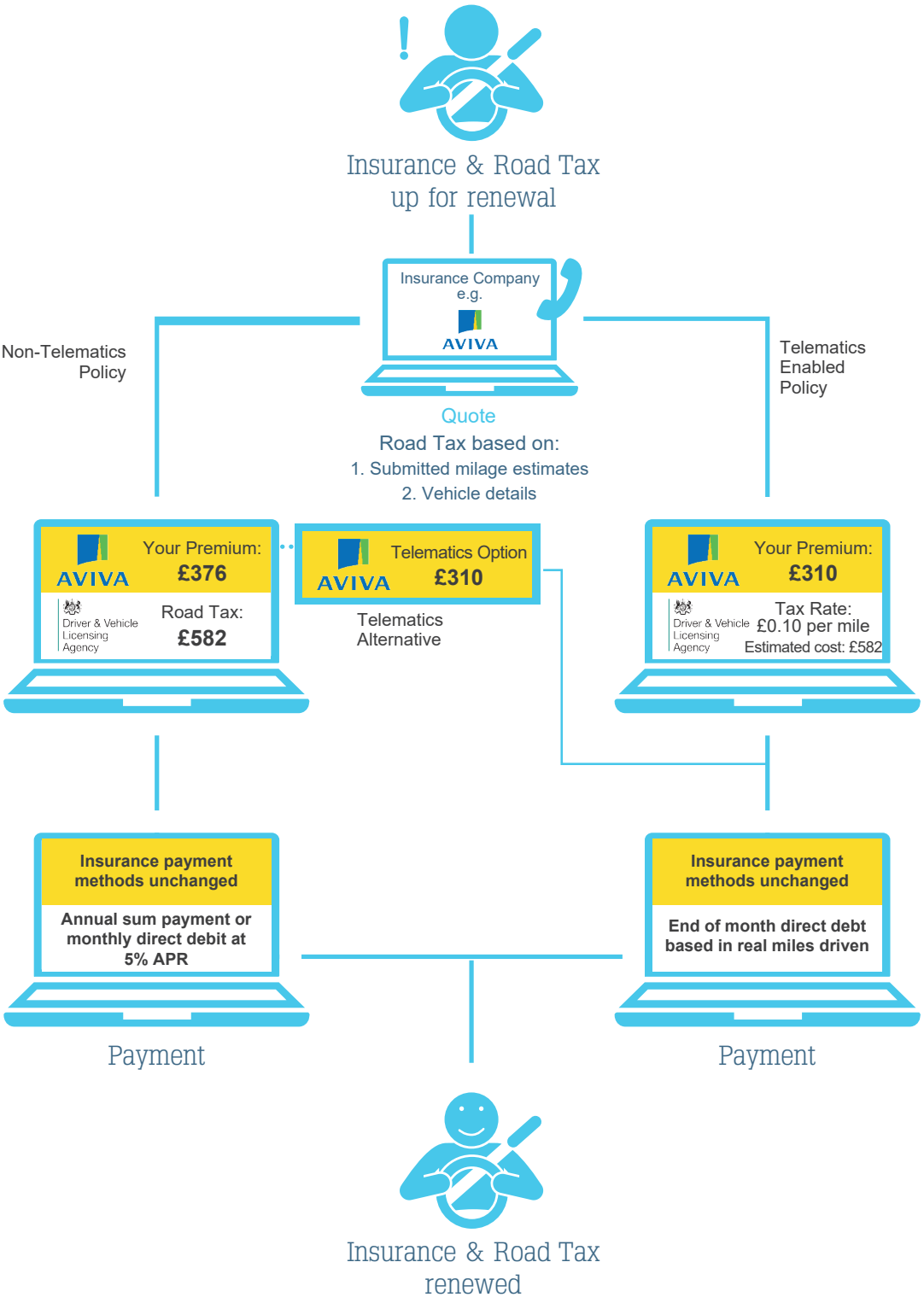
Privacy would not be affected at all because the data required to calculate the amount of Road Tax due is only the vehicle registration number and the annual mileage of the car, both which are already required by insurance companies. The registration number is linked to the DVLA database that would give insurance companies a rate for that specific vehicle which that can be multiplied by the annual mileage. If the insurance policy is telematics based, the estimated annual mileage will not be required. Instead users would be billed on a monthly pay-as-you-go basis and the Road Tax will be collected by the insurance company via direct debit. Such a system would make using the roads not too dissimilar to using water, electricity and gas at present.

3.3 A seamless user experience

One of the key strengths of the proposed Road Tax is that it makes life simpler by bundling two payments into one transaction and removing any additional administrative burdens. This is the same no matter how the road tax is purchased: via phone, in person or over the internet. It will be an easy and straightforward system when buying a car too, because insurance quotes (and by extension the road tax due on the car) can be viewed before buying it. Figure 6 provides an illustration of the customer experience when purchasing insurance and in turn paying their new Road Tax online.

Figure 6: Customer experience: private users

The user experience - private vehicles



It is worth noting that the proposed Road Tax will include a host of incentives to encourage telematics uptake because it makes system administration simpler and the road safer. However, there will always be two options available to users; (i) a no-tech, high-privacy and (ii) a high-tech, low privacy option.

The simplicity of the proposed Road Tax is that it behaves exactly like insurance premium from a billing point of view. If the user switches insurance then when they receive their premium refund they will also receive their Road Tax refund on a pro-rata basis. If the vehicle is SORNed[40], scrapped or exported the user can get a Road Tax refund if they validate their mileage via an approved MOT mechanic. Likewise, before a vehicle is sold the old owner needs to validate the mileage through an MOT mechanic and provide the mileage certificate to the new owner before receiving their Road Tax refund via their insurer.

Vehicles not registered in the UK would have to pay the proposed Road Tax too albeit not in a mileage basis but on a daily basis depending on their vehicle category and emissions. They would pay a deposit and purchase a vignette upon entering the country and would receive a refund or pay the difference at the end of their stay. The Border Force would receive some initial funding to upgrade their systems to be able to keep track of this data.

3.3.1 The no-tech guarantee

In a recent survey on connected vehicles, a third of people said they would not trust anyone with their in-vehicle data.[41] Privacy is likely to be one of the biggest concerns around any scheme that appears to be a form of road pricing. For successful marketing of the proposed Road Tax, it is imperative that the public understand that telematics devices would never be compulsory. An entirely self-declared mileage based Road Tax option would always be present as an alternative.

One of the major benefits of the proposed Road Tax system is that no more data would be collected from individuals than that which insurance companies already hold. Insurance companies already ensure that they store data in a safe manner as such there would not be any costs in setting up additional secure databases. In the case of any dispute, the Information Commissioner's Office would be the ultimate arbiter.

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[40] Statutory off-road notification

[41] INRIX, Connected & Autonomous Vehicle Consumer Survey, May 2017, p. 5

3.3.2 The telematics upgrade

Telematics delivers two crucial benefits to all parties in the transaction: safety and convenience. For this reason, there are a host of benefits from a telematics enabled policy, which are summarised in Table 1. Some of these are already available but others would be developed with the proposed Road Tax.

With the continuing development of connected vehicle features it is likely that the current telematics "black-box" insurance policies in the future will use the connected features already present in vehicles. For example, a vehicle with an e-call functional SIM-device (fitted in every vehicle as standard from April 2018) could perform as a telematics device if the user gives their consent to it.

Table 1: Benefits of buying telematics insurance

With telematics policy	Without telematics policy
Insurance policies would not be liable to IPT, currently 12% of the premium. This is an average saving of £84 per policy.	Need to pay full price on insurance policy
Billed on actual miles at month end	Billed on estimated miles at beginning of year/month
Receive monthly statement on trips and road use	Need to advise insurance company if users will exceed declared mileage.
Stops counting mileage when outside GB/UK	Pays Road Tax regardless of location (like VED)
Feedback on driving ability	-
Stolen vehicle tracking	-
possibility of dynamic road pricing trials	
possibility of "geographical hypothecation"[42]	

[42] At high telematics penetration levels, it is feasible to envisage a data driven funding allocation to replace the highway maintenance block grant. Such a system would create a geographical hypothecation: revenues generated in Blackpool could not be spent in London. Such a system would improve tax transparency and tell road users clearly where their was money is spent.

3.4 Addressing the Problem

Figure 7 highlights what the Economic System of Roads would look like if the New Road tax was implemented. Changes compared to Figure 2 that showed the current system are:

1. restored relationship between traffic levels and government revenues
2. 20% of Road Tax revenues are always sent to the Roads Fund
3. Roads Fund is spent on the SRN and the most important local authority roads ("MRN") allowing for further economic growth.
4. the economic virtuous circle is closed and more traffic leads to more investment and,
5. the benefits of economic growth are captured by the public purse through increased government revenues.

Figure 7: Proposed vision for the road economic system

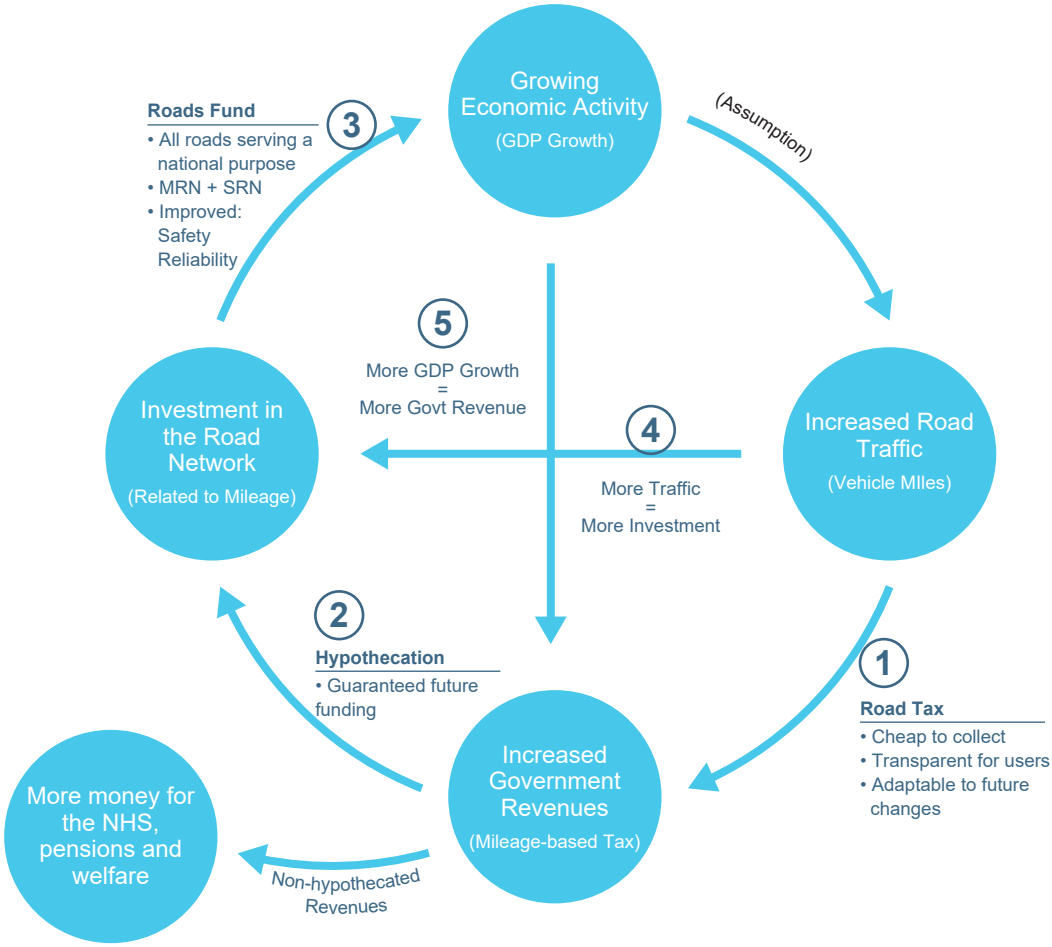

Table 2 summarises the features of the new Road Tax that will address the problems outlined in Chapter 2.

