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IMS Insurance & Mobility Solutions

The future of road pricing

Key considerations for the UK and lessons from the USA experience

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Executive summary

The road pricing landscape in the UK is disjointed and uncoordinated

Various types of road pricing mechanisms currently exist in the UK – duties like the fuel duty, vehicle excise duty, and heavy goods vehicle levy to recoup infrastructure costs, tolling and road user charging schemes like on the M6 or Dartford-Thurrock Crossing, congestion charging schemes such as in London and Durham, and Clean Air Zones or Ultra Low Emission Zones like in London and Bath. These are operated and managed by a wide variety of authorities – central government, local governments, highways authorities and private operators – and use a range of identification technologies and back-office systems which require customers to maintain multiple accounts for the different schemes.

Three key trends will drive an increase in road pricing schemes in the UK

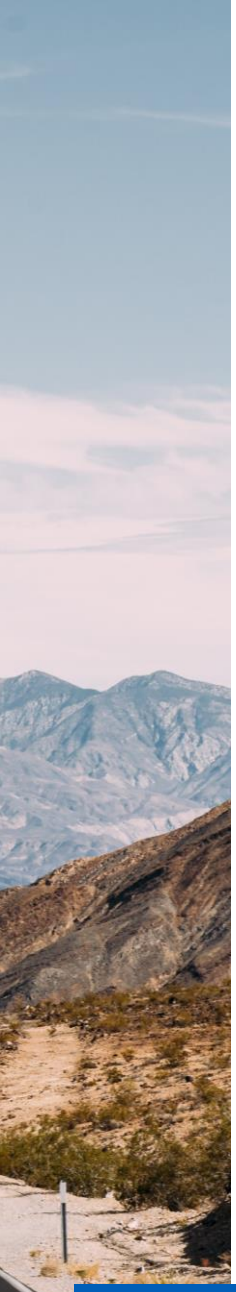
In the next ten years, we expect more road pricing schemes to be established across the country.

1. **As electric vehicles become prevalent and fuel duty declines, road pricing schemes will emerge as a replacement for the fuel duty.**

2. **Carefully planned road management schemes will be needed to tackle increasing traffic volumes, congestion, and short-term air quality issues.**

3. **Customers will begin to demand a more integrated and interoperable road pricing system in which they do not have to maintain different accounts and technologies for different schemes.**

The UK would therefore benefit from a coherent Government vision and policy roadmap for road pricing, which would address fiscal and other challenges in a coordinated manner as well as result in a more integrated and interoperable system.



The UK can benefit from the US road pricing experience when developing its road pricing vision and policy

There are opportunities for the UK to draw from lessons of other road pricing schemes across the world. This paper focuses on the experiences of schemes and pilots in the US.

Road pricing reform in the US has been driven by concerns about declining fuel duty revenues: The policy motivation for road pricing reform in the US has to find an alternative for fuel duty revenues caused by a shift to zero or low emission vehicles and more efficient internal combustion engines in traditional vehicles.

Road pricing schemes have converged on mileage systems: State governments enable distance-based charging in different ways, for example odometer inspection in Hawaii or in-vehicle technology in Utah, Oregon and California. A phased approach where users can 'opt in' to schemes like in Utah and Oregon, has enabled uptake.

Interoperability has been a focus across schemes: The US' prioritisation of interoperability in traditional tolling, has set the stage for standardisation and interoperability of newer schemes, for instance in Oregon, California and Utah.

Consultation has been integral to deployment: Government agencies have pooled resources and collaborated with industry to share learnings and improve efficiency (e.g. RUC West, Eastern Transport Consultation.) Washington State formed a multi-stakeholder steering committee to co-create policy and its pilot scheme.

Data protection and privacy have been tackled through clear policy and the provision of choice: Clear data retention and isolation provisions have been enacted in state legislation. Road users are given a choice of what information to disclose, which makes them more comfortable with the privacy measures in place.

Considerations for the UK

1. **The UK needs a well-communicated, phased and iterative approach to road pricing, with a national policy vision and roadmap, trials and demonstrations to obtain public approval, and a clear articulation of how road pricing policies align with zero-emission vehicle policy.**
2. **A combination of time-of-day, cordon and distance-based pricing schemes will likely be needed to supplement traditional tolling schemes and replace the fuel duty revenues, as well as address the objectives of congestion and air quality management.**
3. **A distance-based road pricing scheme or the upscaling of cordon/time-of-day pricing will require investments in technology and roadside infrastructure, and a more detailed assessment of relative costs and benefits.**
4. **Schemes will have to mitigate equity and privacy concerns – for example through exemptions, discounts, and re-investment of revenues into sustainable public transport – as well as focus on collaboration and consultation.**
5. **As customers and operators demand greater integration and interoperability, the Government will have to consider whether to move to a more regulated regime, for example involving regulations for technologies/back-offices, or a more centralised regime, for example with a common back-office.**

Introduction

Roads play an indispensable role in connecting people to what they need – other people, economic and educational opportunities, social and healthcare services, and everyday goods. A country's surface transportation network is a critical national asset, directly stimulating economic growth and affecting economic productivity.

Over time, the demand for roads has ballooned. Across the world, vehicle miles travelled (VMT) has been steadily increasing. In the UK, between 2018 and 2019, car and van traffic grew by 2.2 % and 2 % respectively, reaching the highest annual estimates ever[1]. In the US, despite a flattening of VMT in the years following the 2008 recession, VMT rose steadily between 2016-2019. Although the COVID-19 pandemic has led to a decline in road demand in the short-term, demand is expected to bounce back in the long term. Whilst on the one hand, restricted travel and flexible working policies in the short term could lead to a reduction in demand, this effect would have to be weighed against an increased reluctance to use public transport, leading to greater pressure on the road network.

Increasing VMT in the years preceding COVID-19 has required increased expenditure from governments to build more capacity and improve the capacity of the existing network. Highways England, for instance, boosted its spending from £15 billion in 2015-2020[2] to £27 billion in 2020-2025[3]. Traditionally, road expenditure has been financed through a range of tolls, duties, and levies. In most economies, the fuel duty on vehicles, in particular, has been a significant source of revenue for governments. However, as more and more vehicles are electrified, the fuel duty will disappear giving rise to a burning platform to establish alternate methods of raising revenue.

The increase in road demand has also led to unprecedented levels of congestion. According to the 2019 INRIX Global Traffic Scorecard[4], UK road users lost 115 hours and £894 a year to congestion on average, resulting in a £6.9 billion damage to the economy. American road users lost nearly 100 hours and $1,400 per capita a year.

Increasing VMT and congestion also has a severe public health cost. Transportation accounts for 28 % of greenhouse gas emissions in the UK, of which 91 % is emitted by road vehicles[5]. This leads to a deterioration of air quality due to exhaust fumes from idling vehicles, which in turn has increased morbidity and mortality effects for drivers, commuters and people living near major roads.

