

Pay As You Go – Achieving Sustainable Roads Funding in England

Roads are one of the most important and valuable infrastructure assets in the UK. Nearly 89% of journeys are made by road,¹ with England’s Strategic Road Network (SRN) carrying some 92 billion vehicle miles, 30% of all traffic.² The SRN also carries 1 billion tonnes of freight, more than all other roads and transport modes combined.³ Ensuring sustainable revenue for maintenance and upgrade is crucial for the UK’s future economic and social wellbeing.

Due to changes in how our vehicle fleet is fuelled, as engines continue to improve in efficiency and as traditional ownership models are stressed by technological developments and social change, taxation of roads will need to be future-proofed. In our State of the Nation 2018: Infrastructure Investment report,⁴ ICE set out the need for a robust policy debate on the future funding of England’s busiest roads, like the SRN. The report recommended that:

“The Government should give serious consideration to replacing the existing generation of road taxes with a pay as you go model for the busiest roads in England.”

Polling conducted for the report by YouGov found that 47% of GB adults would support the introduction of pay as you go if it replaced both Vehicle Excise Duty (VED) and fuel duty. Only 23% would oppose with 30% reporting they would neither support nor oppose or don’t know.⁵

This paper moves the policy debate forward by examining the practical, technological, social, political and regulatory challenges which exist to establishing a pay as you go model. In doing so the paper does not put forward a preferred option. Rather, it outlines a range of high-level recommendations that must be delivered in order for any future pay you go model to be effectively and fairly administered.

The focus of this paper (like the State of the Nation report) is also on SRN funding; recognising the overarching economic significance of this network and its specific sensitivity to the impending carbon fuel crunch. This of course does not preclude the need for a fresh examination of funding models for local roads, which is increasingly important as devolution begins to alter the governance and ownership models associated with these networks.

Recommendations

Recommendation 1: The following principles should be adhered to in developing a future pay as you go (PAYG) model:

- Any pay as you go model that is deployed should consider a range of measures, including: vehicle weight, emissions, noise, overall efficiency and intensity of use.
- Any pay as you go model should not raise more than is collected from existing VED and fuel duty revenues, and care should be taken to avoid additional financial so as to not create any additional financial pressures for people from lower socio-economic groups.
- The Government should consider a road ownership model for the SRN where the Government or private companies collect revenue, manage data and maintain roads on a concession basis.
- In view of the existing simplicity of collecting VED and fuel duty revenues, collection methods underpinning any pay as you go model should be transparent, simple to understand and protect the privacy of all users.

Recommendation 2: The Government must examine the tax revenue implications of electric and self-driving vehicles within the scope of any further consultation into new regulation or legislation for the UK’s self-driving future.

Recommendation 3: A pay as you go replacement for road-related taxes, which safeguards funding of road infrastructure, should be in place by 2030, before revenues from fuel duty decline significantly, or connected and autonomous vehicles become commonplace.

¹ DfT (2016) [Road Use Statistics Great Britain 2016](#)

² Highways England (2017) [Strategic Road Network Initial Report](#)

³ Ibid

⁴ ICE (2018) [State of the Nation 2018: Infrastructure Investment](#)

⁵ Ibid



Nearly 50% of GB Adults would support the introduction of ‘pay as you go’ if it replaced both Vehicle Excise Duty and Fuel Duty.



Support 47%



Oppose 23%



Don't Know? 15%



Neither support nor oppose 15%

YouGov (2018)

The carbon fuel crunch

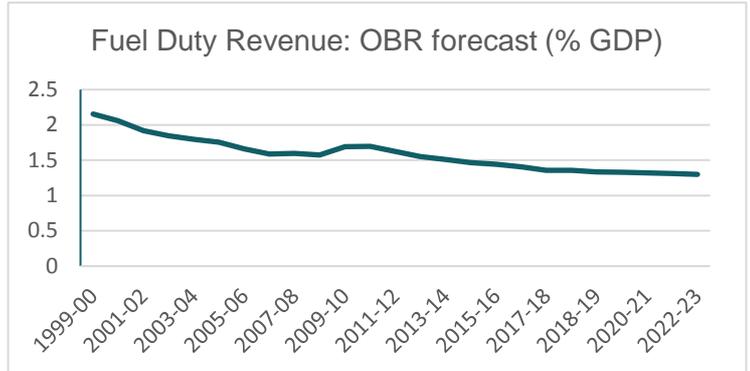
Government policy is for the sale of all new cars and vans to be effectively zero emission by 2040.⁶ This will render fuel duty – the taxation applied to petrol, diesel and bio-fuels – an increasingly diminishing revenue source in the coming decades.

