TRANSPORT FOR THE South East

Report prepared to support the development of the Transport Strategy for the South East

Future transport technology

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Transport for the South East

LOT D - FUTURE TRANSPORT TECHNOLOGY

Final Report

AUGUST 2019

CONFIDENTIAL

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PROJECT NO. 70050793

DATE: AUGUST 2019

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1 INTRODUCTION

1.1.1. Late in 2018 WSP were appointed to undertake a 'Transport Technology Study' as part of the development of the wider transport strategy. This Technology Study (Lot D) is one of the four in a suite of work which informs the main strategy development (Lot A) and the parallel Freight Study work (Lot B). As such, the information contained within this report has been shared with the wider team to inform their work.

1.1.2. Transportation and mobility is at the start of what could be a revolution, largely driven by advances in digitisation, influencing the choices in when and how people (and businesses) access places for a myriad of activities. Traditionally the transport planning focus has been on the 'commuting' peak, but with changes to employment and leisure activities many parts of the transport network are already experiencing significant pressure at other times of the day and week.

1.1.3. Considering the wider access and mobility needs rather than just traditional transportation modes provides for an integrated approach to people, the places they need to visit and the activities they undertake. This also allows for a wider consideration of land use, activity and mobility needs, all within the context of enabling economic growth across the region.

1.1.4. At the heart of our approach is a fundamental assumption that transport / mobility (in all its guises) is an economic enabler facilitating thriving communities, citizens and commerce. We also embrace the need for sustainable outcomes with potential solutions tailored to the specific needs of a place, its people and the activities they undertake, in this case the large and diverse area that is TfSE. Technology (and associated services) should not be 'one size fits all' and must serve regional and local needs, their specific challenges and help realise opportunities.

1.1.5. We have developed an approach which adds value in developing robust inputs to Lot A as well as providing a solid, standalone foundation for policy and strategy development going forward.

1.1.6. This report includes:

- Chapter 1: Introduction
- Chapter 2: Local & National Overview
- Chapter 3: Mega Trends
- Chapter 4: Mobility Trends
- Chapter 5: Trajectories of Changes in the TfSE Area
- Chapter 6: Impacts of New Mobility on Demand
- Chapter 7: Review of Existing TfSE Future Mobility Initiatives
- Chapter 8: Future Mobility Stakeholder Roles
- Chapter 9: Conclusions

2 LOCAL & NATIONAL OVERVIEW

2.1 LOCAL OVERVIEW

2.1.1. Transport for the South East (TfSE) brings together 16 transport authorities and 5 local enterprise partnerships to work directly with the Department for Transport (DfT) on transport issues facing the South East of England, including:

- Bracknell Forest Council
- Brighton & Hove City Council
- East Sussex County Council
- Hampshire County Council
- Isle of Wight Council
- Kent County Council
- Medway Council
- Portsmouth City Council
- Reading Borough Council
- Slough Borough Council
- Southampton City Council
- Surrey County Council
- The Royal Borough of Windsor and Maidenhead
- West Berkshire Council
- West Sussex County Council
- Wokingham Borough Council
- Coast to Capital Local Enterprise Partnership
- Enterprise M3
- Solent Local Enterprise Partnership
- South East Local Enterprise Partnership
- Thames Valley Berkshire Local Enterprise Partnership

2.1.2. It should be noted that the South East area covered by TfSE does not include the counties of Buckinghamshire and Oxfordshire, which comprise the official 'South East' region in terms of statistical areas. Thus, when evidencing future transport technology trends, data from local authorities will be used instead of the area as a whole to provide a more reliable insight.

2.1.3. The TfSE area is advantageously located with extensive transport connections both nationally and internationally, including international airports, several major ports and strategic motorways, trunk roads and railways. TfSE partners border Greater London, Essex, Buckinghamshire, Oxfordshire, Wilshire and Dorset and are home to 7.5million people and 329,000 businesses.

Source: https://transportforthesoutheast.org.uk/about/

Figure 1 - Transport for the South East Partners

2.1.4. As a new Sub-National Transport Body, TfSE plans to realise its vision for the future through a Transport Strategy. The first stage of which is outlined in the Economic Connectivity Review, published in 2018. The review recognises the role of strategic transport in support of the South East and UK economy, identifying key transport corridors which are economically important and makes the case for investment in the area. Like many places in the UK, the South East anticipates significant change over the coming decades and the review outlines three draft strategic principles to help guide future economic changes in the South East:

- Ensure the delivery of a high quality sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace;
- Facilitate the development of a high quality sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all; and
- Facilitate the delivery of high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment.

2.1.5. The review highlights that planning for the future is inherently uncertain, with the impact of interdependent factors such as 'ageing population, vehicles and energy technology, disruptive digital technologies and the need for climate change resilience and adaptation' potentially changing the requirements of a Transport Strategy. In turn, scenario testing will be used to assess the agility of the Transport Strategy for Transport for the South East.

2.2 NATIONAL OVERVIEW

2.2.1. Transport is a means to an end, it connects people with places and the things they need to do, raw materials to manufacturers and goods to market. Over the last twenty years we have seen the explosion of digital technologies opening up new opportunities, new ways of doing things, creating new business opportunities, and this, coupled with air quality concerns and the transition to a low carbon agenda, have led to some significant advances.

2.2.2. Arguably the transportation sector has been late to the digitisation agenda but **it is now clear that considerable changes are anticipated over the coming decades which will impact every aspect of how people engage with and access their mobility needs** – needs which in turn serve society and the wider economy.

2.2.3. These changes are not happening in isolation, they are influenced by wider global trends and disruptors which are in turn influenced, in part, by the transportation response to them. It is this complex set of interactions that underpins technological and associated economic change and growth.

