The Future of Mobility: what's on the horizon?

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Introduction

The UK's transportation system faces many challenges ranging from road congestion and air quality issues to over-priced, over-crowded trains and buses. Rapid changes in technology are offering up new solutions to tackle these problems, which are likely to have a significant impact on the economy, environment, health and wellbeing.

This report explores some of the most pressing transport-related issues we face today and analyses some of the key trends that are shaping the future of mobility in the UK.

Challenges

Transport is now the highest spending category for households, averaging £79.70 a week[1]. Moreover, it is the largest sector for UK greenhouse gas emissions, accounting for 26% of total emissions. Over-reliance on the private car has resulted the in average British driver spending 124 hours per year stuck in traffic; a figure that has been estimated to increase to 136 hours by 2030.[2] Research has found that every extra minute of commute time reduces job satisfaction, reduces leisure time satisfaction and reduces mental health.

Congestion on the road network has also highlighted air quality as a major public health issue: according to the National Audit Office, over 85% of air quality zones in the UK did not meet the EU nitrogen dioxide limits in 2016.[3] Cities are primarily affected, though some towns also experience high levels of air pollution, and policy makers have come under increasing pressure from voters, the media and campaigners to find solutions to reduce emissions.

Our overcrowded rail services on average carry 4.6% more passengers than they are designed to (5.7% in London, 1.9% across other UK cities).[4] Meanwhile ticket prices have been rising almost twice as fast as the speed of wages since 2010.[5] In a recent National Rail Passenger Survey, 67% of commuters said they were dissatisfied with their journeys when it came to value for money, while 70% expressed dissatisfaction with how delays were handled[6]. The perception that rail services are either overcrowded, overpriced or unreliable have forced many commuters to continue to use the private car as their main mode of transportation, which feeds into the issues of congestion and air pollution detailed above.

Buses are the form of public transport that can carry the largest numbers of people quickly, affordably and cleanly in our towns and cities. More people commute to work by bus than all other public transports combined. However, the number of bus passenger journeys in England fell by 1.5% in the year 2016/17.[7] Moreover, supported bus services - routes subsidised by local authorities because they are not covered by commercial companies - are having funding cut by 63% of local authorities[8]. These are often routes which serve communities where no alternative means of transport exists, meaning any cuts often have a huge impact on residents and local economies, while also increasing reliance on private vehicles.

Policy Context

With the advent of new automotive technologies such as ultra-low emission vehicles (ULEV) and driverless cars, as well as new transport models such as Mobility as a Service, the Government has embedded transport into its Industrial Strategy, making 'the future of mobility' one of its four Grand Challenges. Significant investments are being made in the electrification and automation of road vehicles, the modernisation of rail services, and the development of autonomous aerial and marine transport.

The *Industrial Strategy White Paper* sets out four early government priorities for mobility: (i) to establish a flexible regulatory framework to encourage new modes of transport and new business models; (ii) to seize the opportunities and address the challenges of moving from hydrocarbon to zero emission vehicles; (iii) to prepare for a future of new mobility services, increased autonomy, journey-sharing and blurred boundaries between public and private transport; and (iv) to explore new ways to use data to accelerate development of mobility services and enable the effective operation of the UK's transport system.

The White Paper also announced an automotive sector deal between Government and industry. This included: £1.2bn additional investment in R&D for the automotive sector to develop new low carbon technologies, improve battery technology, and pilot connected and autonomous vehicles; measures to improve the business environment for ULEV and autonomous vehicles; and £500m investment in infrastructure for hydrogen transport and electric car charging infrastructure.

The Government has grand ambitions to see fully self-driving cars on the road by 2021 and is putting in place legislation to realise this goal. There are already several self-driving car trials testing the feasibility of Connected and Autonomous Vehicles (CAV) in Bristol, Coventry and Milton Keynes, and Greenwich in London, these are set to conclude in 2018.