Fuel duty has, in fact, been waning in effective value for decades due to increasing fuel efficiency. Department for Transport (DfT) statistics demonstrate that average new car fuel consumption has reduced over 20 years, between 1997 and 2017, from 8.3 to 5.5 litres per 100km for petrol, and 7 to 4.6 litres per 100km for diesel.⁷

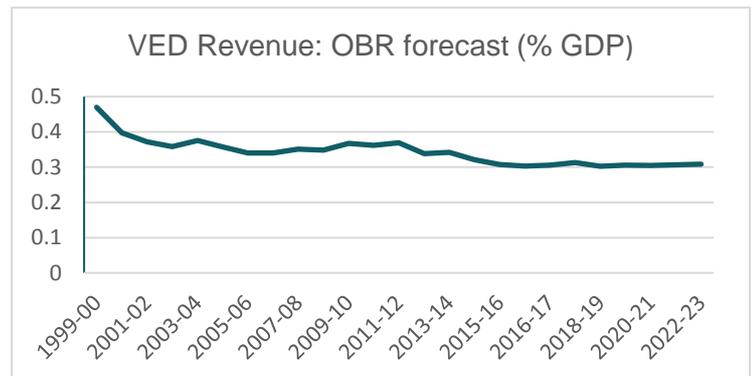
The decade-long fuel duty escalator freeze has further eroded revenue growth, with the latest forecast showing a loss of potential revenue of between £840m and £910m for each year to 2023-24.⁸

Taken together, an increasing number of vehicles exempt from fuel duty and a continuation of the fuel duty escalator freeze will bring about dramatic falls in revenue in the long-term. It is unlikely electric vehicle uptake will increase at a linear rate and variables, such as an increase in the price of oil or increased consumption, will likely bear out the OBR's forecast that fuel duties will remain broadly similar in value over the short-term to 2022-23 as a percentage of GDP.⁹ Yet in the medium to long-term, if the Government is to make progress toward eliminating fossil fuel vehicles, fuel duty will likely raise significantly less than it does at present by the end of the next decade, accelerating a trend which has seen the value of fuel duty fall from 2.2% of GDP in 1999-00 to 1.4% of GDP in 2017-18.

VED revenues are also a concern given the exemptions and discounts that currently exist for electric and lower emission vehicles. Indeed, recent figures suggest a trend toward cleaner fuels: 33% fewer diesel cars were registered between 2017 and 2018 whilst ultra-low emission vehicle registrations increased by 11%.¹⁰ Whilst petrol registrations increased slightly by 3.3%, the DfT attributes this shift to changes to VED charges and the announcement to end the sale of all new conventional petrol and diesel cars and vans by 2040.¹¹ As ultra-low and electric vehicles attract reduced duties, this implies a long-term future trend of decreased VED revenues, in the absence of government intervention, and is especially important considering that VED will be directly hypothecated to fund Highways England's second Road Investment Strategy.



Source: [OBR \(2019\)](#)



Source: [OBR \(2019\)](#)

The benefits of pay as you go

Implemented well, a pay as you go system would have wide ranging benefits for society and the economy. For example, it could help to reduce congestion, which in 2017 cost UK motorists (including SRN users in England) £37.7bn.¹² Such a system would also be more equitable; those who cannot afford more fuel-efficient cars, buying generally older models, are penalised by the need to buy more fuel and, increasingly, as more people benefit from electric vehicles, the current system places a greater tax burden on fewer people.

⁶ Department for Transport (2018) [The Road to Zero](#)

⁷ ONS (2018) [Energy and Environment: data tables \(ENV\) ENV0103: Average new car fuel consumption: Great Britain \(ODS, 14.4KB\)](#)

⁸ OBR, (2018) [Economic and fiscal outlook](#)

⁹ OBR, (2018) [Economic and fiscal outlook](#)

¹⁰ Department for Transport (2018) [Vehicle Licensing Statistics](#)

¹¹ Ibid

¹² Inrix (2019) [Traffic congestion cost UK motorists over £37.7bn in 2017](#)

Pay as you go for roads could encourage more efficient use of roads and could support efforts to reduce congestion. It would encourage road users to think of a per journey cost and would incentivise more people to consider modal shift, vehicle sharing or the necessity of the journey. A real-time and communicative network, supported by increasing vehicle connectivity, could support efforts to divert traffic at busier periods or to avoid roads where an accident has taken place, to help keep traffic moving.