In this context, road pricing has emerged as an economic tool to serve three key policy objectives:

Recouping the cost of infrastructure spending

Increasing VMT leads to wear and tear of roads at a higher frequency. Charging road users for the roads (for example, through tolls) or vehicles (for example, through fuel duty or vehicle excise duty) directly contributes to the construction, capital enhancement, and maintenance of these roads. As electric vehicles replace conventional vehicles with internal combustion engines (ICE) on roads and the fuel duty declines, governments will have to find a way to replace these revenues to recoup the cost of infrastructure spending.

Managing congestion

Infrastructure charges by themselves do not cover the cost of negative externalities like congestion. Charges are placed on motorists to influence travel choices and patterns in crowded city and town centres.

Improving environmental quality

Similar to charging for congestion, road user charges, levies or penalties can be placed on motorists to recompense for the negative impact of their vehicles on air quality or noise levels.

In this paper, we focus our lens on the road pricing context in the UK.

- First, we examine the current system of disparate road pricing schemes across the UK.
- Then, we describe the three factors – declining fuel duty, growing congestion, and customers' demand for integration and interoperability – that are likely to lead to an increase in the number of road pricing schemes, thus strengthening the case for a more coherent road pricing policy and system.
- Finally, to inform the development of the UK's road pricing vision and the future deployment of new road pricing schemes, we distill a few 'critical success factors' from US-based road pricing pilots and schemes – a phased and iterative approach, public consultations and collaborations, and opt-in pricing and information-sharing models focused on maximising consumer choice.

Sources:
(1) https://roadtraffic.dft.gov.uk/summary
(2) https://www.gov.uk/government/collections/road-investment-strategy
(3) https://www.gov.uk/government/news/27billion-roads-investment-to-support-64000-jobs
(4) https://inrix.com/scorecard/
(5) Final UK greenhouse gas emissions national statistics: 1990 to 2018 - GOV.UK (www.gov.uk)

01 State of the nation

Road pricing in the UK

Various types of road pricing mechanisms exist in the UK to respond to the three main policy objectives outlined in the Introduction. Currently, there is **no coordinated approach to the development and management of these mechanisms** and the Government is yet to outline a policy vision for road pricing.

Recouping infrastructure costs

- Fuel Duty – on purchases of petrol, diesel, and other fuels
- Vehicle Excise Duty – on every vehicle using public roads and linked to the carbon dioxide emissions of the vehicle
- Heavy Goods Vehicle levy – additional charge on HGVs
- Individual charging schemes such as the M6 or Dartford Crossing

Congestion charging schemes

- Transport for London's congestion charge
- Durham's city centre congestion charge

Air quality schemes

- Clean Air Zones (CAZ) / Ultra Low Emission Zones (ULEZ) – London and Bath

These schemes are operated and managed by a wide variety of authorities – for example, the Fuel Duty and Vehicle Excise Duty are levied and collected by the central government, Highways England manages the Dart Charge on the Dartford Crossing on behalf of the government, private operators manage the M6 toll toad, and local authorities are responsible for individual air quality and congestion schemes.

The map below shows the locations of most **existing and future major road pricing schemes in the UK**, as in May 2021:

1. Low Emission Zones in Scotland

LEZs to improve air quality are to be introduced across Glasgow, Edinburgh, Dundee and Aberdeen in 2022.

2. Durham City Congestion Charge

In 2002, Durham implemented a £2 daily congestion charge stretching from the Cathedral and Castle to the Market Place. Road users settle their charges/fines through telephone.

3. Lower Thames Crossing

This new crossing between Kent, Thurrock and Essex will involve the construction of a new tunnel under the River Thames and is slated to open in 2027/28.

4. Clean Air Zone Leeds

Leeds originally planned to launch its CAZ in 2020 but is reassessing its air quality issues.

5. Clean Air Zone Manchester

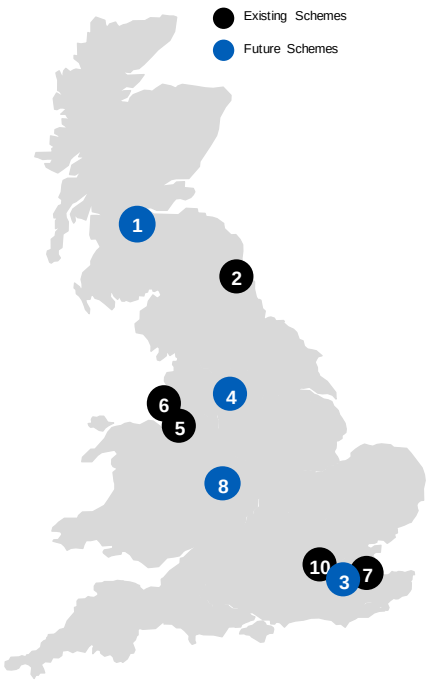
The plan was announced by the Mayor in early 2019 and the launch is being planned for Spring 2022.

6. Mersey Gateway

The bridge was opened for traffic October 2017 and adopted the free-flow charging system on its first day. Only online payment was available at the time of opening. In 2019, a mobile app was released to the road users monitor their usage settle their charges.

HGV Road User Levy

A levy which applies to all UK- and non-UK registered HGVs driving in the country.



7. Humber Bridge

In 2015, HumberTAG was introduced to allow road users to pay for the toll fare without having to stop. Road users still have the option to pay at lanes with booths with either cash or contactless payments.

8. Clean Air Zone Birmingham

Birmingham plans to launch its CAZ in June 2021.

9. Dartford Crossing Charge

Dartford Crossing removed its booths in 2014. Road users are able to pay for/challenge charges or fines through an online account.

Discounts are available for annual/bulk purchases. Local residents are entitled to special rates.

10. Silvertown and Blackwall Tunnel

The construction of Silvertown Tunnel began in 2020. The tunnel is expected to open in 2025/26 and will implement a free-flow charging at Silvertown & Blackwall Tunnel upon the opening of the former.

10. Transport for London (TfL) Congestion Charge

Congestion charge was implemented in 2003. Today, TfL charges vehicles £11.50 per day for entering the charging zones. Online payment is available via Auto Pay or TfL Pay app.

10. TfL Ultra-Low Emission Zone (ULEZ) charge

ULEZ charge was implemented in 2019. A daily charge of £12.50 is payable if road user's vehicle does not meet ULEZ emission standard. Online payment is available via Auto Pay TfL Pay app.

Partly due to the lack of an overall vision and accountabilities being spread across different authorities, **the UK's schemes are not yet interoperable or integrated**. In other words, customers have to maintain a range of accounts with different operators to pay for the schemes. The schemes also use a wide range of identification technologies for roadside infrastructure, including:

ANPR (Automatic Number Plate Recognition) cameras

ANPR cameras are the most common vehicle identification technology used to implement road-pricing in the UK. Vehicles passing through the charging zone are automatically recorded by their plate numbers and mapped against the vehicle registration database to identify their respective owners.

RFID beacons

RFID tags are used by some operators to provide more regular frequenters with cheaper fares. Operators benefit from the user data which can be used to improve their services, conduct demand analysis, and revise fares in the future. Drivers with tags also benefit from access to express lanes, whereas others need to queue for the gated booths. Alternatively, drivers can still opt to pay on a one-off basis.