Table 2: Summary of how the new road tax addresses the problems of the road system

Falling revenues	Mileage based tax will relate to miles driven therefore revenues will increase or decrease according the overall traffic levels. The new Road tax will widen the tax base to electric vehicles and foreign vehicles too.
Congestion	By improving transparency road users are more likely to appreciate the cost of each trip and reduce their vehicle use. After a certain level of telematics market penetration, trials can be run with dynamic road pricing to gauge user responsiveness and congestion benefits.
Transparency	Users will know exactly how much tax they are required to pay annually/ monthly for driving and with telematics they can receive monthly statements detailing individual journeys.
Air Quality	Harmful tailpipe emission would be as important as CO2 emissions in weighing the environmental factor, removing the huge benefit that diesel vehicles enjoy in the present system. By multiplying all emissions with mileage levels total CO2 emissions will be priced contributing to meeting carbon emission targets.
Road Safety	By hypothecating 20% of revenues (6.2.3): a pothole free Britain, roads with guaranteed mobile and data connection, increased roads policing and several major infrastructure schemes could be delivered. The growth in telematics uptake will improve driver behaviour and will reduce young driver KSIs in particular. Safety benefits have the potential to bring financial benefits of up to £14.7bn.[43]
Adaptability to future changes	Because the new Road Tax is based on a set of principles that will remain true for the foreseeable future, the tax can be easily adapted to the needs of the future.

[43] Source: DfT: Young Car Drivers, 2013

The distance-based nature of the charge is fundamental to any new tax regime. It is the only way to sustainably guarantee future revenues both for the wider government finance and the road network. By following that principle, revenues would only decrease if road traffic were to decrease as well, in which case less money would be required for road maintenance. However, if (as expected) vehicle miles continue to increase in the UK then the government budget, and the road network is also guaranteed to reap the benefits of that increased economic activity. The new tax regime will either reduce congestion or increase revenues in the medium-long term. Furthermore, this tax system would be fully compatible with variable road pricing, based on time and/or location, when the public has accepted the need for it.

3.5 Mileage validation

One of the greatest challenges of the present proposal is guaranteeing mileage validation for every vehicle. The current system of fuel duty is virtually unavoidable (except for red diesel)[44]. There will inevitably be some who try to avoid the new Road Tax. The proposal recommends reducing uninsured driver numbers through increased funding of road policing and a cross-referencing exercise between the Motor Insurance Database and the DVLA. Under-declaring mileage would become an offense: people would not risk invalidating their insurance cover for avoiding the tax all the more so because their vehicle mileage would be recorded during the annual MOT check of their vehicle.

3.5.1 Reducing uninsured driver numbers

Uninsured drivers are the number one risk to the fairness of this policy. The proposal has estimated the extent of possible revenue leakage under the new system to be between approximately 2-3%, causing a potential revenue loss between £796m and 1.194bn at 2015 prices.[45] This would most likely reduce in future years because:

1. enforcement would improve significantly as a consequence of the hypothecated police revenues,
2. communication would improve between DVLA[46] and the Motor Insurance Bureau's Motor Insurance Database (MID)[47]

There are an estimated 1 million[48] uninsured cars in the UK, while only half a million unlicensed cars[49]. In this measure vehicle registration seems to get higher compliance levels that third party insurance. By comparing the vehicle registration database against uninsured the Motor Insurance Database it should be possible to cross reference the vehicles that have had their VED paid but are not insured. On the prevention side, many of those involved in uninsured collision claims are aged under 30. By making telematics options even cheaper, younger people might be more likely to afford car insurance and less likely to risk driving uninsured.

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[44] Crown Oil: Red Diesel Q&A

[45] Calculated at 2% and 3% of £39.8bn respectively

[46] DVLA holds the registration details (V5C) of all vehicles licenced in GB and collects VED from road users. DVLA: About-us

[47] MID is the Motor Insurance Database that police uses to check if a vehicle involved in a collision has valid insurance. MIB: The MID

[48] Source: Callwiser: A worrying increase in the number of uninsured drivers, 2015

[49] Source: DfT: Vehicle licencing statistics, 2015

3.5.2 Behavioural deterrents

For insurance to be valid the driver needs to have paid their Road Tax (currently VED) and have a valid MOT. In case of a collision, if the driver was found to have not paid their Road Tax, this would have also voided their insurance. By extension, if they paid their Road Tax, but had already exceeded their declared miles their cover would not be valid. If this is communicated to users clearly in advance, it will act as a powerful deterrent for all those buying insurance. Customers purchase insurance to be protected from uncertainty that is only guaranteed if they declare their prospective mileage honestly. The likelihood of people deciding to buy insurance (to cover themselves against the risk of a collision) and under-declaring their mileage (thereby risking their insurance to be void) is low as most people who would take on such a risk would probably not purchase insurance altogether.

The second deterrent needs to target various "defeat devices" that can alter a cars mileage records. Currently it is illegal to sell a car with a knowingly altered mileage but it is not against the law to alter the mileage of a vehicle or to sell devices capable of doing so. 50 The proposal recommends outlawing the sale, purchase, possession and use of mileage clocking devices and thereby clarifying this currently grey legal area. This should act as a clear deterrent to those would-be-tax-evaders who would not risk criminal charges and would also help in tackling the market that has developed around such equipment.

3.5.3 Independent validation

This section deals with how the people who do evade tax will be caught and prosecuted. When a

vehicle owner of a car over 3 years completes their car's MOT their data will be uploaded to the central MOT database. New vehicles, whose MOT is not due yet will not have to validate their miles, but when they sell the car then they will have to carry out an MOT and pay their outstanding road tax before the car can be sold. Additionally, both validation and the enforcement will improve with time because

1. better vehicle data will be available,
2. the increasing role of Personal Contract Purchases (which include a mileage limitation), and
3. telematics policies will be more common and enforcement will need to concentrate on fewer vehicles.

[43] RAC: Mileage correction: how to spot a clocked car, 2016

4. Implementation Strategy

This proposal benefits from an adaptable implementation strategy, which can be compressed if need be. Below it will present an implementation strategy with an aim to give motorists as much time to adjust. Trials will be crucial since nowhere has a government attempted to delegate tax collection to insurers and this would be an innovative solution.

Figure 8 will show an indicative implementation timeline aiming at full-scale implementation by 2022.

4.1 International examples

The majority of road pricing studies have focused on international congestion charging examples such as Stockholm and Singapore. The present proposal in not a national congestion charging scheme or road pricing in its traditional sense as such these examples are not directly relevant. This proposal has argued consistently that such schemes are not going to work in the UK because people feel that their trips are not flexible enough in time or space.

On the other hand, several US states are currently experimenting mileage based charges in one form or another. The most interesting program, "My OreGO" by the state of Oregon has been trialling since July 2015 with 5000 volunteers who can opt-in and receive a gas tax rebate through an OBD2 dongle. Under this scheme users can choose whether to pay a flat mileage rate or a variable on/off peak mileage rate as well. Other distance charge scheme trials are ongoing in Nevada, Minnesota and are being commissioned by California and Washington.[51] The communications used for these trials should be studies in more details as they can help this proposal use the clearest and most effective language to persuade the public of the virtues of the new Road Tax.

All existing schemes have been either funded and run by governments or procured via specialist tech companies. As far as this proposal is aware, nowhere has a government invited insurance companies to collect their road user charges yet. This is both an exciting opportunity to implement an innovative solution and a risk, which must be mitigated through a trial based implementation strategy.

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[43] Congressional Research Service: Mileage-based Road User Charges, pp. 8-10

4.2 A trial based implementation

Despite the current preference for exclusively prospective tax reforms, this proposal recommends avoiding the complications that would arise from such an approach. Instead it recommends a trial scheme approach, similar to the one in the various states of the USA. This would be followed by a transition period and full-scale implementation. The benefits of this approach is that there is time to evaluate and tweak the policies based on the evaluation from the pilot schemes prior to full scale implementation. It also removes the complexity and cost of having to run multiple parallel systems. See Table 3 for a summary of the strengths and weaknesses of various policy implementation mechanisms.

Table 3: Implementation strategy strengths and weaknesses

Implementation Strategy	Strengths	Weaknesses
"Big Bang": the new policy applies to all users after a certain date	Simplicity Low Cost	Unfairness Unpredictability
Prospective: the new policy only applies to future users after a certain date	Fairness Predictability	Potentially high cost Complexity
Opt-in/trial: users can choose to use the new system	Public Acceptance Ability to test small	Revenue gap (worst of both) Cost / Complexity

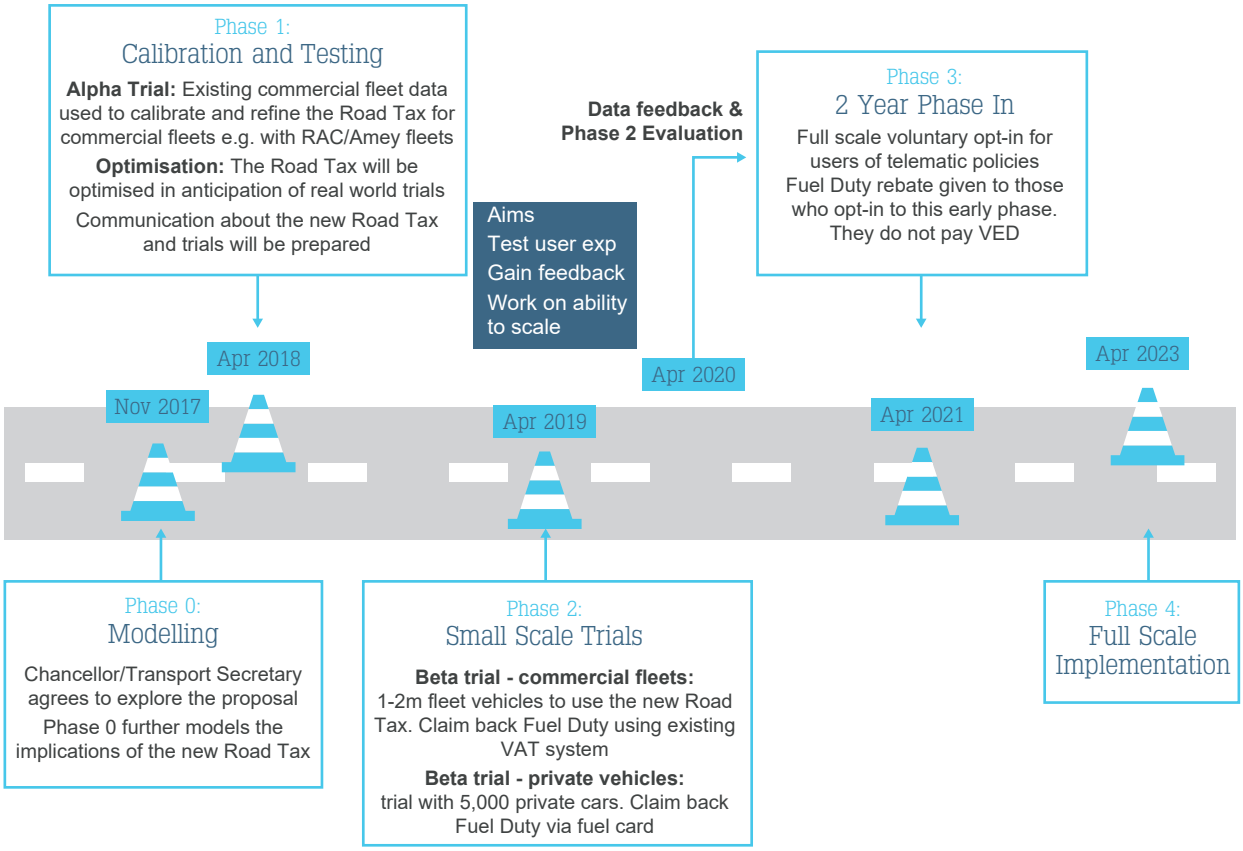
4.3 Implementation timeline

Figure 8 shows the indicative implementation timeline. Current political uncertainty makes it difficult to point to an exact time for full scale implementation but one of the advantages of this proposal is the speed at which it could be delivered.