A key benefit of introducing pay as you go on England’s busiest roads, like the SRN, would be consistent measurement of use, based on access or distance. It would also allow for the adoption of road pricing which could consider vehicle weight, emissions, speed or route efficiency. The Government’s strategy for reforming the Heavy Goods Vehicle (HGV) Road User Levy seeks, as a key objective, to encourage operators to reduce vehicle miles through planning efficient routing.¹³ A distance-based measure is likely to incentivise HGV operators far more effectively than another incentive or subsidy.

A pay as you go model can also be priced to factor in individual vehicle wear and tear costs on road maintenance based on realised usage. It could also price in incentives for non-domestic vehicles to use cleaner engines in a simpler way than the HGV Road User Levy does at present and apply it to other types of vehicle.

Forms of pay as you go models

There are three main forms of pay as you go models or road pricing currently in use around the world which could serve as a pay as you go model. These have differing costs and benefits in relation to each other. ICE believes the cross-cutting challenges include; technology, privacy, cost for users, regulation and collection cost. These would all need to be addressed with each system having strengths, or weaknesses.

The table below sets out our estimation of the challenge, cost or risk inherent in three of these models. This is not to rule one system out, but to give a realistic overview of where challenges might need to be prioritised and where most effort might need to be expended if that model were to be adopted.

	Low	Medium	High							
				Technological challenge	Privacy and social concern	Cost for motorists	Need for regulation	Collection cost	Adaptability	Network coverage
Gated tolls				Low	Medium	Low	High	Low	Medium	High
Distance-based				Medium	High	Low	High	Low	Low	Low
Zonal				Medium	High	Medium	Medium	High	High	Medium

Table 1: Potential impacts of different pay as you go models

Gated toll roads

Gated toll roads are used in much of Europe, most noticeably in France through the Autoroute system. Roads are tolled directly with physical or electronic booths, regulating access and egress from the network. Autoroutes are managed by private companies who are responsible for the construction, operation and maintenance of owned sections of the motorway network on a concession basis.

Broadly speaking, revenue from tolls goes back into maintaining and expanding the Autoroute network, with collection as and when the Autoroute network is accessed. Depending on the model, this could be a single access charge, or a charge based on distance with gates at off-ramps.¹⁴

Distance-based models

Technology is in place which can allow for active monitoring of a vehicle’s location, speed and direction as part of a fully connected road network. There are three potential distance-based systems which could be adopted, the first two of which could exclude roads from the charging network.

¹³ Department for Transport (2017) [Reforming the HGV Road User Levy: Call for Evidence](#)
¹⁴ RAC Foundation (2016) [Governance and Funding of National Road Networks: Three case studies](#)

- 1) Telemetric 'black box' GPS units placed in individual vehicles reporting to a real-time database over an 'always on' GSM connection as used by the insurance industry.¹⁵
- 2) Onboard units which periodically report mileage to road side transponder markers as is the case with the LKW Maut in Germany.¹⁶
- 3) A full road network charge could, in theory, use a simplified reporting system, reporting mileage between MOTs.

Further, car manufacturers have begun to adopt GPS/GSM based systems to allow direct communication with the manufacturer for maintenance purposes or as part of the eCall¹⁷ system. As new vehicles join a connected fleet, they will have the technology to allow for active monitoring of location.

Cordon, zonal and congestion charging

The cities of London, Stockholm and Singapore deploy a form of area-based charge for control of pollution, congestion and to raise funds for maintenance. Vehicles are registered as having entered the chargeable zone automatically through number-plate recognition cameras mounted on overhead gantries.

Whilst these schemes were implemented to tackle congestion and emissions and are supplemented with additional public transport options they do allow for variable charges and represent an alternative to traditionally gated toll roads. However, they do generally have significantly higher running costs than alternatives.¹⁸ Of key consideration is the adoption of clean air zones in the UK. The Ultra-Low Emission Zone will replace the congestion charge in London from April 2019 whilst five cities, Birmingham, Leeds, Derby, Nottingham and Southampton, delivered initial proposals for a clean air zone in March 2018.¹⁹

Challenges facing pay as you go models

As with any change, there are foreseeable challenges to replacing long-established revenue collection methods. Familiarity with VED and fuel duty are high with motorists so it would follow that a period of adjustment would be required following the introduction of pay as you go models. This section explores some of the common challenges of pay as you go models.