DSRC (Dedicated Short Range Communications) – OBU (Onboard Unit)

A DSRC with a complementing OBU has not yet been adopted in any part of the UK but is the EU standard when it comes to road pricing technology. Many heavy goods vehicles (HGVs) arriving from mainland Europe through the channel will be equipped with an OBU, which raises a question for how the UK will handle cross-border interoperability.

02

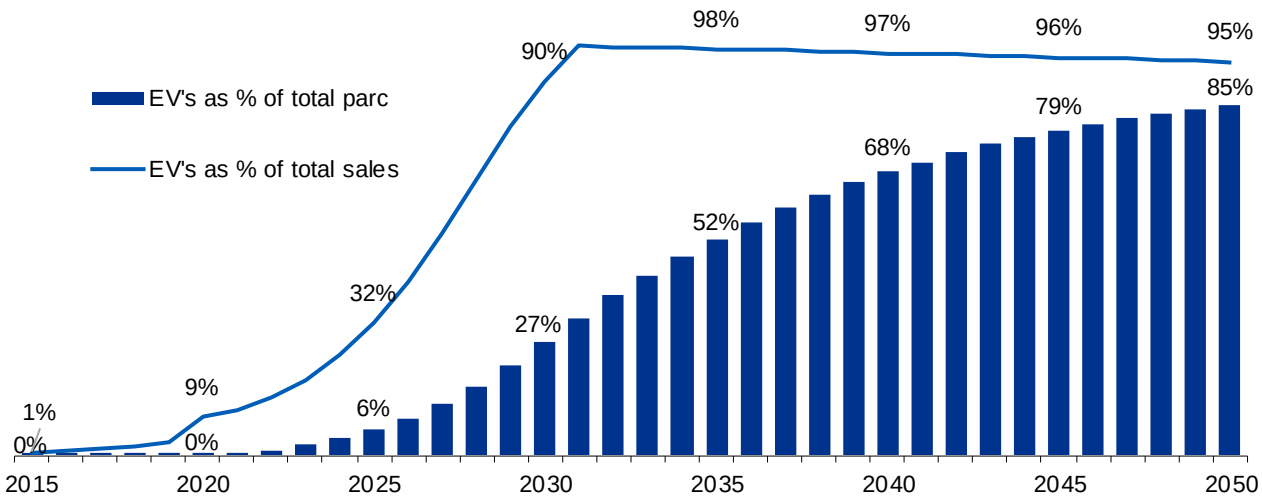
The evolving landscape

The future of road pricing in the UK

The road pricing landscape is constantly evolving as policy, technology, customer, and mobility trends intersect. In the next ten years, we expect more and more road pricing schemes to be established across the country, driven by three needs – replacing the fuel duty, managing congestion, and responding to customers' demands for integration and interoperability.

1. As electric vehicles become prevalent and fuel duty declines, road pricing schemes could emerge as a replacement for the fuel duty

In May 2019, the UK Parliament declared a climate emergency. Since then, the Government has articulated its ambition to reach net zero emissions by 2050. Over 230 councils have followed suit and declared their own climate emergencies, with many aiming for more ambitious targets of 2030 to be carbon neutral. Road transport is widely recognised to be one of the largest contributors of GHG emissions in the UK, making up around a fifth of all emissions in 2017[6]. As a result, the Government has introduced a ban on vehicles with internal combustion engines (ICE), making it illegal to sell new vehicles that run exclusively on fossil fuels after 2030. KPMG's Mobility 2030 team expects the already-growing sale of zero emission cars and vans (Light Commercial Vehicles) to reach 98% of sales in 2031 and 27% of the parc (or number of vehicles on the road) by 2030. This will be driven by four connected factors –the Government's ban on petrol and diesel cars from 2030, a shift in manufacturing by Original Equipment Manufacturers (OEMs), growing environmental consciousness among the general population, and Total Cost of Ownership (TCO) benefits for fleet operators and private individuals alike, **The rise of EVs coupled with better fuel efficiency in newer ICE engines will lead to a significant drop in the revenues from fuel duty and vehicle excise duty.**

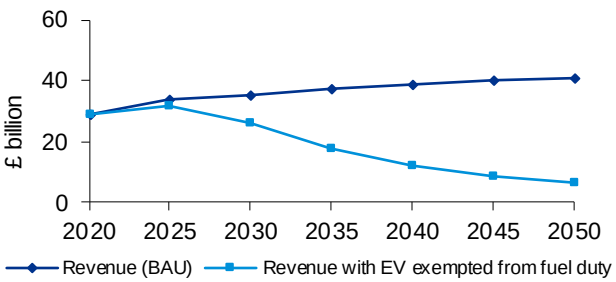


Graph 2.1: EV's as a % of total sales and parc in the UK

At £28.4 billion in 2019-2020 (excluding VAT), tax revenues from the fuel duty account for a significant two % of GDP. In addition, Vehicle Excise Duty (VED) receipts was estimated to account for £6.5 billion in 2019-2020[7]. According to the Institute for Fiscal Studies, switching from conventional ICE (internal combustion engine) vehicles to electric vehicles (EVs) will cause tax revenue to drop by £28.4 billion[8], a significant amount considering the Road Investment Strategy 2 (RIS2) for 2020-2025 allocated a similar amount of £27.4 billion to Highways England for the development of the Strategic Road Network. The contribution of fuel duty to GDP is expected to decline significantly, to below 1.5% in 2023-24 (pre-COVID19). Similarly, according to the RAC Foundation, the share of Vehicle Excise Duty to GDP will fall from 0.3% to 0.1%[9].

Sources: (6) https://www.ons.gov.uk/economy/environmentalaccounts/articles/roadtransportandairemissions/2019-09-16
(7) https://obr.uk/forecasts-in-depth/tax-by-tax-spend-by-spend/vehicle-excise-duty/
(8) https://www.ifs.org.uk/publications/14409
(9) https://www.racfoundation.org/motoring-faqs/economics#a18

Graph 2.2: Fuel duty projections up to 2050



Source:Office of National Statistics

From a public exchequer perspective, this is problematic because, fuel excise receipts are a critical source of funding for road improvements and maintenance. The government will, therefore, require new sources of funding to substitute these revenues.

Various options exist to substitute lost fuel duties. These include, but are not limited to:

Taxing the charging of electric vehicles

Conceptually, taxes could be levied on charging of electric vehicles at both public charge points and at-home charging (the latter assuming that energy companies are able to identify load/draw through smart metering). However, this would not only contradict the Government's decision to promote the uptake of electric vehicles, but also be regressive by penalising drivers of 'cheaper' vehicles with less effective battery management software/tools and worse-performing batteries and be technically complex to implement.

Imposing a Vehicle Excise Duty (VED) on pure electric vehicles and increasing it for hybrid vehicles

Since electric vehicles are currently exempt from VED, such an approach is very likely, in the short term, to significantly disincentivise transition to zero emission vehicles, and is therefore not recommended.