- Phase 0 will delivery further revenue modelling and tax optimisation to create the initial factors for the environmental and vehicle categories.
- Phase 1 will include an on ground small scale testing with commercial players to test system capabilities and enhance user experience based on feedback from companies. This is done to prepare for the Phase 2 beta trials, where user experience will have to be already outstanding. This phase will finalise the environmental and vehicle category factors such that they can be communicated to the public before the start of beta trials. One of the key outputs of this phase is a website, where individuals can view how the changes will affect them depending on their mileage and vehicle type.
- Phase 2 will involve two parallel trials: commercial users will test the scaling of the system and make sure that it is functional with high vehicles volumes as well, while 5000 private users will be able to trial the new payment system through one insurance company that is willing to offer this service. They will receive a Fuel Duty rebate through a vehicle-specific fuel card. The feedback from both the scaling up and the private user experience will be analysed and vehicle mileages independently validated at the beginning and the end of the trial through a free MOT test.
- Phase 3 will progress if Phase 2 evaluation confirm the initial modelling and mileage validations. It will make the new Road Tax fully accessible to all those with telematics insurance policies (they receive the rebate the same way as the beta testers). After a two- year phase-in period the new Road Tax would come fully implemented: Fuel Duty and VED would officially be abolished[52]. Fuel prices at the pump would drop to approximately £0.50 per litre.

[52] A new name could be found for the "showroom tax", since it would no longer be part of VED.

Figure 8: Implementation timeline



By working with insurance companies, the trial phase costs will be minimised and therefore if necessary their length can be extended. This approach also gives time for all regulatory and legislative changes to be prepared without it delaying the overall implementation of the proposal.

4.4 Northern Ireland and Brexit

The greatest source of present political uncertainty is the shape of the Brexit deal that the UK will secure before leaving the European Union in April 2019. One consequence of the general election result might be a type of Brexit which would leave the UK as a member of the European Economic Area (EEA or "the single market"). Table 4 summarises the implications of the UK eventually remaining part of the single market or the EU in one shape or another.

Table 4: Brexit policy implications

Brexit Opportunities	Alternative solutions
UK Government can abolish Fuel Duty (EU Directive 2003/96/EC currently prevents this)	Instead of abolishing Fuel Duty altogether it would be set to the lowest possible level.
UK Government can charge all foreign (including EEA) drivers a vignette fee for road use.	Would require negotiating an agreement with the European Commission.
UK Government can give vehicle owners the right to use their e-call enabling devices for other connected and telematics services.	This policy option would depend on approval by the European Commission.

The scrapping of fuel duty in Northern Ireland would cause high levels of fuel tourism from across its southern border. While this would be beneficial for fuel VAT receipts for the UK, it would also cause excessive levels of congestion within Northern Ireland itself. Requiring vehicles registered in Ireland to pay a vignette-like fee at the border, like other foreign drivers would prove to be highly impractical due to the currently existing free border and the amount of border crossings. Therefore, this proposal recommends:

- consultation with the devolved government of Northern Ireland regarding the implementation of the new Road Tax,
- consultation with the government of Ireland regarding a joint implementation of the proposal in Ireland and Northern Ireland, or
- maintaining the existing status quo in Northern Ireland and implementing the proposal in Great Britain only.

5. Fairness: rebalancing the vehicle hierarchy

"The ultimate measure of fairness of a proposed change in taxation is how much I benefit from it."

This chapter will aim to guide political decision makers on how to explain effects of the new Road Tax to members of the public. This proposal will require 2 sets of further tax optimisation works by HM Treasury in order to produce the final environmental and vehicle category factors. One set of rates would apply to vehicles purchased prior to implementation of the new tax rates and the other set of rates would apply after implementation.

Those purchasing a vehicle prior to the new Road Tax implementation date will see their rates after implementation broadly reflect their existing costs in VED and Fuel Duty, meaning people would be largely unaffected by the changes. The tentative methodology of achieving this is outlined in 80. For those vehicle owners, the main change will refer to how taxes are paid, but not how much tax they have to pay. Communicating this clearly will be paramount to the successful implementation of the proposal, because currently the large sums of tax people pay the government are not visible, whereas after the new Road Tax they will be visible.

The second set of optimisation works will aim to rebalance the vehicle hierarchy by pricing the three externalities in a fair relationship between them. This will create the right financial incentives for both vehicle purchase and vehicle use. The following sections will discuss the impact of the changes on key market segments.

5.1 Ultra-Low Emission Vehicles (ULEVs)

ULEVs purchased after the implementation date will have to pay significantly more under the new Road Tax, because they currently do not pay fuel duty nor VED. This proposal argues that £0 contribution from ULEVs would not be sustainable in the long term and that it is crucial to charge ULEVs proportionately to their social costs, because they still contribute to congestion even if they have lower environmental costs. The urgency of this change might seem low at present, because at present only 0.26% of the UK car and van fleet is a ULEV[53], however now is the time when future expectations for prospective ULEV buyers should be set. Changing this in future years will become politically difficult.

[53] Source: VEH0101 and RACF: Plug in grant elegible vehicles by quarter

Additionally, ULEVs do have an environmental footprint, they require power to be generated and batteries to be disposed of at the end of their life-cycle. The majority of the UK's power still comes from hydrocarbon fuels. This means that ULEVs will still pollute the environment 60% of the time via a coal plant somewhere in the UK. Therefore, while this proposal sees clear merit in greater ULEV uptake to improve air quality and urban quality of life, they still need to be priced more appropriate according to their overall social costs.

Although a concern following this might be that ULEV uptake will slow down, this proposal does not believe that would happen because ULEVs would remain the cheapest vehicles to operate under the new Road Tax, even if they will have to pay more than a ULEV purchased before the implementation date. Under the current system diesels are the most economical vehicles to operate, proved by the fact that most commercial vehicles are diesels. By removing the unfair advantage diesels currently enjoy it is quite possible that commercial entities will start replacing their diesel fleets with ULEVs very rapidly.

5.2 Diesel vehicles

Diesel vehicles will be the other vehicle type that will be a "loser" under the new Road Tax regime when compared to previous systems. Diesels are enjoying an unfair tax advantage compared to petrol cars at present, because all taxation is CO2 and fuel economy based and no taxation is based on harmful emissions of NOX and particulates, which is where diesels have a worse performance compared to petrol cars

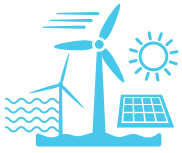
Diesels will still have a role under the new Road Tax, for example some parts of commercial vehicle fleets or those with very high extra-urban mileages. However, they will no longer be the default choice as petrol vehicles and ULEVs will have become more competitive. This will be a fairer system as diesels would still be extremely fuel efficient and therefore worth using for specific kinds of journey, but they will not be gaining the advantage twice.

5.3 Impact on business

Businesses will be affected by the new Road Tax due to the fact that most of the commercial vehicle fleet is diesel powered. In general, business fleets are replaced on a three year basis, As such by changing the "cheapest to run" vehicles from diesel to ULEVs businesses it should accelerate ULEV uptake. Such an investment would be highly beneficial both for their business finances and the environment.

UK Power Mix 2016

Nuclear
19%



Renewables
19.3%

Gas & Coal
60%

For businesses to innovate there needs to be appropriate financial incentives in place. By redefining the costs on society of using different vehicles and pointing to the transparent metrics applied to measure them, businesses will develop new solutions to pay less taxes and thereby reduce their costs on society. This "internalisation" of currently external business costs is one of the core ambitions of the tax. Businesses will most likely respond in the following ways:

1. reducing per-mile emissions by accelerating ULEV uptake,
2. reducing axle-loads by platooning lighter vehicles and smarter packaging, and
3. reducing overall mileage by using technology to replace physical presence.

There are existing drivers for innovation, but a Road Tax with the right principles behind its pricing would allow businesses to quantify more accurately the benefits they can gain by finding more efficient ways to work.

As a good example, online retail is a strongly growing business model and taking over large parts of the overall retail market. However, the "last mile delivery" model is making huge profits partly, because road use is "free" and the van fleet, made up almost entirely of diesels, is very cheap to run. In a fairer system, the previously negative externalities such as:

1. increased local road maintenance costs from the van's axle weight,
2. increased congestion due to miles driven, and
3. worsening air quality from diesel exhaust fumes

will become internalised by these business models. Those who can find the most innovative ways to reduce these externalities will continue to make profits but this time through reducing their societal impact as well. Initially, these costs might be passed on to the customers but the market will ultimately reward the most frugal and the most efficient players.

5.4 Other road users

Table 5 provides a summary of the exemptions and discounts that the proposal envisages. The list is non-exhaustive and other user groups can be added during the tax optimisation process.

Table 5: Exemptions and discounts

User Group	Discount	Justification
Disability adapted vehicles	50%	Currently receive VED exemption, those whose mobility depends on roads should be supported.
Emergency Service vehicles	*	The weight (vehicle category) of these is not considered, because they provide an essential service.
Bus operator buses	50%	Currently receive Bus Service Operator Grants, the new Road Tax would keep the discount in line with the current subsidy.[54]
Freight	*	Freight equipped with telematics could receive a discount for using Motorways, which are best equipped to bear heavy loads.

[54] DfT: Bus service operator grants, 2016

6. Government finances

The expected revenues from the proposed Road Tax are between £0.91bn and £5.99bn over the first 5 years after implementation. This is in addition to the approximately £4bn in revenue decline that it will prevent.[55] Implementation costs amount up to £140m, the greatest proportion of which is the initial invitation for insurers to collect the tax. Operating costs are in line or below those of Fuel Duty and the risk of potential tax evasion has been estimated to be 3% of total revenues, in line with the current number of vehicles that are uninsured.

In 2015/16, public spending on roads added up to £9.1bn, comprising of £3.9bn spent by central government and £5.2bn spent by local governments.[56] Central government has already committed to spending VED revenues on strategic roads starting from 2021/22.[57] This proposal would recommend hypothecating an additional £1bn to the Roads Fund in the new Road Tax introduction year and 20% of all Road Tax revenues in subsequent years. The initial investment would be recouped from the growth in vehicle miles within the first 5 years.

6.1 Tax Revenues

In 2015, fuel duty contributed £27.4bn and VED £5.9bn to the UK's budget.[58] Additionally, Fuel Duty also generated revenues through VAT on Fuel Duty, amounting to an additional £6bn.[59] Therefore, the total revenue that the new Road Tax will need to raise to be revenue neutral is £39.8bn.