Technology and system architecture

Depending on the complexity of the system, a communicative system which tracks vehicles in real time and manages traffic flow, something similar to the automatic number-plate recognition system as used in London, or a simpler database which cross checks reported mileage, any pay as you go model will need new systems and infrastructure. This inevitably will require time to implement as well as potentially significant set up costs.

T-Systems runs a number of toll systems in Europe and their experience in Belgium with a system similar to the LKW Maut suggests that it can take less than two years to implement with an estimated life of 12 years; facilitating collection for 154,000km of road with approximately 130,000 vehicles subject to charges per working day.²⁰

Privacy and security

Privacy is the most immediately identifiable social concern, especially for models which would track location data. A survey conducted by the Information Commissioner's Office found that only 20% of the UK public have trust and confidence in companies and organisations storing their personal information.²¹ An always-connected vehicle would, in theory, be able to be tracked in real-time. A personal car is often thought of as a means of independence and freedom, especially for remote or rural communities with few alternatives, people with disabilities or those with a libertarian outlook who may not be comfortable appearing on a government database.

¹⁵ MoneySuperMarket (2018) [Compare black box car insurance quotes online](#)

¹⁶ T systems (2018) [Go Maut 2.0 speaks European](#)

¹⁷ European Commission (2019) [The interoperable EU-wide eCall](#)

¹⁸ Tri-State Transportation Campaign (2018) [Road Pricing in London, Stockholm and Singapore. A Way Forward for New York City](#)

¹⁹ RAC (2018) [Clean Air Zones – what are they and where are they?](#)

²⁰ T Systems (2016) [Intelligent Toll System Ser Up in Record Time](#)

²¹ ICO (2017) [ICO survey shows most UK citizens don't trust organisations with their data](#)

There would also be security concerns in relation to hacking of any such network and issues around acceptability, particularly for those who, whilst traveling over the speed limit is illegal, do so with routine. According to DfT statistics, of nearly 350,000 observed cars, some 48% were exceeding motorway speed limits.²² A system of active monitoring which could be perceived as raising a levy on established habits would be resented, even if it only enforced existing law.

Opposition to location data can be overstated; some 87% of people in the UK own a smartphone.²³ It is significant that 84% of these people are concerned their personal data is being shared with third parties,²⁴ but it is a device which has all the same technology a vehicle would have. Whilst people do have misgivings, so long as appropriate privacy safeguards and oversight is in place, especially if managed by a trusted organisation or intermediary, people will likely come to accept a new system.

Rural communities and local roads

It is important that rural communities, which often rely disproportionately on roads due to a lack of alternative travel options, are not disadvantaged by a pay as you go system.

ICE set out a 'displacement' concept in State of the Nation 2018: Infrastructure Investment²⁵ whereby funds raised from a pay as you go model on the SRN could include a redirection of funds to support local road improvement. This would work by pricing at a point which enables maintenance and improvements in design and capacity to the SRN and providing any surplus to local authorities. This would acknowledge both historic underfunding and the potential for increased load capacity on local roads which might result from any pay as you go model being applied on the SRN. ICE believes that a pay as you go network limited to the busiest roads, like the SRN, is worth exploring as a potential sustainable funding model.

A pay as you go system of this type could then interact with local transport authorities and city regions if they implement their own similar schemes in the future, especially congestion or emissions charging zones as these develop.

Affordability

Some users and stakeholders will have concerns about affordability of a pay as you go system for those from lower socio-economic groups who may be disincentivised from accessing the road network. Any model should not raise more than VED and fuel duty do at present. The OBR expects fuel duty to raise some £28.2bn in 2018-19, equivalent to £1,000 per household.²⁶ Around 36 million vehicles are subject to VED, raising £6.2bn or £220 per household.²⁷ The combined average per household charge is £3.30 per day or £102 per month.²⁸

Larger vehicles and freight traffic will, on average, pay more in VED and fuel duty due to vehicle classification and increased mileage. On the other hand, many low-charged or VED-exempt vehicles, such as newer electric or lower emission vehicles, tend to be more expensive, meaning those able to update their vehicles, or avoid buying second hand, pay less tax when initially registering the vehicle and benefit from better fuel economy.