Increasing VAT and/or Income Tax

The Treasury could look to recoup lost funding through other tax mechanisms (e.g. VAT and/or Income Tax). However, this would contradict the 'user pays principle' by re-distributing the tax for the funding of roads away from road users to the general population who may not have access to vehicles and/or derive additional benefit.

Road pricing

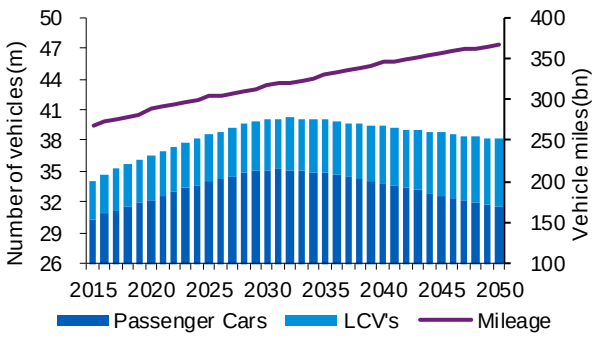
The Government could support the expansion of the current set of tolls, congestion and air quality charges and/or consider implementing distance-based pay-per-mile road user charging schemes to together form a coherent 'road pricing policy' in which users are charged according to the 'user pays principle' – for the use of the vehicle rather than vehicle ownership.

This would not only provide the Government with revenues for infrastructure spending, but also address other objectives such as optimising the capacity of the finite road asset, managing congestion, or improving air quality.

In some ways, such a regime would be less regressive in the short term – when electric vehicles are more expensive than conventional ICE vehicles – than the fuel duty, which penalizes those who cannot afford electric vehicles. However, it would have to effectively address equity considerations by ensuring that those from lower income groups who live in 'transport-poor' areas or outside popular areas and city centres are not disadvantaged, by for instance, reinvesting the revenue into sustainable public transport alternatives. We raise some of these questions in more detail in Section 4 on 'What next for the UK?' But to successfully deploy a distance-based scheme, these open questions would need further study.

2. Carefully planned road management schemes will be needed to tackle increasing traffic volumes, congestion, and short-term air quality issues

Vehicle miles travelled or VMT is expected to increase in the UK over the next three decades. According to KPMG's Mobility 2030 forecasts, while vehicle numbers are expected to peak in the early 2030s, the total vehicle miles travelled is expected to increase all the way to 2050, driven by an increase in the use of shared and autonomous mobility forms. This is because the effect of shared mobility on individual mileage is likely to be outweighed by a greater demand from a larger number of people.



Graph 2.3: Total Number of Vehicles and Billion Vehicle Miles of Passenger Vehicles and Light Commercial Vehicles in England and Wales

This challenge also exists for freight traffic. In 2018, 79 % of domestic freight in the UK was moved by road with tonne kilometres moved having increased by 3 % since 2017[10]. Road freight has twice the carbon impact of other road transport and increases costs at £1 per minute in traffic[11]. Solutions for the decarbonisation of heavy goods vehicles (HGVs) are nascent – electric batteries are not yet powerful enough to cover long distances and heavy loads, and hydrogen fuel cell and electric road technologies are yet to be tested at a useful scale.

In this context, alongside policies to promote electrification of passenger vehicles and identify solutions for HGV decarbonisation, road pricing has the potential to be an effective demand management tool and support the Government's decarbonisation agenda. It is important to consider that simply swapping ICE vehicles for electric vehicles might address the problem of road user emissions, but not overall whole-life carbon emissions in the manufacturing process. Due to the manufacturing process involved and frequency of usage over its life, a zero-emissions vehicle still produces more carbon emissions than public transport alternatives. To address its Net Zero objectives, the Government needs to supplement the ban on ICE vehicles with other measures which encourage modal shift to public transport alternatives. One way to do this is by managing the demand for roads through road pricing.

Road pricing schemes could be designed to have several simultaneous benefits – saving the amount of time spent in queues, reducing greenhouse congestions caused by idling or slow-moving vehicles, incentivising road users to switch to greener forms of transportation such as public or active transport, and reducing the need for road construction.

Although congestion charging is currently not widespread in the UK, we are likely to see more and more cities use their powers to implement it. A number of cities including Cardiff, Reading and Bristol are already considering this seriously. Similarly, there are clear indications that other cities like Birmingham and Manchester will follow London's lead in establishing Clean Air Zone (CAZ) and Low Emission Zone (LEZ) schemes[12], though these are subject to consultation in respect of the long-term impact of COVID-19 and the advancement of the ban on ICE vehicles.

3. Customers will begin to demand a more integrated and interoperable road pricing system

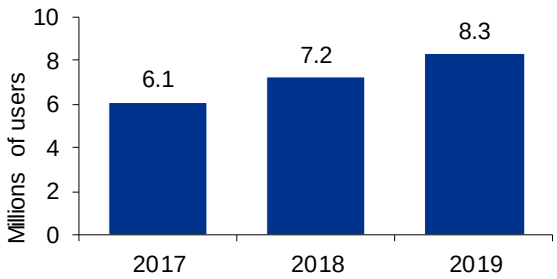
As mentioned above, the UK's road pricing schemes – both tolls and road user charging – are highly disparate. First, they are operated by different types of organisations – local authorities (e.g. London Congestion Charge), the national highways authorities (e.g. Dart Charge), and private infrastructure owners and operators (e.g. M6 toll). Second, there is a large variation in the technologies used both in the roadside infrastructure and within the vehicle. Third, payments are managed by multiple operators who typically look after only a stretch of highway, bridge or crossing, using different payment platforms such that the customer is expected to maintain multiple accounts to track usage and make payments.

As more congestion and air quality schemes are introduced, the challenges of integration and interoperability will only increase, particularly if these are all run by different local and devolved authorities. For instance, whilst the Joint Air Quality Unit (JAQU) is providing a centralised vehicle classification and payments portal service for England's air quality schemes, responsibility for enforcement is devolved to local authorities. Meanwhile, Wales and Scotland will deliver their own schemes.

However, over the next few years, the lack of interoperability will become more and more unacceptable to customers – both passenger vehicles and freight vehicles – who will begin to demand a system that is seamless, integrated and much easier to use. They will want a customer-centric one-stop-shop in which they are provided end-to-end services – vehicle identification, payments, customer service, billing documents, information – through a single interface.

This customer demand will be driven by two technology trends:

- The adoption of connected vehicles – estimated to reach 95 % of all passenger vehicles by 2030[13]. As more customers begin to use connected vehicles, they will expect their vehicles to seamlessly connect with road pricing systems.
- As more people switch to digital wallets and use smartphone apps for mobility, they will expect these to be connected to the road pricing schemes.



Graph 2.4: Mobile payment users in the UK[14]

What types of road pricing mechanisms should the UK consider?

The UK would benefit from a coherent Government vision and policy roadmap for road pricing to address fiscal and congestion-related challenges in a coordinated manner and create a more integrated and interoperable system. Its road pricing model will have to involve a range of mechanisms to meet the needs of specific geographies. In our view, a combination of time-of-day, cordon, and distance-based pricing would be needed to recoup the loss of the fuel duty at an adequate scale and manage congestion. While a more detailed examination of the relative pros and cons of each mechanism in different contexts is yet to be undertaken, we summarise some of the policy, technology, infrastructure, and equity considerations at a high level.