The earlier the proposed Road Tax reform is implemented the better it is for future revenues. As the intervention will be revenue neutral in the year of implementation every year of delay reduces not only the current revenues, but also the future revenue growth which depend on the base year. To illustrate this, Table 6 shows potential revenues from the proposed Road Tax, based on the DfT's Road Traffic Forecasts for England (RTF). It uses 2015 as the basis of an implementation year and it calculates a growth in revenues entirely proportionally to the growth in traffic levels. The columns on the right indicate the difference in revenues that the new Road Tax would raise compared to the implementation year based on the lowest and highest levels of growth in traffic levels.

[55] When calculated at 2015/16 values 2010/11 revenue was £37.6bn, 2015/16 revenue was £33.54bn. Source: RACF: Road user taxation highway spending

[56] Source: TSGB 2016 and RACF Data on Local Government Spending and National Government Spending

[57] House of Commons: Vehicle Excise Duty, 2017, p. 14

[58] RACF: Fuel Duty VED revenue annual

[59] VAT is included in the revenue neutrality calculations but is not referred to elsewhere in the text because it is a separate income stream from Fuel Duty.

Table 6: Road tax revenues based on RTF 2015 scenarios and 2015 prices (£ bn)[60]

Year	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Worst Case "Profit"	Best Case "Profit"
2015 Revenues	£39.80	£39.80	£39.80	£39.80	£39.80	£-	£-
T+5 years	£43.12	£42.45	£41.84	£40.71	£45.79	£0.91	£5.99
T+10 years	£46.56	£45.31	£43.80	£43.30	£49.90	£3.50	£10.10
T+15 years	£48.87	£46.99	£44.58	£44.75	£52.92	£4.78	£13.12
T+20 years	£51.21	£48.67	£45.40	£46.60	£55.58	£5.60	£15.78
T+25 years	£53.37	£50.13	£46.19	£48.30	£58.14	£6.39	£18.34

Therefore, implementing the proposed Road Tax reforms would:

- prevent income loss from fuel duty, which was £4.06bn over the five years between 2010 and 2015[61], and
- generate additional revenues based on increasing traffic levels. This is estimated to be a total of between £0.91bn and £5.99bn over the first five years of implementation and between £3.5bn and £10.10bn over the first ten years of implementation (Table 6).

6.2 Investments

6.2.1 Implementation costs

One major insurance company estimated the costs of adjusting their systems to collect the new Road Tax to be in the region of £1.5-1.7m whenever a change is made to the Road Tax calculation formula. Since this is not envisaged to occur too often it will be accounted for as an implementation cost. Considering all insurance companies with a licence to sell insurance in the UK the likely setup costs would be between £50-100mn, which are significantly lower than any other road-pricing-like scheme before. Some additional set-up grants would be required to the Border Force and for the DVLA and MIB for them to prepare for the changes under the new system as well as some funding for the trials. In total implementation costs are expected to be £140m as per Table 7.

60 Source: DfT: RTF2015 for England

61 When calculated at 2015/16 values 2010/11 revenue was £37.6bn, 2015/16 revenue was £33.54bn. Source: RACF: Road user taxationspending data

Table 7: One-off scheme implementation costs

Road Tax feature	Capital cost
Insurance companies' adaptation of their systems	£100m
Implementation trials	£10m
DVLA and MIB (MID) grants for database synchronisation	£5m
ORR expansion	£5m
Border Force ANPR and enforcement system installation	£20m
Total	£140m

6.2.2 Operational costs

Fuel duty collection costs were £52mn[62] and VED collection costs were £136mn[63] in 2015. One of the major strengths of the new Road Tax is the very low operational costs delivered by using an existing payment collection and billing system. The biggest proportion of the bill is the tax evasion buffer, which was nil for Fuel Duty as it was collected directly from industrial producers. The initial figure for this is £1.194bn,[64] but this would need to be carefully monitored in the initial years. Table 8 summarises the ongoing operational costs and savings expected from the new Road Tax.

Table 8: Indicative summary of operational costs

Policy Intervention	Annual operational costs
Introducing new Road Tax	<£50m
Abolishing Fuel Duty	Saving £52m
Abolishing annual VED	Saving £136m
ORR operational grant	£5m
Scrapping IPT for telematics policies	£50m
Revenue buffer for tax evasion	£1.194bn
Total	£1.1bn

[62] Source: RACF: Acceptability of Road Pricing, 2011, p. IX

[63] DVLA Annual Report 2015-16, p. 24

[64] This estimate was arrived at based on 3% of the vehicle fleet being uninsured and the 2015 total revenues from VED, FD and VAT on FD amounted up to £39.8bn. 3%*£39.8bn=£1.194bn.

6.2.3 The Roads Fund and policy investments

In 2015/16 £3.9bn[65] were spent on roads by the central government on strategic roads in Great Britain such as via Highways England's Road Investment Strategy (RIS). In the same year local government spent £5.2bn[66] which were raised from sources such as local taxes (council tax and business rates) and central government maintenance block grants. Overall investment in roads for 2015/16 was £9.1bn or 22.8% of all direct contributions of motorists to the treasury.[67] Current VED hypothecation commitment is set to guarantee expected revenues of an additional £2.8bn for spending on the SRN from 2020/21[68], meaning a 16.8% hypothecation on 2015 prices. Overall spending on roads, including the non-hypothecated local government spending would be 29.9% of 2015 tax receipts, assuming that local-government funding remains the same as today.

This proposal believes that reaching 20% of hypothecation is desirable in the long term. It would guarantee a reinvestment in the infrastructure underpinning Britain's economy. A 20% hypothecation also guarantees that for every £1 invested in roads there are £4 available to spend on the other critical government services (NHS, pensions and schools) as described in Figure 7. Furthermore, the current majority of the current RIS schemes have high or very high returns on investment, meaning that investment in roads will yield great transport benefits and wider economic benefits too.[69]

To reach the 20% hypothecation commitment based on 2015 revenues means guaranteed £8bn to the Roads Fund, an additional £1.26bn further to existing commitments. But since the proposed Road Tax would not be implemented until 2020 and revenues from motoring taxes are likely to fall significantly between now and then, it is estimated that an additional £1bn commitment to the Roads Fund will be sufficient in the scheme implementation year. In future years, this proposal recommends maintaining the 20% committed Road Tax revenue reinvestment to the Roads Fund.

As explained in the following chapter, local authorities will no longer need to spend £5.2bn on roads, because they will have fewer and less busy roads to maintain. All things being equal they will have gained £2-3bn[70], which they can now use to improve their local road infrastructure and deliver on the promise of pothole free local roads. Local authority revenues will not be hypothecated, but the delivery of pothole repairs and maintenance would be monitored through the ORR, to guarantee that the money is first used to catch up on the maintenance backlog and only after to fund other local services.

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65 RACF: Road Spending National Government, 2017

66 RACF: Road Spending Local Government, 2017

67 Based on the £39.8bn figure, which includes VAT on Fuel Duty only (excludes VAT on the remaining portion of fuel).

68 Additional £2.8bn is based on estimated VED revenues in 2021/22 of £6.7bn, which would include the existing SRN funding of £3.9bn annually. Source: House of Parliament: VED Briefing, 2017, p. 15

69 Source: DfT, Road Investment Strategy: Economic analysis of the investment plan, 2015, pp. 9-10

70 This is the estimated current spending of local governments on the Major Road Network. The exact roads of the MRN have not been identified and hence the range.

In total central government would be required to spend an additional £1bn on the Roads Fund starting from the scheme implementation year. This would create a hypothecated Roads fund of nearly £8bn in the base year, which is expected to grow between £1-2bn within the first 5 years as 20% of the revenue growth from the Road Tax is allocated to it. Table 9 gives an indication of the prices of some of the schemes that this proposal would aim to deliver within 5 years from implementation.

Table 9: Indicative road investment schemes within (based on 2015 prices)

Policy Recommendations	Capital scheme (one-off)	Revenue scheme (annual)
Pothole free Britain Fund (local roads)	-	- (£2-3bn)[71]
Augmented roads policing funding	-	£100-300mn[72]
5G Connectivity on Motorways	£380mn[73]	-
Electric Vehicle charging network	£750m[74]	-
Roads Fund for filling Britain's infrastructure gaps (including RIS2)	-	£7-8bn
Total	£1.18bn	£7.1-8.3bn

Figure 9 shows how the revenues collected from road users are passed on to HM Treasury, after a small handling fee for insurance companies. 20% of revenues go directly in the extended Roads Fund, while the remaining 80% is used by the treasury for general purpose expenditure. This money is used for maintaining and enhancing both the Strategic Roads and most important Local Roads, which are the lifeline of the British economy. This leaves local authorities with only having to maintain roads with a clear local purpose like high streets or residential roads while having access to the same amount of funding as before from local taxes and central government grants. The Roads Fund would also provide operational funding to the ORR, which would set the Road Tax rate according to investments required and increase existing roads policing levels to pre-crisis levels.

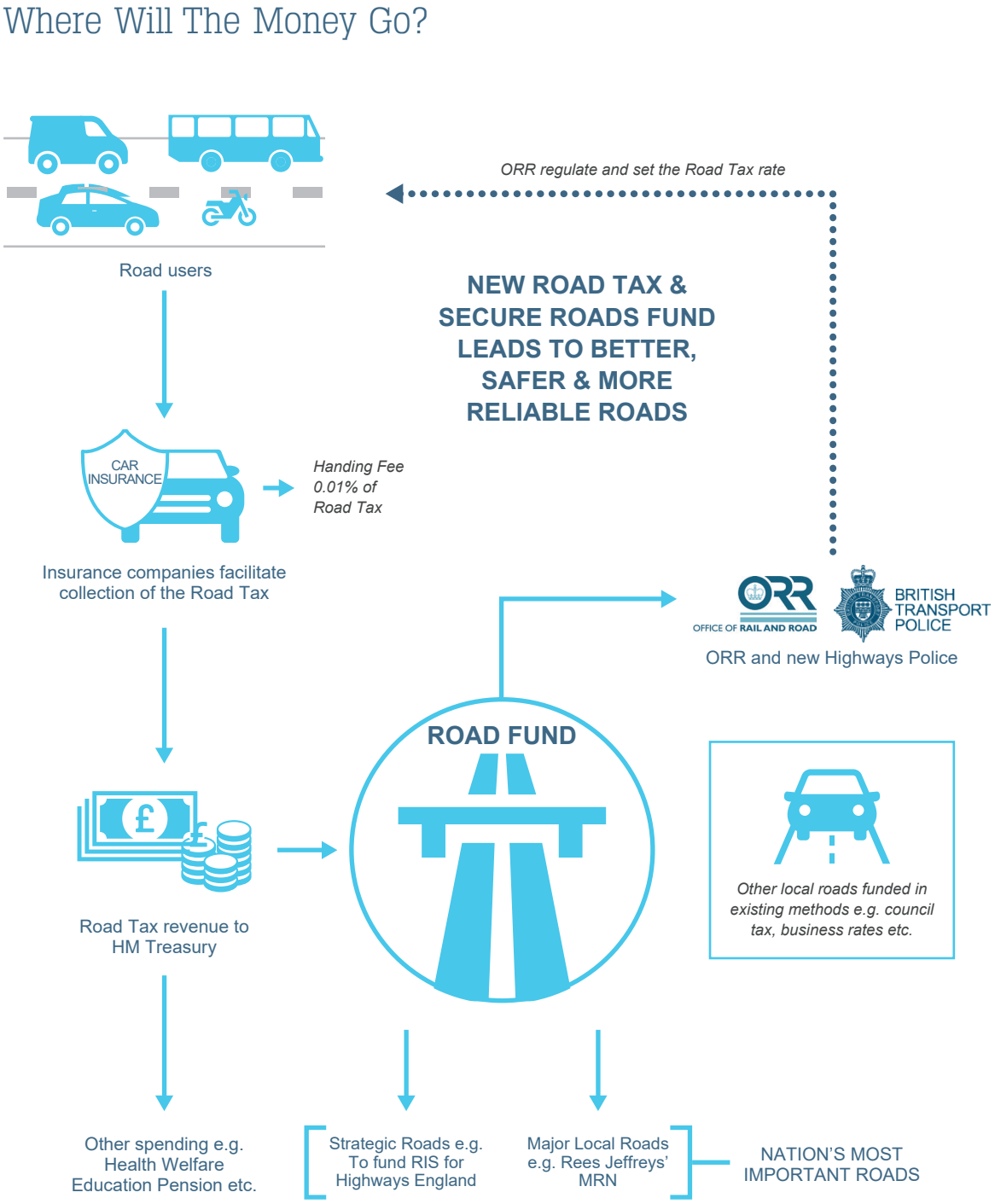
[71] This comes from local government accounts, which have £2bn additional revenues (they do not need to spend on MRN maintenance) and can instead use for pothole repairs on the remaining local roads.