The Automated and Electric Vehicles Act 2018, which received Royal Assent on 19th July 2018, aims to ensure that the regulatory framework keeps pace with the fast-evolving technology for automated and electric cars. The Bill establishes the legal framework for CAVs by setting out liability and insurance issues in relation to self-driven cars. It also provides for regulations to be made in relation to facilities for charging automated and electric vehicles.

The Autumn Budget 2017 announced a £1.7bn Transforming Cities Fund for intra-city transport. This will fund projects that drive productivity by improving connections within city regions. Half of this fund is to be shared between the six Mayoral Combined Authorities and the remainder is open to competitive bidding by other cities in England. In addition, the Chancellor announced £100m to help people buy electric cars and a £200m Charging Investment Infrastructure Fund.

Most recently, the Department for Transport launched a consultation into the Future of Mobility, which ran from 30th July 2018 to the 10th September 2018. The consultation was split into two parts: the first focused on the background to changes in transportation and key emerging trends; while the second section sought evidence on how the Government can support innovation through 'mission-oriented' policy making and the right regulatory framework. The evidence collected in this consultation will feed into the Government's Future of Urban Mobility Strategy which is expected to be released towards the end of 2018.

Analysis

Three key trends that provide a backdrop for a discussion on the future of mobility are set out below, each of which are interlinked:

1. Cleaner Vehicles

A shift towards cleaner vehicles, which is set to accelerate significantly with the development of electric cars and ultra-low emission vehicles. These are expected to bring benefits for air quality, energy security and tackling climate change as the Government works to meet its ambition to have all new cars and vans effectively zero emission by 2040.

2. Connected and Autonomous Vehicles

Improved connectivity and digital infrastructure, including the advent of 5G networks, will play an important role in enabling better journeys and network management. Looking ahead, 5G connectivity speeds will provide the foundations for connected and autonomous vehicles, enabling vehicle-to-vehicle communications in ways that will increase the effective capacity of the road network without significant reshaping of existing physical infrastructure.

3. Mobility as a Service

A significant generational shift in transportation ownership models is taking place. A Department for Transport study found that young adults in the UK are driving less now than their counterparts in the 1990s, with car ownership among these groups also decreasing. As a result of this, car manufacturers are investing heavily in new mobility services, or partnering with ride-hailing firms in anticipation of a growth in shared economy models, Mobility as a Service and advances in automation.

These trends in mobility are likely to reshape transportation systems across the country - with significant implications for other policy areas: electric and ultra-low emission vehicles have the potential to improve air quality and assist in reaching carbon reduction goals; connected and autonomous vehicles could help to solve congestion issues and assist with traffic management; while mobility as a service can break down traditional divisions between public and private transport, with potential benefits for both travellers and transport operators. Nevertheless, it is worth examining each of these developments in turn to draw out the opportunities and potential shortfalls.