Sources: (10) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/870647/tsgb-2019.pdf
(11) KPMG Mobility 2030 analysis
(12) https://www.fleetnews.co.uk/fleet-faq/what-are-the-proposed-uk-clean-air-zones-caz
(13) KPMG Mobility 2030 analysis
(14) Statista data

Table 2.1 – Types of road pricing and their policy, technology and equity implications

Type	Description	Preliminary considerations
Toll	Fixed fee for using a particular road, primarily used to raise revenue. (e.g. M6, Dartford Crossing)	— Policy: Tolling more roads could theoretically substitute the loss of fuel duty revenue but would not manage congestion. — Technology: Existing Automatic Number Plate Recognition (ANPR) camera network could be expanded, or new connected vehicle/existing telematics infrastructure could be used. — Equity: Potential for geographic and spatial inequality if toll revenues were earmarked only for those roads.
High Occupancy Vehicle Lane	A scheme wherein high occupancy vehicles are prioritised and low occupancy vehicles are charged a fee (e.g. A647, Leeds)	— Policy: Revenues limited by the number of low-occupancy vehicles that choose to travel within them. — Technology: Existing ANPR network could be easily expanded — Equity: Adverse impact on those without access to good public transport.
Time-of-Day Pricing	A fee that is higher under congested conditions and intended to shift some traffic to other routes, times and modes (e.g. London Congestion Charge)	— Policy: Could be used to recoup infrastructure spending and reinvest in public transport while managing congestion. — Technology: Complexity would depend on whether it is applied to a small or large area. For the latter, more ANPR cameras with advanced edge computing would have to be installed. Connected vehicle/telematics/satellite technology could be used. — Equity: Potential to disadvantage those outside popular areas and city centres – exemptions and revenue redistribution needed.
Cordon Pricing	A fee charged for driving in a particular area, intended to reduce congestion or manage air quality in major urban centres (e.g. London Congestion Charge)	— Policy: Could be used to recoup infrastructure spending and reinvest in public transport while managing congestion and addressing air quality concerns. — Technology: Complexity would increase as the number of cordons increases. More ANPR cameras would have to be installed or connected vehicle/telematics/satellite infrastructure could be used. — Equity: Potential to disadvantage those outside popular areas and city centres – exemptions and revenue redistribution needed.
Distance-based or Mileage-based Pricing	A fee charged based on the number of miles a vehicle has driven.	— Policy: Could be used to recoup infrastructure spending. Is arguably the most effective cost management scheme because it charges people exactly for what they used. — Technology: Installing ANPR cameras across a large network could be expensive. A combination of connected/telematics technologies could be used. Countries like Singapore (which has the most comprehensive distance-based pricing scheme) use the satellite network, but the UK would have to invest in the US' GPS or Europe's Galileo satellite systems, which may be expensive. — Equity: More equitable in some respects because it charges people for use of a vehicle rather than ownership. However, it has the potential to disadvantage those who are reliant on private vehicles to travel long distances, like those without good public transport access.

03 How can the UK benefit from US road pricing experiences?

The UK is already one of the most forward-thinking countries in the world of transport and mobility planning. Now, as it embarks on a journey towards a more policy-driven approach to road pricing, there are valuable lessons and insights to be garnered from the experiences of other countries – Singapore's dynamic distance-based electronic road pricing scheme (ERP2), Sweden's consultation-focused approach to cordon pricing, Ireland's interoperable tolling system eToll, and the HGV road user charging schemes in Belgium and Netherlands, to name a few.

In this paper, we focus on the experiences of schemes and pilots across the United States, highlighting the lessons that can be learned in respect of enabling interoperability, incentivising take-up, garnering political consensus, encouraging innovation, and maximising customer choice.

Road pricing reform in the US has been driven by concerns about declining revenues

Surface transportation in the US is funded through state and federal taxes on fuel consumption, vehicle registration fees, tolls, a Federal Highway Trust Fund and financial instruments based on related revenue streams. However, like in the UK, global advancements in vehicles through electrification, increased fuel efficiency, and adoption of hybrid engines are impacting revenue based on fuel consumption. In the US, the effect of reduced fuel tax revenue is exacerbated by fixed dollar amounts set for fuel taxes, usually not indexed to inflation, and rarely increased. The Federal Highway Trust Fund is projected to be insolvent by 2022 and will reach a $134 billion-dollar deficit by 2029 if an alternate funding solution is not found.[15,16]

This urgent need to address revenue shortages is the primary motivation for exploring alternate road pricing schemes across the US, due to the limitations of the first two mechanisms that are typically considered to fix transportation funding shortfalls – increasing toll charges and/or increasing fuel taxes.

When it comes to tolling, the US market has toll road coverage in 39 states across 350 toll facilities, but this represents only 0.6% of road miles in the US, and all toll funds are directed through private and state entities to maintain the tolled roads, bridges, or tunnels[17]. Most of the remaining 99.4% of the road network is impractical to toll using traditional means due to the vast distances and sparse traffic relative to the fixed and ongoing operational costs of traditional gantry-based tolling systems. The business case for tolled assets works when the revenue is directed into operating and maintaining the asset itself but fails if revenue is dispersed beyond the tolled asset. Unfortunately, the vast majority of maintenance costs are incurred across the broader transportation network and cannot be borne by simply increasing fees on existing toll roads due to contractual limits on fee increases.

Meanwhile, increasing fuel taxes has diminishing value given the acceleration of electric vehicle production and mandates in some states[18]. Indeed, in January 2021, the US federal government ruled out raising fuel

taxes as an option to fix the revenue shortfall[19]. Multiple states have completed studies, pilots and enacted legislated deployments for alternate road pricing schemes, many with funding support from the US federal government. These proactive actions by US states all converged on mileage-based models with vehicle-based measurements as the basis for sustainable and equitable long-term transportation funding.

Road pricing reform in the US has converged on mileage-based systems

The convergence on mileage-based usage fees for transportation funding in the US should not come as a surprise, especially when looking back at the original debates that resulted in the introduction of the first gas tax in the US in 1919. The original motivation was to introduce "A tax on gasoline and automobile oils, as being an equitable measure of the power of the car and its consequent wear on the roads, and as a means for providing funds for state highway improvements"[20]. While the quality of the gasoline proxy is dropping quickly, the underlying need and original justification to find an equitable measure of the wear on the road remains relevant today.

For the last two decades, state governments have been studying alternate ways to fund roads based on wear or use[21]. While the specific methods for data collection vary, the common result across studies is the use of mileage as a replacement for the obsolete proxy of gasoline consumption. Some states, like Hawaii, have explored using an annual odometer inspection to collect simple mileage data, whereas other states like Utah, Oregon, and California, have explored using only technology in the vehicle rather than methods reliant on adding new infrastructure to automatically collect mileage. These automatic mileage collection options unlock additional value by providing data that can help manage congestion or providing the capability to apply different mileage fees based on country, state, county, or road.