[72] With the objective to increase to £300mn to match current British Transport Police budget. BTP: Policing Plan 2016-17

[73] Source: NIC: Connected Future p 14

[74] Element Energy, Pathways to High Penetration of Electric Vehicles, 2013

Figure 9: The flow of money



7. A vision for better roads

This chapter will first discuss the recommended governance and funding structure for the road network. The two main proposed changes to the existing system would be:

- to guarantee funding to the most important local authority roads (the Major Road Network) through the Roads Fund, such as to deliver a minimum Level of Service on these roads serving both local and national traffic[75].
- a performance specification for local roads, monitored annually by the ORR, to guarantee that local highways authorities deliver on clearance of the local highways maintenance backlog within 5 years from implementing the Road Tax.

Secondly, the proposal will introduce a safety driven vision for showing what the raised revenues could buy for Britain in the future (part discussed in 6.2.3). This section is mostly based on the proposals outlined by Michael Dnes in his 2017 Wolfson Prize entry "Roads to Tomorrow":

1. Clearing Britain's maintenance backlog and within 5 years of the reforms[76],
2. Increasing the funding for dedicated and specialist road policing,
3. Developing 100% mobile network coverage along Motorways by 2025[77],
4. Removing IPT on telematics insurance policies to accelerate their uptake[78],
5. Filling the infrastructure gaps of the Strategic and Major Road Networks within 10 years of policy implementation.

7.1 Road governance and funding

This proposal believes that extended Roads Fund revenues should be spent not only on strategic roads (the Strategic Road Network in England) but on a proportion of the most important local authority roads (the "Major Road Network") as well. The government structure would:

- take decisions on the shape of road maintenance and enhancement programmes,
- secure best value for money, and
- ensure the resulting programmes are informed by and support national, regional and local plans for development and economic growth.

Building on the experience of the first Road Investment Strategy, we also advocate the development of performance measures and metrics so that road users can see far more clearly the quality of service they should expect to get for their money. These performance metrics could be communicated to road users when they purchase or renew their insurance in a bid to improve communication between road users and the government as "service providers".

[75] Quarmby D. and Carey P.: A Major Road Network for England, 2016

[76] Source: RACF, Condition of England's Local Roads and how they are funded, 2015

[77] NIC, Connected Future, 2017: p14

[78] BIBA press release, 22 November, 2016

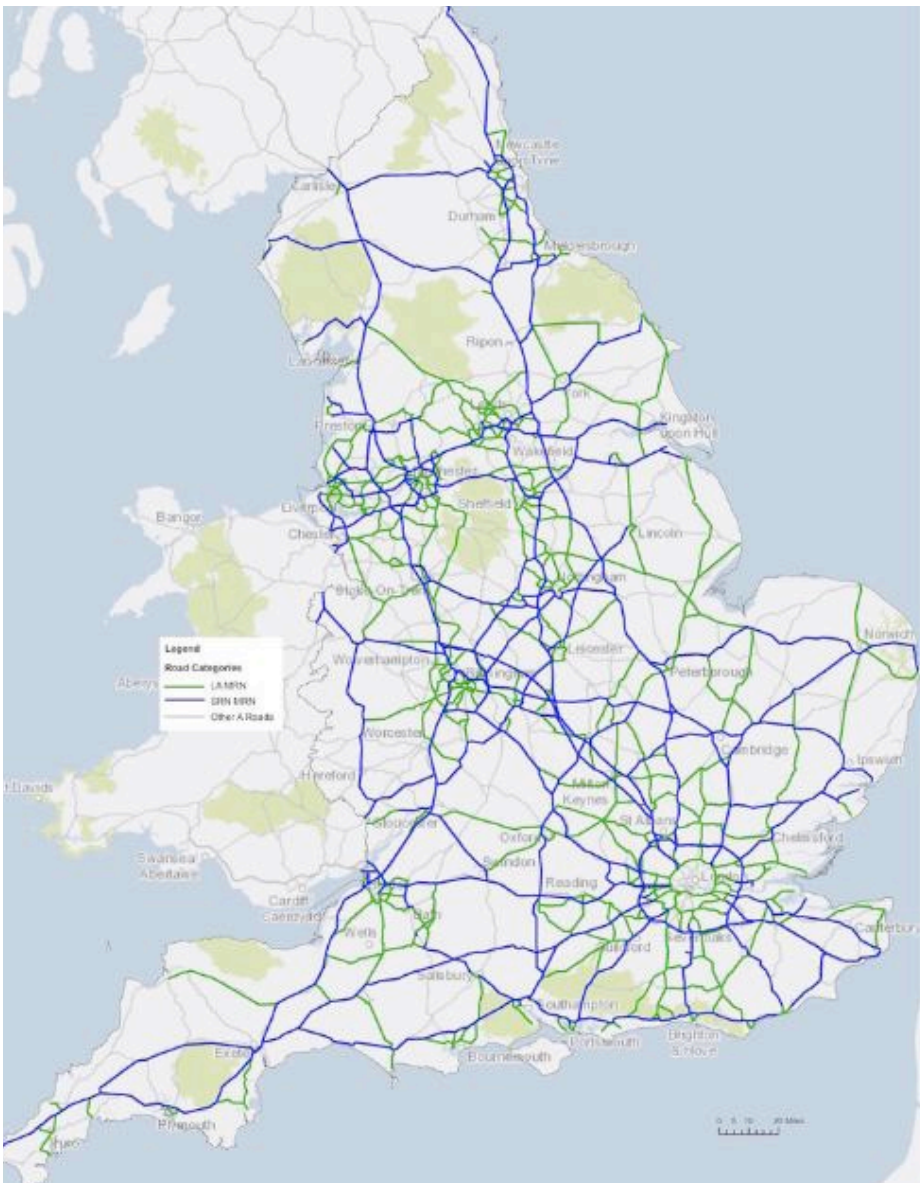
7.1.1 The Major Road Network

This proposal sees great merit in the 2016 Rees Jeffreys Roads Fund study[79] into major roads that identified an interim tier of roads between the Strategic Road Network (SRN), which is unquestionably serving a 'national' purpose, and local roads predominantly carrying local traffic. The study's authors, David Quarmby and Phil Carey, termed this the Major Road Network, based on the importance of roads for a significant proportion of regional and national traffic movements.

Their study did not categorically identify those roads, but proposed a way by which they might be identified and posited an illustrative map for England reproduced in Figure 10. The study calculated that the MRN would comprise some 8,000 miles of road (the existing SRN plus a further 3,800 miles of local authority-controlled 'A' roads), in some places filling in links missing from the SRN, in others providing alternative routes.

[79] Quarmby D. and Carey P.: A Major Road Network for England, 2016

Figure 10: Illustrative map of the major road network



The Rees Jeffrey's study makes a compelling case to recognise the importance of the MRN for supporting national and regional economic activity, with the implication that decisions about the prioritisation of improvements and the availability of funding for operation and maintenance should also have this in view.

The study did not, however, propose a change of ownership or the 'trunking' of the MRN, which would be the mechanism by which the roads could be added to the SRN and taken into national stewardship. Rather, the study advocated steps to be taken to improve the way decisions are informed, and supported development of performance metrics. Table 10 and Table 11 summarise the hierarchy, governance structure and funding mechanisms envisage by this proposal.

Table 10: Recommended distinction of roads based on funding purpose[80]

Motorways	Predominantly serving a national purpose; already clearly identified by blue signs	2300 miles, all but a fraction managed by Highways England, or by national authorities in Scotland and Wales	Funded through the Roads Fund (hypothecated revenues from the new Road Tax)
Expressways	Carrying a mix of traffic, but still serving an important role as a national and/or regional distributor	Comprising the 5300 miles of all-purpose trunk road managed by Highways England and the ca. 3800 miles of the major road network managed by local authorities.[81]	
Roads for access	Residential streets and rural access roads	Managed by local authorities on behalf of residents and local businesses.	Funded through council tax and business rates.
Roads for place	High Streets whose main function is as a retail centre		

Table 11: Recommended governance structure[83]

Motorways	Predominantly serving a national purpose; already clearly identified by blue signs	The Secretary of State would continue to set the output specification for the Roads Fund, which would be distributed by the ORR. The budget would be held by Highways England, but • sub-national transport bodies • Land Use planning authorities and • Local Enterprise Partnerships would be given a statutory role as consultees. Funding for the Expressways would also pass through Highways England, which would act as managing agent for the local highway authorities in commissioning maintenance and enhancement works[82].
Expressways	Carrying a mix of traffic, but still serving an important role as a national and/or regional distributor	
Roads for access	Residential streets and rural access roads	Decisions made by Local Highway Authorities, who now have significantly more (£2-3bn) funding available to spend on local roads. ORR to create a local roads minimum performance specification, which LHAs need to meet.
Roads for place	High Streets whose main function is as a retail centre	

This governance structure would be analogous in the devolved governments and in London. The implementation of changes would occur during the trial phases of the new Road Tax, such that by full implementation of the new Road Tax, the governance structure is already in place. In the implementation period, sub-national transport bodies would apply the Quarmby criteria to identify the Major Road Network, which would be subject to Secretary of State approval and Local Highways Authority (LHA) involvement.

[80] RACF: Wolfson Prize Entry: Paying for our roads, a better way. 2017 Source: DfT Road Lengths 2014

[81] DfT: Road Lengths 2015

[82] If practical and Local Highways Authorities and Highways England agree on the transfer, then roads can be trunked and transferred into Highways England ownership on a case by case basis.

[83] RACF: Wolfson Prize Entry: Paying for our roads, a better way. 2017

7.1.2 Funding allocation

Funding formula would be devised based on existing (2020/21) budgets. For Highways England that would take the last year of RIS 1 and the budget trend line over the RIS 1 period, for local roads the allocations would start with the road-length formula by which the highway maintenance block grant is allocated.

The proposal would be applied starting from the RIS2 period. During this time, major enhancement projects on local roads would still be eligible for funding from broader Government funding competitions (e.g. growth deals, city deals). The ORR would be given the responsibility of devising a more appropriate allocation mechanism for RIS3, and for commissioning the development of an appropriate suite of performance metrics, starting with the Expressways.