The ICE is clear that driving with a future pay as you go system should not cost the average driver any more than it does currently.

Ownership and regulation

Whilst revenue from pay as you go could be collected centrally, expanding the concept of the National Roads Fund (which will hypothecate VED to the second RIS), should be explored. Allowing direct grant of a concession to a management company, either a private entity or Highways England, would allow that company to collect the revenue from pay as you go and use it to directly maintain the roads it would manage.

Providing concessions would have the likely effect of increasing efficiency and operation in a way which makes sense from a management of asset perspective, with revenue raised from use linked directly to the costs of maintaining the infrastructure asset.

²² Gov.UK (2018) [Vehicle speed compliance statistics: data tables \(SPE\) SPE0111 Vehicle speed compliance by road type and vehicle type in Great Britain](#)

²³ Deloitte (2018) [Mobile consumer Survey 2018L The UK Cut](#)

²⁴ Ibid

²⁵ ICE (2018) [State of the Nation 2018: Infrastructure Investment](#)

²⁶ OBR (2018) [Fuel duties](#)

²⁷ OBR (2018) [Vehicle excise duty](#)

²⁸ An assumption of an average of £1220 per household per year divided by number of days and/or months in a year

Operating the SRN on this basis would also allow leveraging of additional private investment as there would be a direct investable asset with a revenue stream which is feasibly linked to future performance.

The regulation of charges and operation will also be a necessary consideration. The recent experience in France, where the French Competition Authority reviewed road charging prices in 2014 and found that rising revenues as a result of traffic growth and higher toll rates were divorced from the costs of maintaining the concession,²⁹ show that close regulation would be necessary, as it is under the Regulated Asset Based model.

It would be necessary to establish a regulator with comparative powers to Ofwat or Ofgem, a function which the Office for Rail and Road (ORR) might be able to fulfil.

Revenue collection

One of the most often cited attractions of the existing generation of road taxes, especially fuel duty, is the relative simplicity of collection for the Treasury. This line of thinking does however mask that costs for collection are present in the current system which are often discounted by commentators. The Treasury might collect fuel duty from relatively few companies which compile how much fuel has been sold but the cost of collection, enforcement and compliance from selling that fuel to individuals, from which that revenue is derived, is still borne by those companies.

The cost of individual collection in pay as you go models

A Congressional Research Service report found that administrative and enforcement costs of collection of user fees for mileage-based charges to be “in the range of 5% to 13% of collections” for electronic billing, card and bank fees, alternative methods of payment and enforcement.³⁰

The Midland Expressway reported staffing costs of £4.44m in 2017 against an operating income of £89.07m, indicating around 5% of income spent on the day-to-day staffing costs of collection.³¹ The LKW Maut collected some €4.34bn in revenue in 2014, with costs of some €0.54bn to operate enforcement, maintenance, a central database and staffing – a ratio of 12.4%.³² By way of comparison, Shell estimates that of the consumer cost of fuel, 7% is retained for transport, retailer site costs and profit. They state only “a few pence profit on every litre of fuel” sold.³³

Collection by insurance, telecoms or manufacturing companies

There are existing relationships which could be leveraged without adding any significant administrative burden. In his report, *Miles Better*, Gergely Raccuja proposed a single per-mile charge which could be collected by insurance companies acting, as collection agents. This would need a ‘one-off’ investment of around £100m to adapt their systems and allow for billing, with mileage collected by insurance companies through telematic data or self-reporting cross-referenced against MOTs.³⁴

Aviva have told us they estimate that there is a £100 per customer cost for installation of a black box unit, with ongoing running costs of around £20 per user, though they expect costs to fall as technology improves. Further, as more vehicles are built with connective technology as standard, the set-up costs for pay as you go relying on GSM and GPS enabled vehicles will fall over time. Competition could also be opened to other sectors, with telecoms or car manufacturers being possible candidates.

²⁹ RAC Foundation (2016) [Governance and Funding of National Road Networks: Three case studies](#)

³⁰ Congressional Research Service, (2016) [Mileage-Based Road User Charges](#)

³¹ Midland Expressway Limited (2018) [Annual report and financial statements for the year ended 31 December 2017](#)

³² Fraunhofer (2016) [Economic impact of introducing road charging for Heavy Goods Vehicles](#)

³³ Shell (2019) [Pump Pricing](#)

³⁴ Wolfson Economics Prize and Policy Exchange (2017) [Miles Better](#)

Electric fuel duty

A key element of the National Infrastructure Assessment³⁵ is a focus on a nation-wide rapid charging network enabling long-distance journeys and reducing range anxiety. The Government's Construction Sector Deal commits to support this initiative through a £400m investment in charging infrastructure. The aim is a network of rapid charging points to service inter-city, coach and freight traffic.