Even with the convergence on mileage-based systems to cover the vast and sparse transportation network across the US, infrastructure-based tolling solutions remain relevant and important for fixed assets. The electronic tolling schemes that are commonly used for tolled assets in the US already comprise the fundamental building blocks of any road pricing system, including transactional payments, pre-paid wallets, enforcement, and are already accepted by society. They thus provide valuable learnings on the end-user experience for mileage-based schemes, should the UK choose to move in that direction.

Utah provides a good example of how a mileage-based scheme can be phased-in over time, with an enacted deployment focused on electric and fuel-efficient hybrid vehicles using annual odometer validation as a viable means to detect potential anomalies. Moving forward, many states are now preparing for legislation to enroll all vehicles, while the US federal government is testing interoperability and national implications of road usage charging in partnership with key public and private stakeholders. Key learnings from these studies and pilots that are applicable beyond the US include the importance of proactive public outreach and education, provision of choices to participants to pay for transportation in different ways, and a phased approach to mileage-based schemes to ensure all stakeholders are aligned.

Sources:
(15) Highway Trust Fund Accounts – CBO's Baselines as of March 6,2020. Congressional Budget Office. https://www.cbo.gov/system/files/2020-03/51300-2020-03-highwaytrustfund.pdf
(16) These Congressional Budget Office projections do not incorporate the disruption caused by COVID-19, which has resulted in reduced vehicle usage, lowering tax revenues even further as more individuals work from home and drive less. A steady trend toward work-from-home situations among many businesses has further widened the revenue shortages.
(17) https://www.fhwa.dot.gov/policyinformation/
(18) https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/
(19) https://www.rollcall.com/2021/01/21/buttigieg-faces-largely-friendly-panel-at-confirmation-hearing/
(20) https://www.enotrans.org/article/the-gas-tax-at-100-oregon-enacts-americas-first-ever-motor-fuel-tax-february-25-1919/
(21) Oregon's Mileage Fee Concept and Road User Fee Pilot Program (https://www.myorego.org/wp-content/uploads/2017/07/RUFPP_finalreport.pdf)

Interoperability has been a key focus area across states and schemes

The US has a long history of prioritising interoperability and integration across its traditional tolling schemes. Four interoperable hubs have emerged across the country[22]:

— Southeast: Georgia (Peach Pass), Florida (SunPass) and North Carolina (NC Quick Pass);

— Northeast: 17 states (E-ZPass), which form the Interagency Group;

— Central: Kansas (K-TAG), Texas (TxTag) and Oklahoma (PikePass); and

— Western: The Toll Roads of Orange County.

These systems have a high degree of interoperability, accommodating different types of payment mechanisms across schemes. The E-Z Pass system, by way of example, accommodates both pre-payments (manual and automatic) and post-paid plans for commercial accounts. When credit cards are used for replenishment such that the 'home' agency pays the 'away' agency for tolls incurred by local customers on the 'away' agency's facilities, the 'away' agency reimburses the 'home' agency for the credit card fees.

These sophisticated approaches to interoperability in traditional tolling have set the stage for prioritising interoperability in newer road pricing schemes. More than half the US states (30 in total) completed studies and pilots to validate how a mileage-based scheme would work or could be adapted to meet local needs, including California, Oregon, Utah, and many more (see Figure 3.1[23]). Oregon, as the first state to introduce the gas tax in the US in 1919, was also the first to pilot and enact a road usage charge scheme in the US. This pioneering effort in Oregon sought to establish system guidelines and frameworks that could be re-used across other states in the US (and neighbouring jurisdictions in Canada), helping promote future standardisation and interoperability efforts. Some of these guidelines included system auditability, privacy and data protection measures, and the importance of participant choice.

Collaboration and consultation have been key to deploying new road pricing schemes

Along the journey to arrive at mileage-based models, it was very important to understand, investigate, and share information about potential challenges and concerns. These challenges were widespread – education, privacy, equity for rural drivers or others, adoption, enforcement and interoperability – and are relevant to any country or jurisdiction. In the US, different government agencies pooled resources and collaborated with private industry to improve efficiency and avoid duplication of effort by sharing learnings; examples include RUC West and the Eastern Transportation Coalition.

Some of these learnings include dispelling the rural driver equity myth with results showing that a rural household will actually end up paying 1.9%-6.3% less and urban households 0.3%-1.4% more within a mileage-based scheme designed to replace the fuel tax[24]. This is due to a combination of complex factors including rural drivers using their vehicles more judiciously and rural vehicles being less fuel-efficient. While these results may seem counter-intuitive, they are an excellent example of why it is important to dig deep into the potential concerns from as many vehicle owners and stakeholders as possible, and ideally, representative of the affected population.

Sources: (22) https://www.cittimagazine.co.uk/a-progress-report-on-us-toll-system-interoperability/

(23) Washington State Road Usage Charge Assessment Final Report – Volume 1. January 2020. https://waroadusagecharge.org/wp-content/uploads/2020/01/WSTC-Final-Report-Vol-1-WEB-2020_01.pdf

(24) https://www.rucwest.org/wp-content/uploads/2018/07/RUC_RuralDrivers_folio_final-LTR.pdf

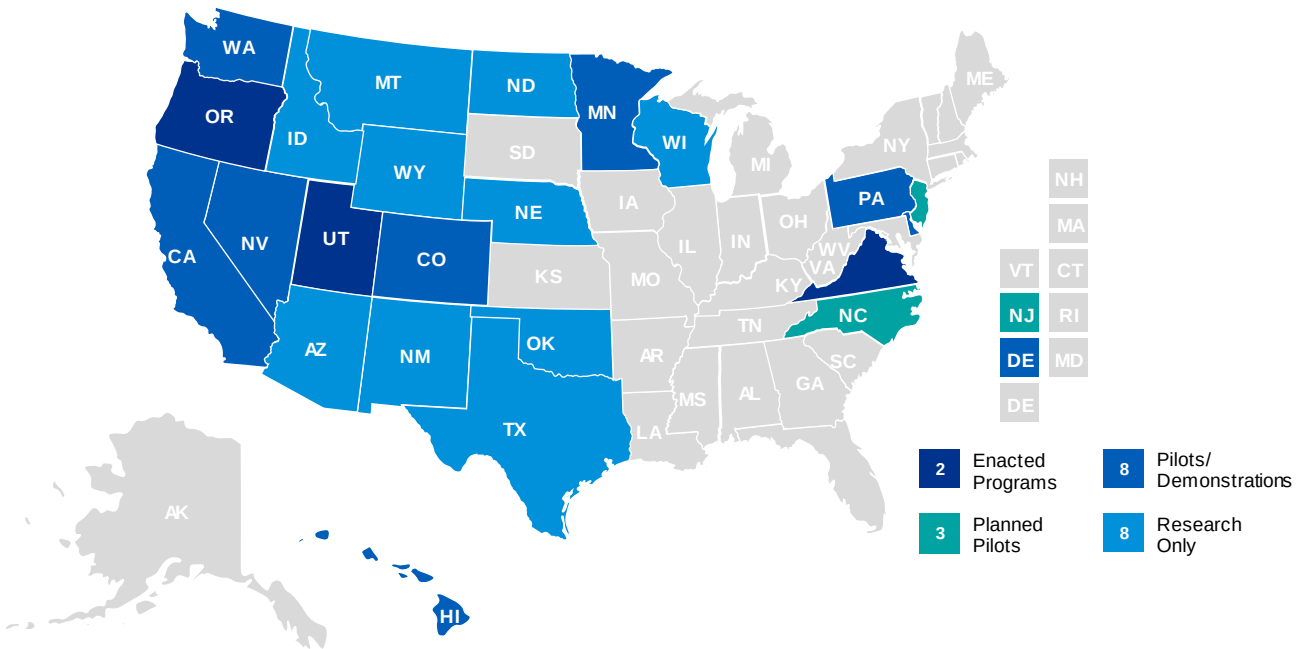


Figure 3.1 - Road usage charging research, programmes, pilots, and planning.