The performance metrics will be set to prioritise the purpose of the specific road or stretch of road.[84] So, a residential street would have, say, road surface quality and removal of trip hazards as key measures, but not through-flow speeds; a high street might have public transport and van access as priorities, alongside adequate provision of lateral pedestrian crossing facilities; whilst the SRN already has a matrix of national measures, including freight and intercity travel time reliability, but which could be developed into more regionally specific packages. For Local Highway Authorities who regularly fail to deliver on their commitments an alternative highways ownership structure could be considered, such as the "Highway Mutuals" idea proposed by Michael Dnes[85].

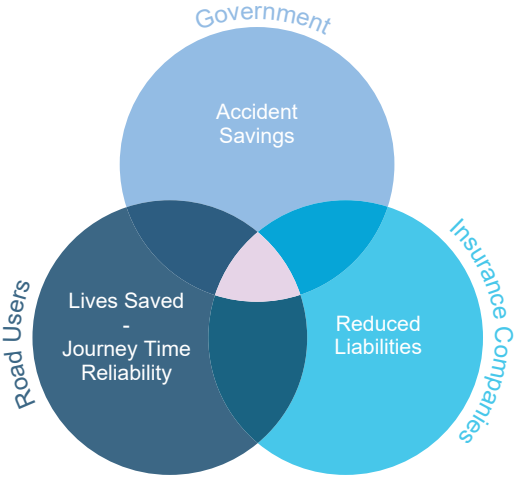
7.2 A safety driven vision

The common interest between Government, Road Users and Insurance companies is road safety (Figure 11). Driving automation will deliver significant road safety benefits in the medium term, but no-one knows yet what kind of adaptation and retrofitting of the road network will be required to make autonomous vehicles an everyday part of our lives.

[84] Recognising that some roads – such as the A14, A272, A27, whilst having a single number for navigation purposes may well serve different purposes along their route length.

[85] Michael Dnes: Roads to Tomorrow, Wolfson Prize submission, 2017, p. 40

Figure 11: Road safety is the shared interest of all stakeholders



More immediate action is required, because by improving road safety congestion and journey reliability problems will significantly improve too. In the short term, the proposed focus of the proposal's road strategy would be:

- to reduce the severe maintenance backlog on local roads in particular, as this is fundamental for safe roads,
- to deliver additional policies improving road safety, which will improve journey time reliability and reduce congestion, and
- to fill the infrastructure gaps of the UK, thereby delivering jobs and opportunities to every corner of the country.

7.2.1 Filling Britain's Potholes

Transport Focus' survey from 2015 (Figure 12) found that filling potholes and improving road surface quality is the single most important deliverable that the new Road Tax should meet[86]. There is a huge consensus on the matter, because potholes affect all road users including those on buses, and are safety critical for motorcyclists, cyclists and pedestrians.

By guaranteeing funding for the MRN local authorities will have an approximate annual surplus of £2-£3bn a year, allowing them to fill all potholes on local roads within 5 years of scheme implementation[87]. The ORR will be responsible for the monitoring of this target, with the prospect of revising road ownerships of local authorities failing to deliver.[88]

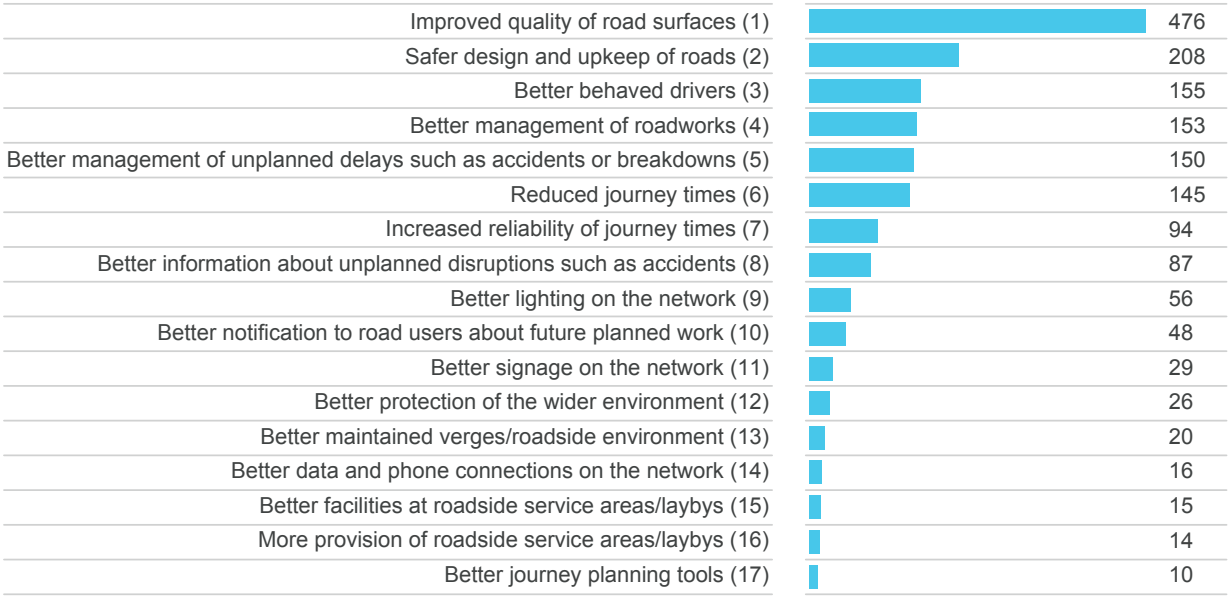
[86] Source: Transport Focus, Road User Priorities, 2015, p4

[87] Estimated cost of the backlog is between £8-12bn. RACF, The Condition of England's Local Roads and how they are Funded, David Bayliss, 2015, p. 11

[88] Michael Dnes suggests the possibility of creating Highways Mutuals as a new entity being in charge of road management. Roads to Tomorrow, 2017, p. 40

Figure 12: Road user survey amongst car and van drivers 2015[89]

Base: All England ca/van SRN users, 4578



7.2.2 Road policing

As road traffic increases, there will be a need for addressing both driver behaviour and improving accident management and road safety, concerns which ranked as the 3rd and 5th most important in the Transport Focus survey. Currently local police forces depend on local and central government funding. The central government funding is set to reduce by £330m by 2018. [90] This is following a previous 27% reduction of road policing officers between 2010 and 2014 (outside London).[91] This proposal sees great value in securing additional funding for road policing, particularly as preparations are made for a transitioning period of autonomous and human driven vehicles, which might temporarily lead to more collisions. Therefore, roads policing funding will be gradually increased against traffic levels with the ambition to secure up to £300m a year to match the levels of funding the British Transport Police receives.

[89] Transport Focus: Road User Priorities, 2015 p. 4

[90] Source: Fullfact: Police funding and Brake: Roads Policing in the UK

[91] Ibid.

7.2.3 Mobile and 5G coverage

Guaranteeing complete 5G coverage of the Motorways will be the first requirement for large scale uptake of connected vehicles. 5G allows the transfer of large amounts of data that connected vehicles will need to function safely. The National Infrastructure Commission highlighted the importance of delivering this by 2025 the latest92. However, an even more basic communication feature is mobile coverage across both the SRN and the MRN. A new connected safety feature named e-call will be installed as standard in all vehicles sold after April 2018, which is going to automatically alert 999 with accident location data in case of a collision93. For e-call to work successfully, this proposal recommends mobile coverage on the SRN and the MRN to be guaranteed within the first 3 years of implementation and 5G network on the motorways to be delivered within 5 years of implementation.

7.2.4 Telematics devices

In addition to preparing for the 100% penetration of connected vehicles, telematics policy uptake will be encouraged by removing insurance premium tax (IPT). Young drivers with telematics are more than 3 times less likely to be involved in a collision within the first 6 months of their policy, compared to those without telematics according to Marmalade94. Telematics insurance policies are becoming ever more popular: they grew from 12,000 in 2009 to 750,000 policies in 2016 according to BIBA.[95]

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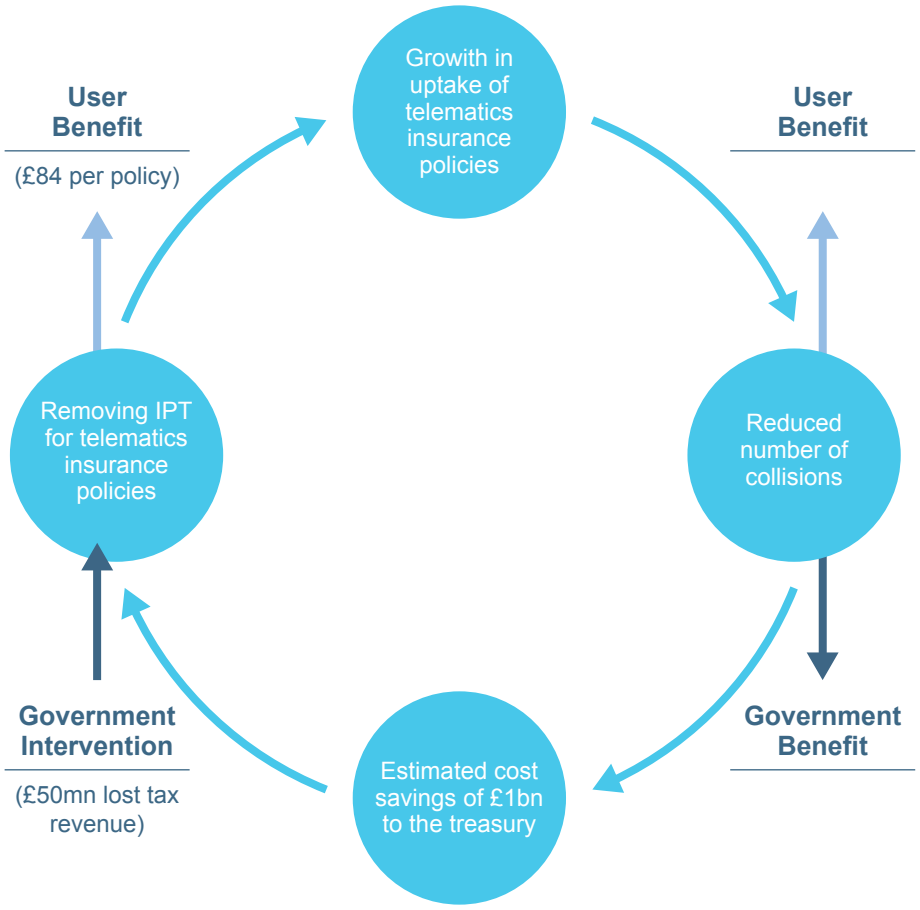
[92] NIC, Connected Future, 2017, p. 14

[93] EENA: Kremonas and Paris, e-call factsheet, 2015

[94] Source: BIBA: press release, January 2017

[95] Ibid.

Figure 13: estimated effects of removing IPT on telematics insurance policies[96]



This proposal recommends exempting telematics policies from Insurance Premium Tax, which would save telematics users an average of £84 a year, with even greater savings for younger drivers whose insurance premiums are more costly. Crucially, greater telematics penetration would lead to improved driving standards as insurance companies give feedback to drivers and drivers are rewarded for good driving via lower policy costs. Improved driving standards will reduce collisions. If all young drivers used telematics and this reduced their collision rates from 20% to 6%, then more than £1bn of the estimated £2.9bn of accident costs involving young drivers could be prevented[97].