It would be an attractive proposition to raise revenue from these charging points and might even be possible with domestic supply. Whilst it is difficult to determine what energy is used to power which device once in a domestic setting, it is thought smart meters will be able to do this.³⁶ New software and algorithms are also being developed which can 'learn' when a particular device is being powered.³⁷

However, the long-term business case for private companies developing rapid charging points infrastructure could be undermined in the future by emergent technologies, including on-road charging. Sweden are currently trialling the world's first electrified road capable of charging vehicles in transit³⁸ and more advanced designs might allow for viable contactless charging through electromagnetic induction, embedded photovoltaic cells or piezoelectric energy harvesting.³⁹ Indeed a number of these technologies are undergoing trials in the UK with financial support from the Government.⁴⁰

What could connected and autonomous vehicles mean for pay as you go models?

VED might appear to be a more sustainable revenue model than fuel duty at first glance. However, whilst VED exemptions for electric vehicles are a policy decision which could be reversed, it is not the only axis of change. For example, the onward introduction of connected and autonomous vehicles (CAVs), could present policy makers with a future where more journeys are being taken using fewer vehicles and where a greater proportion of those journeys are shared.

CAVs are a technology which, if realised, have the potential to profoundly change the way we travel. CAVs could increase the prevalence of shared ownership models and on-demand services and reducing individual car ownership,⁴¹ whilst still increasing the demand for road travel.⁴²

A poorly handled future scenario, where individuals maintain their own cars or prefer to travel alone could increase road traffic density as empty cars travel waiting for a customer or return home after dropping off their owner.⁴³ What is perhaps more likely is a future where there are fewer cars with a 'socialised' ownership model where one car will serve many people in a day and carry multiple passengers on a journey, dropping off as it goes. This would likely see fewer cars on the road overall.

Either scenario would have implications for VED or pay as you go. In a future with fewer individuals or companies owning vehicles outright (or where there are multiple owners for each vehicle), VED would potentially become less sustainable as a revenue model. Equally, a pay as you go system based on vehicle miles, in the context of current ownership models, might see a reduction in revenue even as passenger miles increase; simply because more carpooling would result in fewer miles driven overall.

Thought also needs to be given as to how sustainable a pay as you go model would be beyond the immediate concern of declining VED and fuel duty revenues. Perhaps, as technology develops and as currently private modes of road transport become more communal, a public transport style model costed according to passengers travelling rather than the vehicle alone will be required.

This possible scenario, alongside the fuel duty crunch, could mean that the need for a replacement tax and revenue system is no longer a distant proposition. There is a short timeframe for a new system to be designed, developed and installed and remain equitable with a foreseeable funding bottleneck at the end of the next decade. ICE would recommend that an alternative system is in place before this point, and in any event, no later than the end of 2030.

³⁵ NIC (2018) [National Infrastructure Assessment](#)

³⁶ Sensus (2019) [Manage Water and Energy Flow More Effectively](#)

³⁷ Loop Energy Saver (2019) [Website](#)

³⁸ The Guardian (2018) [World's first electrified road for charging vehicles opens in Sweden](#)

³⁹ InsideEVs (2019) [Smart and Sustainable Roads: The Future solution](#)

⁴⁰ Gov.uk (2019) [Technological trials to help future proof roads](#)

⁴¹ Gov.UK (2018) [Future of Mobility call for evidence](#)

⁴² ICE (2016) [National Needs Assessment](#)

⁴³ Ibid

ENGLAND

From roads to railways and bridges to power stations, high-performing infrastructure is vital for economic growth and thriving communities.



1. Highways England (2017) The Road to Growth

2. HS2 (2018) HS2's vision is to be a catalyst for growth across Britain

3. Ofwat (2018) Water sector overview

About ICE

Established in 1818 and with over 92,000 members worldwide, ICE is a leading source of expertise in infrastructure and engineering policy and is widely seen as the independent voice of infrastructure. ICE provides advice to all political parties and works with industry to ensure that civil engineering and construction remain major contributors to the UK economy.

For more information please contact:

Martin Shapland, Policy Manager, ICE

policy@ice.org.uk