Washington State embraced this approach for strong representation by forming a road usage charge steering committee in 2012 and legislating the need for representation across key stakeholders including auto and light truck manufacturers, environmental, counties, trucking industry, cities, public transportation, the public at large, department of licensing, ports, and more. This approach served Washington well since challenges and potential concerns were thoroughly analysed from diverse perspectives. As part of this process, Washington completed a successful pilot programme to help assess public acceptance, understand participant reactions across five different methods to report mileage, and refine policy for future legislation.

Data protection, technology and privacy have been tackled through clear data retention and isolation provisions, and by giving road users a choice of what data to share

Privacy and data protection are common concerns raised by participants during planning and outreach campaigns about road usage charging. US states have embraced global best practices to model privacy policies and measures for data protection using mature examples from the European Union General Data Protection Regulation, the California Consumer Privacy Act of 2018, and the privacy protection provisions introduced in the initial enacted deployments in Oregon.

These initial enacted deployments provided clear data retention and isolation provisions similar to Senate Bill 810[25] in Oregon that established a framework in which the certified private sector partner is responsible for the management of mileage records containing personally identifiable information without disclosure to the state, and a

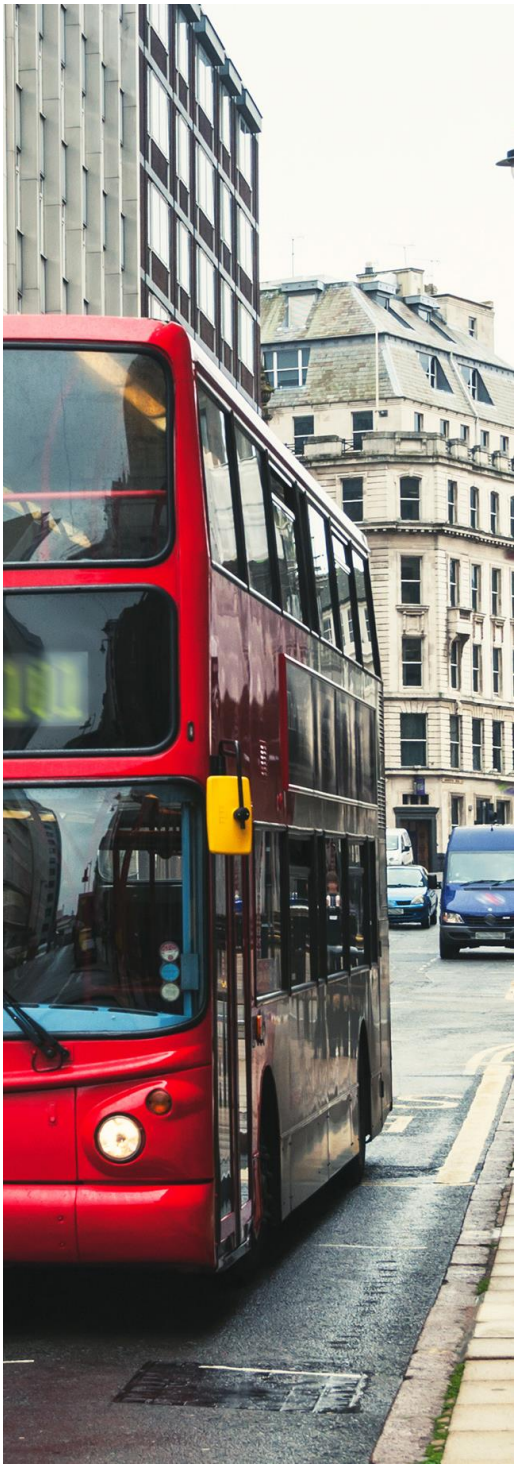
default 30-day data retention period for mileage records that contain personally identifiable information, unless participants opt-in for longer retention periods with the private sector partner.

These simple rules were complemented with technology choices for participants, enabling some participants to disclose only distance information (and pay for all distance), and other participants to choose to disclose location and distance information so they only pay for distance travelled on relevant state roads. When presented with options, participants are sufficiently comfortable with the privacy measures in place to share their location detail. This is evident across multiple deployments, including California where choices included a range of no-location and location options. In this example, most participants chose to share their location information with trusted service providers in exchange for the enhanced value and ease of use:

Table 3.1 – Snapshot of flagship US schemes

State	Type of charge	Critical success factors
Oregon	— Milage-based fee with optional location sharing (in-state vs. out-of-state)	— Phased 'opt-in' approach — Interoperability provisions — Privacy protections
California	— Mileage fee with optional location sharing and private road differentiation	— Technology and information sharing choices to users — Privacy protections
Utah	— Mileage fee limited to an annual maximum	— Phased approach to mileage-based scheme using odometer validation
Washington	— Mileage fee with an option to report at vehicle licencing offices	— Rigorous public consultation — Strong myth-busting campaign

Sources: (25) https://olis.leg.state.or.us/liz/2013r1/Downloads/MeasureDocument/SB810



04 What next for the UK?

The UK and US markets are very different for a myriad of reasons – size, geography, structure of government (unitary vs. federated), form of government (parliamentary vs. presidential), road funding systems, transport networks, and culture. However, in the context of road pricing, they also face similar challenges – declining fuel duty, challenges of equity and public acceptability, and the need for policy to keep pace with evolutions in technology. Therefore, the examples of various road pricing schemes in the US shed light on some key considerations for the UK, as summarised below, and also trigger some additional considerations in the context of the UK landscape.

1. A phased and iterative approach is critical to a successful roll-out

Road pricing is a complex policy so its implementation must be phased and iterative. Trials and demonstrations are crucial in obtaining public approval. For example, a voluntary approach similar to Oregon's could educate road users about the relationship between fuel duty and road maintenance.

From a policy perspective, given the differences in government structures, in the UK context, a national policy vision and roadmap would be useful for local authorities, highway and transport authorities, technology providers, vehicle manufacturers, individual road users, and fleet operators. As we have described above, road pricing schemes can be used to fulfill multiple policy objectives, some more than others. The UK government, like others, will need to make certain policy choices and communicate these clearly to users.