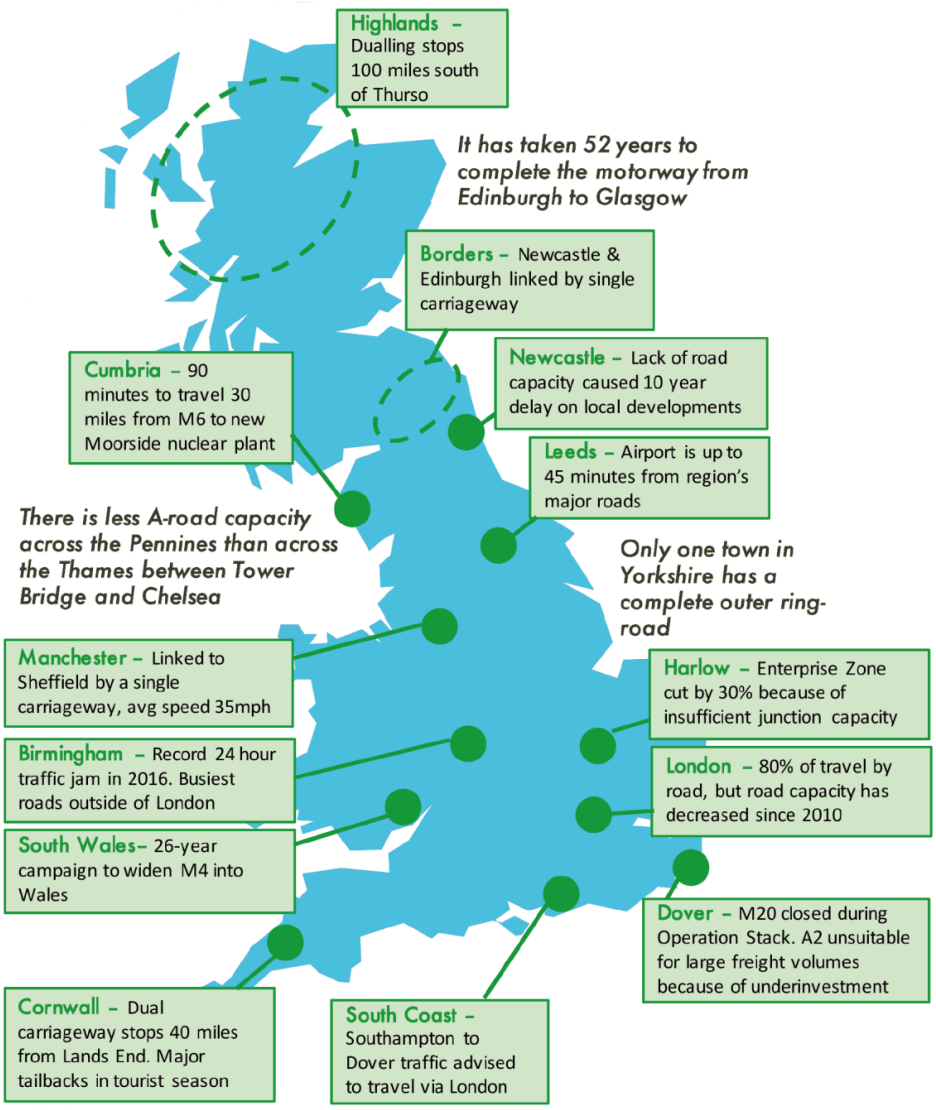
[96] User Benefit based on Q1 average costs of £781. Source: Confused.com and BIBA: press release, January 2017

[97] Source: DfT: Facts on Young Car Drivers, June 2015

7.2.5 Infrastructure gap

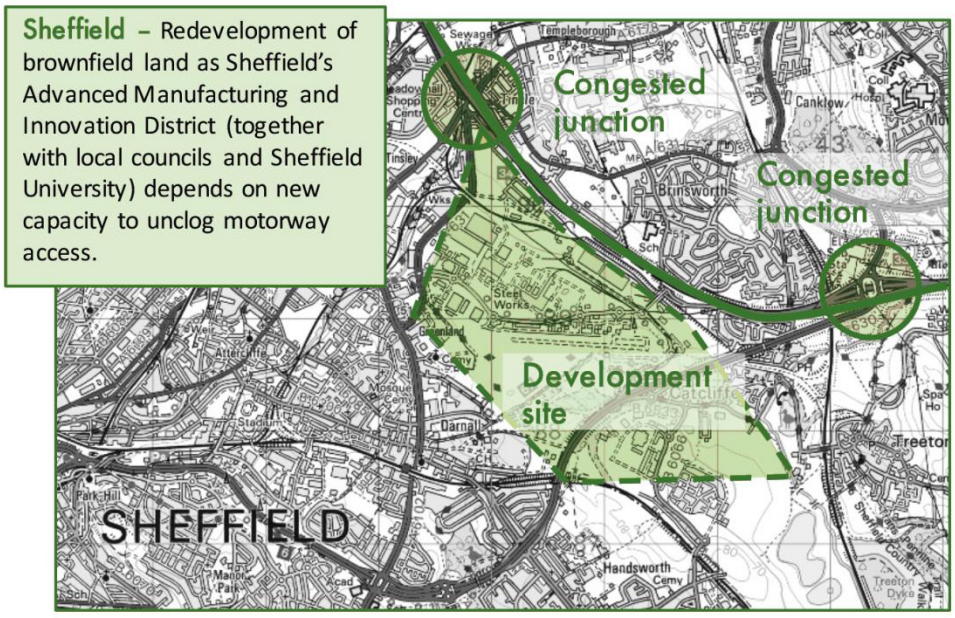
Michael Dnes has presented examples of infrastructure gaps in key locations of the UK, which are shown on Figure 14 and Figure 15. The lack of Bypasses and ring-roads, dual carriageways, and improved junctions are all negatively affecting road safety. These gaps are either on the SRN or MRN, both of which will enjoy a guaranteed future revenue stream from the Roads Fund if this proposal is implemented. The secure source of funding and the application of the existing RIS performance specifications means that these schemes are potentially deliverable within the RIS2 and RIS3 timelines.

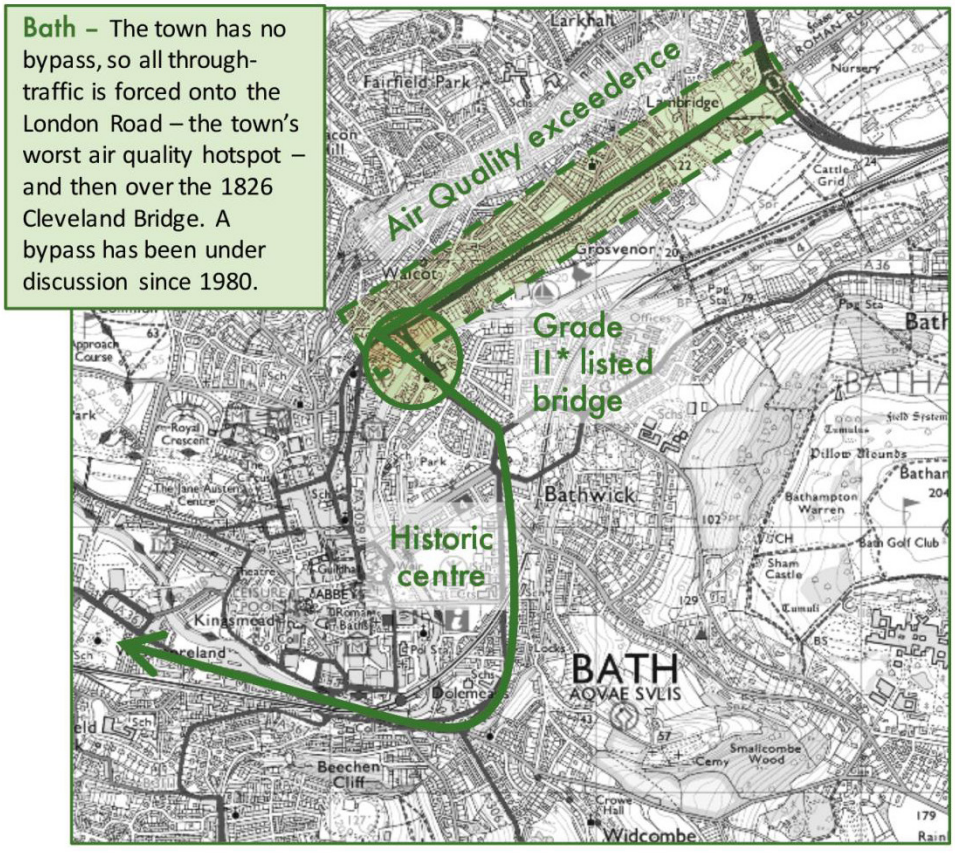
Figure 14: Examples of Britain's infrastructure gaps[98]



[98] Michael Dnes: Roads to Tomorrow, Wolfson Prize submission, 2017, p. 16

Figure 15: Case studies of infrastructure gaps[99]





[99] Michael Dnes: Roads to Tomorrow, Wolfson Prize submission, 2017, p. 17

8. Conclusion

The new Road Tax system would be fairer for road users; those who use roads more would contribute more than those who use the road less. The environment would benefit because the new Road Tax would discourage the purchase and use of vehicles that does less damage to the Earth (CO2) and our health (CO, NOx, PM). The new system would be positive for the economy for many reasons. By using an established payment system to collect the new Road Tax, unnecessary implementation and operating costs can be kept to a minimum resulting in a lean and efficient tax- take. Secondly, the New Tax system would generate additional revenue as road traffic levels increase (as they are expected to do so). Thirdly, it would create financial incentives for businesses to find innovative ways to use their vehicles more efficiently or reduce their axle-load leading to reduced road maintenance costs.

Securing funding for the MRN and removing the maintenance burden of the MRN from local authorities would reduce the maintenance backlog of the local highway network. The achievement of this objective by local authorities would be monitored by the ORR, against an agreed performance specification. These investments in the local highway network, both through the Roads Fund and through the less stretched budgets of local authorities, would yield large safety benefits through the improvement of infrastructure and a potential increase in police enforcement.

The removal of IPT from telematics policies (to make them 12% cheaper) would incentivise the uptake of telematics insurance policies. Young drivers with telematics are three times less likely to be involved in a collision than their counterparts as such there is a large potential safety benefits by encouraging young drivers to use telematics systems[100]. Furthermore, the funding surplus generated by the new Road Tax would allow Britain to pioneer the adaptation of today's infrastructure to accommodate Autonomous Vehicles which are also expected to bring vast safety benefits.

While we keep our eyes on the future we mustn't lose sight of the present either. A third of people said that they would not trust anyone with their in-vehicle data, that means we cannot expect them to give away any more data than they already do. Respecting and guaranteeing individual privacy means that a simple "no-tech" option needs to remain available until there is demand for it. Britain has a strong tradition of the individual's right to privacy and any scheme interfering with this will encounter fierce public resistance. When these attitudes eventually change then the new Road Tax system proposed in this paper will be easily adaptable for implementing wider ranging demand management measures too.

Britain's current circumstances require decisive action to deliver reform to roads transportation and prepare the country for the future. Politically what can make a difference is a proposal where there are no losers, only winners. This proposal passes the loser-free test and delivers a win-win solution because it finds efficiencies in using an existing – but underutilised system – that of insurance companies. In today's uncertain times, an idea that resolves the looming fiscal crisis, is inexpensive to implement and can be adapted future to technological change is the best way to reform Britain's road system – to make our roads "miles better".