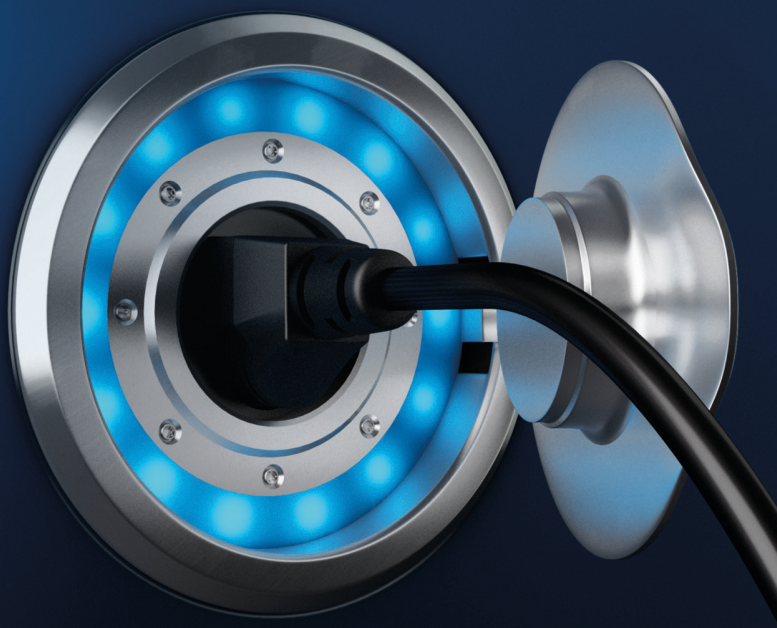
Cleaner Vehicles

Electric and ultra-low emission vehicles promise to tackle the problem of air pollution that have been plaguing cities and towns in the UK. Air quality has become an increasingly pertinent political issue in recent years, receiving much attention across the media and in Westminster. Indeed, it is a pressing public health issue - the WHO recently named air pollution the single biggest environmental health issue - and more than 40 towns and cities in the UK have been found to be at, or exceeding air pollution limits set by the WHO[9]. With many countries, the UK included, set to phase out environmentally harmful vehicles, investment in clean automotive technology has been rising rapidly.

There are, however, some under-reported risks which have often been overlooked when discussing the electromobility revolution. The first is a scarcity of natural resources, specifically when it comes to rare metals and mineral resources needed for batteries. Growth in the electric vehicle sector is expected to exacerbate the the race for scarce natural resources - such as cobalt and lithium - the majority of which are located in only a small number of countries. This poses the real and lasting danger of bottlenecks in the supply chain, especially when global demand in multiple minerals and metals needed for electric vehicles is increasing at a higher rate than mineral extraction. The fact that the monopoly over some of these resources is controlled by corrupt, unstable or authoritarian regimes (for example, the Democratic Republic of Congo accounts for 65% of cobalt supply) only exacerbates this natural resource problem[10].

The second issue concerning electric vehicles is that they are not necessarily as green as some might think. Many of the components in an electric vehicle cannot be reused or recycled at the end of their life, which is especially true of lithium-ion batteries. Moreover, the actual environmental cost of producing electric vehicles is quite high, for example, nickel and cobalt generate high levels of air, soil and water pollution when being mined and smelted[11]. To some extent, the environmental damage from these vehicles actually comes from the supply chain and manufacturing, rather than at the point of use. Of course, the electricity they run on also needs to be taken into account: whether this is generated by sustainable resources or fossil fuels will have implications for the environmental benefits of electric vehicles.

The point here is not to argue that electric vehicles should not be promoted as means for tackling air pollution. Electromobility is likely to bring significant benefits to society. Still, it is important to look beyond the opportunities, factoring in environmental costs in the manufacturing of these technologies, to form a deeper understanding of how electric vehicles might fit into a sustainable and clean future mobility strategy.



Connected and Autonomous Vehicles

According to the SMMT, the trade association for the UK motor industry, connected and autonomous vehicles (CAV) will 'provide huge social, industrial and economic benefits to the UK' by expanding the country's industrial base, improving safety and congestion, and driving up productivity[12]. The applications of CAV are indeed far reaching, straddling a variety of different sectors. Indeed, a KPMG report from 2015 lists a wide array of benefits including: integrated transport with seamless journeys comprising of train, bus and vehicle transportation; improved driver safety; smart parking options allowing for better use of urban spaces; and reduced congestion, improved air quality and better traffic flows.[13]

Despite the benefits of this technology, there have been issues raised about the Government's approach to CAV. A report from the Lords Science and Technology Select Committee, published on 21st February 2017, raises the point that the Government must broaden its focus so that its work on CAV cuts across all sectors and does not focus so heavily on highly-automated private road vehicles[14]. CAV technology is likely to have more significant early benefits outside the road sector, such as in marine and agriculture. A future mobility strategy also needs to take account of public transport vehicles and lorries, linking the deployment of CAV to wider policy goals such as increased use of public transport and the reduction of congestion and pollution.