An additional consideration in the UK context is the interface of the road pricing policy with the Government's explicit policy regarding electric vehicles. It is critical for road pricing schemes to not be viewed as a 'tax' on electric vehicles. To align with the zero emission vehicle (ZEV) initiatives, pricing schemes should avoid creating a perception that it is 'cheaper' to pay the fuel tax than the road price.

2. Like in the US, a combination of time-of-day, cordon and distance-based pricing schemes will likely supplement traditional tolling schemes

While a detailed examination and relative cost-benefit analysis of different road pricing mechanisms in various geographical and economic contexts within the UK is yet to be conducted, it is likely that, like in the US, a combination of these schemes will be required. While tolls and High Occupancy Vehicle (HOV) lanes could be expanded to recoup the cost of infrastructure spending and manage congestion to some extent on motorways and large roads, we expect that these will be supplemented with more time-of-day and cordon-based schemes within towns and cities in the short term to simultaneously tackle fiscal, congestion, and air quality objectives. In the medium to long run, as the decline in fuel duty becomes more acute, more widespread distance-based pricing – which is theoretically the most effective demand management tool – may emerge. However, key concerns around equity and privacy would have to be addressed, possibly using the approaches that have been successfully trialled in the US and other countries. As experienced in the US market, distance-based pricing options provide fair assessments of road use across the entire network, beyond just specific assets or urban regions, and also enable policy flexibility to vary pricing based on time of day, geographical location, and occupancy.

3. A distance-based road pricing scheme or the upscaling of cordon/time-of-day pricing would require investments in technology and roadside infrastructure, and an assessment of relative costs and benefits

Currently, the UK does not adopt or mandate a consistent technology across its tolling or road user charging schemes with ANPR cameras being the most common vehicle identification technology. However, in order to introduce distance-based pricing or upscale cordon/time-of-day pricing schemes, a much larger network of ANPR cameras would be needed, potentially with advanced edge computing. Alternatively, vehicles could self-report distance information, as demonstrated in the US deployments including Oregon and Utah. This self-reporting option can re-use existing in-vehicle telematics in most newer vehicles or use aftermarket on-board units. In both cases, the equipment in the vehicle is self-reporting road use information over existing telecommunication networks without additional infrastructure, optionally using data from Global Navigation Satellite Systems (GNSS). To factor in the relative costs and benefits of various technologies into its road pricing decisions, the UK will benefit from studying and modelling the practical economic outcomes from deploying different technologies as well as track relevant trends domestically and internationally, for example, connected vehicle technologies or cellular V2X technology to connect to I2V road infrastructure.

4. Schemes will have to mitigate equity and privacy concerns and focus on collaboration and consultation

Road pricing schemes in which charges are varied by time of day, congestion levels, and distance come with equity challenges which must be mitigated. Some options for schemes to consider include exemptions and discounts based on income group. For example, Deirdre and Edmund King whose submission was nominated for the Wolfson Economics Prize in 2017 suggested that drivers should get at least 3,000 free miles each year with 1,000 extra miles for rural drivers[26]. Another way to mitigate equity concerns around cordon pricing and the disbenefits for those who live in 'transport-poor' areas would be to reinvest the revenue from road pricing schemes in public transport in those areas. Additionally, road pricing technology should be tech-agnostic with minimal cost implications for road users. From a public acceptability perspective, privacy will also be key – providing customers with the choice of what information to share, as has been the case in California, could help tackle this concern.

As described for Washington State, regular public consultation during the trial and implementation of road pricing schemes can help demonstrate the benefits of schemes to road users. From a public education perspective, making schemes voluntary such as in Oregon can also help take road users on a journey to a better and fairer system for all.

5. As customers and operators demand greater integration and interoperability, the Government will have to consider whether to move to a more regulated and/or centralised regime

In the US' federated system, different states have different policies and operating principles in respect of tolling and road user charging. However, interoperability is a key focus. In July 2012, the United States established new federal legislative language regarding Electronic Toll Collection (TC) interoperability. Work is in progress to also clarify interoperability for distance-based fees across the US.

In the UK's unitary system of government in which authority is devolved by the Parliament in Westminster to various other authorities, the Government will have to consider what role it wants to play in response to vehicle owner demand for an integrated proposition.

Source: (26) https://policyexchange.org.uk/news/finalists-for-wolfson-economics-prize-unveiled/

Some degree of centralisation and/or regulation may replace the current deregulated federated approach to tolling and road user charging:

— A regulated federated system, in which the responsibilities of tolling and road pricing would continue to be delegated to local authorities but with regulation which would encourage the market to provide integrated and interoperable services.

— A regulated centralised system in which the Government would be accountable for all tolling and road user charging schemes with standards as well as a complete integration of the back offices of the schemes.

The Government will have to decide which option to adopt and what regulations to enforce iteratively, based on the evolution of technology and business models. For instance, if distributed ledger technologies like blockchain develop fast enough, such that operators begin to link their back offices as a business imperative, a centralised back office would not be necessary. If a definitive business model for on-board units emerges, the Government could put in place standards and regulations accordingly or deliver a centralised back office for road pricing schemes across the UK.

Conclusion

We believe that the UK will need a coherent **road pricing vision for the future** to tackle the challenges of the rapidly-declining fuel duty, increasing congestion, and the imperative to reach Net Zero by 2050. Like in the US where road pricing reform has converged on mileage or distance-based schemes, a **combination of pricing mechanisms** – including time-of-day, cordon-based, and distance-based schemes – will have to supplement traditional tolls and duties. In the design of these schemes, equity considerations and the relative costs and benefits of various technology and infrastructure combinations, will have to be carefully weighed, leveraging best-practice from other countries.

The pilots and schemes that we have examined across the US – for example, in Oregon, Washington State and California – demonstrate that a **phased and iterative approach** has been critical to their success. More specifically, these have included **public consultations, 'opt-in' models, and voluntary information-sharing mechanisms** to address concerns around equity, affordability, and privacy.

Finally, while integration and interoperability has been a priority in the US, the UK has a more disparate set of road pricing schemes operated by different authorities using myriad platforms and technologies that are not currently integrated. However, in the context of the UK's non-federated form of government, the Government may have to **consider a greater degree of regulation or centralisation** to respond to customers' demands for integration and interoperability – for instance, by specifying standards or moving to a centralised back office – while still promoting innovation and maximising consumer choice.

Authored by

Malini Bose
Manager, Mobility 2030
KPMG UK
malini.bose@kpmg.co.uk

Dr. Ben Miners
Chief Innovation Scientist
IMS
bminers@ims.tech

Timothy Kaard
Associate Director, Mobility 2030
KPMG UK
timothy.kaard@kpmg.co.uk

With

Michael Zhan
Assistant Manager, Mobility 2030
KPMG UK
michael.zhan@kpmg.co.uk

Claire Alleaume
Head of Market Strategy
IMS
calleaume@ims.tech

Special acknowledgements

Ben Foulser
Co-Head Mobility 2030
KPMG UK
ben.foulser@kpmg.co.uk

Ivan Costermans
Executive Director
KPMG Belgium
icostermans@kpmg.com

kpmg.com/uk