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[100] Source: BIBA: press release, 2017

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Appendix A – The proposed Road Tax Calculation Formula

Road tax calculation:

$$T = \sum_{\tau} t_i$$

$$t_i = a\,[w_j(m_i)] + b\,[c_k(m_i) + n_l\, f_p(m_i)]$$

where, T is the revenue raised per annum

t_i is the tax per annum for vehicle i

a,b are vehicle mass and environmental weighting factors, respectively

wj is the weight category factor, where j = 1,..., 4

ck is the CO_2 factor, where k = 1,...,13

nl is the NO_x factor, where l = 1,..., 7

fp is the fuel type, where p = 1,..., 4

mi is the annual mileage of vehicle i

Vehicle mass factors *(wj)*

The vehicle mass factors are based on the categories used in issued driving licenses:

j = 1 Motorcycles (two wheels)

j = 2 Four wheeled vehicles less than 3,500kg

j = 3 Four wheeled vehicles more than 3,500kg and less than 7,500kg

j = 4 Four wheeled vehicles more than 7,500kg

CO_2 factors *(c_k)*

The CO_2 factors are based on the current VED categories:

k =1 CO_2 at tail pipe is zero

k = 2 CO_2 at tail pipe is between 1g/km and 50g/km

k = 3 CO_2 at tail pipe is between 51g/km and 75g/km

k = 4 CO_2 at tail pipe is between 76g/km and 90g/km

k = 5 CO_2 at tail pipe is between 91g/km and 100g/km

k = 6 CO_2 at tail pipe is between 101g/km and 110g/km

k = 7 CO_2 at tail pipe is between 111g/km and 130g/km

k = 8 CO_2 at tail pipe is between 131g/km and 150g/km

k = 9 CO_2 at tail pipe is between 151g/km and 170g/km

k =10 CO_2 at tail pipe is between 171g/km and 190g/km

k = 11 CO_2 at tail pipe is between 191g/km and 225g/km

k =12 CO_2 at tail pipe is between 226g/km and 255g/km

k = 13 CO_2 at tail pipe is over 225g/km

Harmful emissions (NO_X) factors *(nl)*

The harmful emissions factors are based on Euro standard classes:

l = 1 Pre Euro 3

l = 2 Euro 3

l = 3 Euro 4

l = 4 Euro 5

l = 5 Euro 6

l = 6 Euro 6d phase 1 (Conformity factor=2.1)

l = 7 Euro 6d phase 2 (Conformity factor=1.5)

Fuel type factors *(f p)*

There are four categories for fuel type:

p = 1 Zero emissions at tailpipe (Battery Electric/H2)

p = 2 Hybrid and other alternative fuel technologies

p = 3 Petrol

p = 4 Diesel

The table is Appendix B gives an example of the calculation of this Road Tax for a small selection of hypothetical vehicles, based on arbitrary values for each of the parameters defined above.

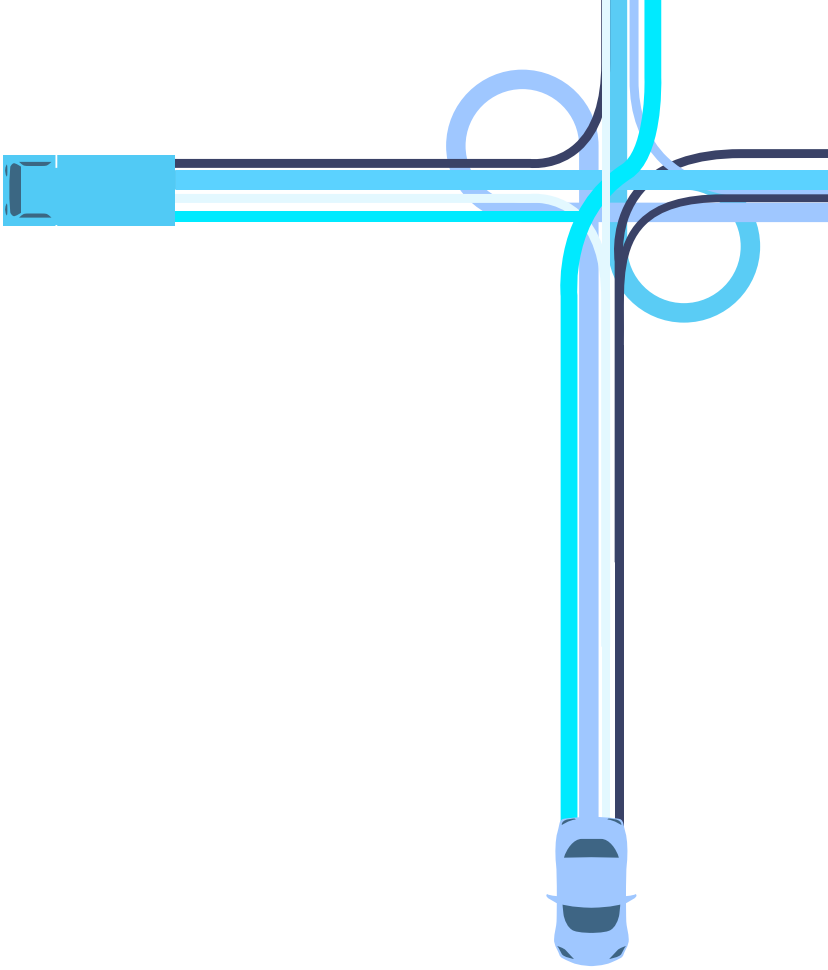
If the vehicles in this table where assumed to be all vehicles in the UK parc and the revenue currently earned from VED and Fuel Duty is to be maintained, $T_{proposed} - T_{current}$ should be equal to zero, while t_i is minimized for each i so that no person is adversely affected by a move from the current method of taxation to the proposed Road Tax.

Appendix B – Optimisation example

Yellow cells are the factors that will be adjusted during the optimisation process.

Weighting factors		Vehicle mass factors			CO_2 factors			NOx factors (Euro standards)			Fuel type factors		
a	0.4	w1	Motorcycle	0.05	c1	0	0	n1	preEU3	0.5	f1	ZeroEmission	0
b	0.6	w2	Less3500	0.1	c2	1 to 50	0.02	n2	EU3	0.4	f2	AltTech	0.1
		w3	3500to7500	0.5	c3	51 to 75	0.03	n3	EU4	0.3	f3	Petrol	0.5
		w4	More7500	1	c4	76 to 90	0.04	n4	EU5	0.2	f4	Diesel	0.8
					c5	91 to 100	0.05	n5	EU6	0.06			
					c6	101 to 110	0.06	n6	EU6d1	0.02			
					c7	111 to 130	0.07	n7	EU6d2	0.01			
					c8	131 to 150	0.08						
					c9	151 to 170	0.1						
					c10	171 to 190	0.25						
					c11	191 to 225	0.4						
					c12	226 to 255	0.6						
					c13	Over255	0.75						

Vehicle No.	Vehicle Info	Year of first registration	Annual mileage	Vehicle mass factor	CO2 factors	NOx factors	Fuel type factors		Current tax	Tax difference
i		*(2016)*	*m*	*w*	*c*	*n*	*f*	*t*		
1	Toyota Yaris	2016	1,000	0.1	0.07	0.06	0.5	£100.00	£112.54	-£12.54
2	Ford Fiesta	2016	1,000	0.1	0.08	0.06	0.5	£106.00	£67.97	£38.03
3	Ford Focus Zetec	2016	1,000	0.1	0.08	0.06	0.8	£116.80	£230.71	-£113.91
4	PASSAT SE BUSINESS TDI BMT	2016	1,000	0.1	0.06	0.06	0.8	£104.80	£92.83	£11.97
5	BMW 5 Series 520D M SPORT AUTO	2016	1,000	0.1	0.07	0.06	0.8	£110.80	£112.54	-£1.74
6	MERCEDES S CLASS S 350	2016	1,000	0.1	0.08	0.06	0.5	£106.00	£252.65	-£146.65
7	Audi TTS TFSI QUATTRO S-A	2016	1,000	0.1	0.08	0.06	0.5	£106.00	£231.42	-£125.42
8	C-MAX ZETEC TDCI	2016	1,000	0.1	0.06	0.06	0.8	£104.80	£92.83	£11.97
9	Toyota Yaris	2016	2,700	0.1	0.07	0.06	0.5	£270.00	£252.86	£17.14
10	Ford Fiesta	2016	2,700	0.1	0.08	0.06	0.5	£286.20	£183.53	£102.67
11	Ford Focus Zetec	2016	2,700	0.1	0.08	0.06	0.8	£315.36	£393.43	-£78.07
12	PASSAT SE BUSINESS TDI BMT	2016	2,700	0.1	0.06	0.06	0.8	£282.96	£216.65	£66.31
13	BMW 5 Series 520D M SPORT AUTO	2016	2,700	0.1	0.07	0.06	0.8	£299.16	£252.86	£46.30
14	MERCEDES S CLASS S 350	2016	2,700	0.1	0.08	0.06	0.5	£286.20	£427.16	-£140.96
15	Audi TTS TFSI QUATTRO S-A	2016	2,700	0.1	0.08	0.06	0.5	£286.20	£395.35	-£109.15
16	C-MAX ZETEC TDCI	2016	2,700	0.1	0.06	0.06	0.8	£282.96	£216.65	£66.31
17	Toyota Yaris	2016	7,500	0.1	0.07	0.06	0.5	£750.00	£649.05	£100.95
18	Ford Fiesta	2016	7,500	0.1	0.08	0.06	0.5	£795.00	£509.81	£285.19
19	Ford Focus Zetec	2016	7,500	0.1	0.08	0.06	0.8	£876.00	£852.85	£23.15
20	PASSAT SE BUSINESS TDI BMT	2016	7,500	0.1	0.06	0.06	0.8	£786.00	£566.24	£219.76
21	BMW 5 Series 520D M SPORT AUTO	2016	7,500	0.1	0.07	0.06	0.8	£831.00	£649.05	£181.95
22	MERCEDES S CLASS S 350	2016	7,500	0.1	0.08	0.06	0.5	£795.00	£919.89	-£124.89
23	Audi TTS TFSI QUATTRO S-A	2016	7,500	0.1	0.08	0.06	0.5	£795.00	£858.18	-£63.18
24	C-MAX ZETEC TDCI	2016	7,500	0.1	0.06	0.06	0.8	£786.00	£566.24	£219.76
25	Toyota Yaris	2016	10,000	0.1	0.07	0.06	0.5	£1,000.00	£1,680.79	-£680.79
26	Ford Fiesta	2016	10,000	0.1	0.08	0.06	0.5	£1,060.00	£1,359.49	-£299.49
27	Ford Focus Zetec	2016	10,000	0.1	0.08	0.06	0.8	£1,168.00	£2,049.28	-£881.28
28	PASSAT SE BUSINESS TDI BMT	2016	10,000	0.1	0.06	0.06	0.8	£1,048.00	£1,476.64	-£428.64
29	BMW 5 Series 520D M SPORT AUTO	2016	10,000	0.1	0.07	0.06	0.8	£1,108.00	£1,680.79	-£572.79
30	MERCEDES S CLASS S 350	2016	10,000	0.1	0.08	0.06	0.5	£1,060.00	£2,203.05	-£1,143.05
31	Audi TTS TFSI QUATTRO S-A	2016	10,000	0.1	0.08	0.06	0.5	£1,060.00	£2,063.49	-£1,003.49
32	C-MAX ZETEC TDCI	2016	10,000	0.1	0.06	0.06	0.8	£1,048.00	£1,476.64	-£428.64



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