The Committee also states that the Government has so far focused too heavily on the R&D for the technology behind CAV, without commissioning enough social science research to look at its implementation, especially user acceptance for autonomous vehicles. There are many social and behavioural, even philosophical, questions, that need to be understood better before this technology can be safely deployed. For example, there has not been enough research into the behaviour of drivers taking back control of a fully autonomous vehicle in an emergency situation; and evidence suggests that reactions could be slow and poor in these circumstances. On a philosophical level, autonomous vehicles present a real-life 'Trolley Problem' scenario, where a car may have to choose between putting the car passenger or some other pedestrian(s) in danger. These are not abstract questions: there are real implications for car manufacturers, drivers and motor insurers over who is culpable (legally, financially and morally) in motor accidents involving CAV.

Clearly, there are significant opportunities with CAV and the technology should certainly be a key part of a future mobility strategy. Nevertheless, focusing too much on the private driverless car is likely to limit the real benefits of these technologies applied to other sectors. Moreover, a better understanding of the deployment of how these vehicles will fit into actual transport systems and how pedestrians and drivers will behave towards them is needed to ensure that CAV is safely implemented in a future mobility strategy.

Mobility as a Service

Mobility as a Service (MaaS) describes a shift away from personally-owned modes of transportation and towards mobility solutions that are consumed as a service. It involves harnessing technology to offer more travel choices, with the potential to greatly improve personal mobility. These services might include car clubs, dockless bike hire, and app-based bus services. The benefits to the consumer are clear, but there are also benefits to transport providers who are able to gather better data about travel patterns and tailor their services to be more efficient. The Transport Select Committee is running a live inquiry to explore the 'transformative potential' of MaaS and look at how to overcome barriers to implementation in UK cities and regions.[15]

There are a number of providers currently competing to define and offer different visions of MaaS. Many motor manufacturers have been looking into the potential of MaaS to provide a new market for cars in the wake of declining car sales and a generational shift away from car ownership. To a great extent, the current debate is dominated by commercial mobility service providers, offering a version of MaaS that does not adequately address wider objectives of a city or region. If MaaS is to deliver on the opportunities it promises - better, faster and more personal transportation - it needs to be embedded in a mobility strategy that looks beyond enabling consumer choice, and instead becomes a practical way to connect intra-city transport modes.

Cubiq Transportation Systems defines MaaS as 'a combination of public and private transportation services within a given regional environment that provides holistic, optimal and people-centred travel options, to enable end-to-end journeys paid for by the user as a single charge, and which aims to achieve key public equity objectives.'

This last part is important, as it puts wider public values at the heart of MaaS, rather than simply increased consumer choice with travel options. Cubiq argue that MaaS must be co-ordinated and focus on meeting common objectives[16], otherwise services will become fragmented and risk undermining the goal of a well-connected city. Co-ordinated MaaS, they argue, will enable shared capturing of travel data that will help to shape better service provision.

MaaS offers the potential for an efficient, integrated and personalised multi-modal transport system for the modern city or region. However, it needs to be founded upon the right principals that shape how it works in practice - this means linking the technology to wider policy objectives for cities and regions. These objectives might include limiting traffic congestion, reducing private car ownership, better use of existing infrastructure, more efficient traffic and capacity management, and lessening the environmental impact of our transport system.

Conclusion

This report has analysed some of the key trends that provide a backdrop to the future of mobility: cleaner vehicles, including electric cars and ultra-low emission vehicles; connected and autonomous vehicles; and Mobility as a Service. This is by no means an exhaustive list, and it focuses more heavily on road transportation than rail or other sustainable transport modes like cycling, but it provides some context for understanding what might be on the horizon.

With each technology development, there is a real opportunity to enhance our transport systems, making them more efficient, effective and sustainable than what is currently available. However, there need to be wider considerations about what these technologies are *for*, beyond simply focusing on they are capable of doing.

A future mobility strategy needs to consider: how each technology should be deployed; where they will be most appropriate; how they will interact with current infrastructure; what behavioural impacts they might have on travellers and residents; and how they can be linked to wider policy objectives in cities and regions across the country.

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