2.2.4. There have been a number of significant developments with regards to policy and strategy over recent months which provide the foundations for the Future Mobility agenda:

- **Call for Evidence on Mobility as a Service (MaaS), Transport Committee (November 2017)** – In November 2017, the Transport Committee launched an inquiry into the 'transformative

potential of integrated, multi-mode MaaS apps and overcoming barriers to implementation in UK cities and regions'. The concluding report is still awaited.[1]

- **Strategic Business Plan 2019-2024, Network Rail (February 2018)** – The report presents the plan for Britain's railways between 2018 and 2024, with the focus on improving collaborative working between track and train through shared targets and priorities. The plan for Britain's railways is built around four key themes; safety, reliability, efficiency and growth, and highlights that the application of new technologies will be employed as a method of enhancing these key responsibilities. The plan highlights that R&D spend on technology in the rail industry is pitiful compared to other sectors, however that Network Rail are committed to transforming the Britain's railways to 'reap the benefits from emerging trends in automation, intelligent mobility and mobility as a service'.[2] £440m is forecast to be spent on internal research and development activity which will be matched by third party funding and the result will feed into major industry programmes e.g. Digital Railway.
- **Regulatory Review for Autonomous Vehicles, Law Commission (March 2018)** – As part of the Future Mobility Grand Challenge, the Government commissioned a three-year detailed review of driving laws to ensure the UK continues to offer a conducive environment for developing, testing and driving connected and autonomous vehicles. The review aims to examine any legal obstacles to the widespread introduction of self-driving vehicles and identify where reforms may be required.[3]
- **Call for Evidence on Maritime 2050, Department for Transport (March 2018) –** The Government ran a consultation on 'Maritime 2050' between March-May 2019, which is a long-term strategy to secure the future of the UK Maritime sector. The report acknowledges that disruptive technologies have the potential to threaten the UK's position as a leading maritime nation and therefore a long-term strategy is essential.[4] The results from the consultation are expected sometime in 2019. Insights from the document include:

    - The Government's current focus in on smart shipping, particularly autonomy and digitisation - Technology for remotely-operated or autonomous shipping is already in existence, however there is a lack of evidence that it is effective in the role it plays and is economically viable. Demonstrating the technology's application will generate appetite for wider implementation. There is greater potential for technology implementation in the construction of new ships due to the long lifetime of ships. Skills shortages could potentially drive the switch to increasing levels of smart shipping.
    - Alternative maritime propulsion fuels – Potential to transform the way ships look, their requirements for refuelling, journey planning in additional to environmental impacts.

[1] UK Parliament (2018). Mobility as a Service inquiry. [online] UK Parliament. Available at: https://www.parliament.uk/business/committees/committees-a-z/commons-select/transport-committee/inquiries/parliament-2017/mobility-as-a-service-17-19/ [Accessed 7 Dec. 2018].
[2] Network Rail (2018). *Strategic Business Plan - Summary*. [online] Available at: https://cdn.networkrail.co.uk/wp-content/uploads/2018/02/CP6-Strategic-Business-Plan-Comprehensive-Executive-Summary.pdf [Accessed 9 Jan. 2019].
[3] Department for Transport (2018). Government to review driving laws in preparation for self-driving vehicles. [online] GOV.UK. Available at: https://www.gov.uk/government/news/government-to-review-driving-laws-in-preparation-for-self-driving-vehicles [Accessed 7 Dec. 2018].
[4] Department for Transport (2018). *Maritime 2050 - Call for Evidence*. Navigating the Future. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/694879/maritime-2050-call-for-evidence.pdf [Accessed 9 Jan. 2019].

- Additive manufacturing – Presents opportunities and challenges for marine manufacturers, specifically the latter in terms of the need for goods transportation between locations.

- **Mayor's Transport Strategy, Greater London Authority (March 2018) –** The report outlines the Mayor's plans for transport in London over the next two decades. At the centre of the proposals and policies is the aim for 80% of all trips in London to be made on foot, by cycle or using public transport by 2041. For this aspiration to be realised, the strategy acknowledges that engaging with trends such as 'new economic models based on shared access rather than private ownership will continue to evolve and new technologies and increasing digital connectivity' is essential.[5] In turn several proposals are outlined in the strategy that relate to the future mobility and include:
  - 'Proposal 102 - To ensure its information systems and payment platforms take account of technological advances and evolve to remain fit for purpose;
  - Proposal 103 - To explore and monitor the relationship between access to kerb space, including for car parking, and the level of demand for all forms of car use to inform assessment of how demand management measures should evolve over time;
  - Proposal 104 - explore and trial demand-responsive bus services as a possible complement to 'conventional' public transport services in London. This will include consideration of trials that could unlock otherwise difficult-to-serve areas of outer London;
  - Proposal 105 - To take part in trials of new vehicle technology, adopting a safety-first approach, and will consider the application of new vehicle technology in support of the Healthy Streets Approach; and
  - Proposal 106 - To adopt an appropriate mix of policy and regulation to ensure connected and autonomous vehicles develop and are used in a way that is consistent with the policies and proposals of this strategy'[5].

- **Beyond the Horizon: The Future of UK Aviation, HM Government (April 2018) -** The report outlines that the aim of the new aviation strategy is to achieve a safe, secure and sustainable aviation sector, outlining six objectives in detail. New and emerging technologies are identified as a means of addressing some of the challenges facing the sector such as empowering passengers through information at all stages of their journey, minimising delays at borders, developing innovative solutions for aviation security, encouraging data sharing between aviation sector organisations and advancing automation and electrification of aircraft. The final, fully informed aviation strategy will be published in early 2019.[6]
- **Digital Rail Strategy, Network Rail (April 2018)** - Digital Railway is the proposal for the UK to adopt modern digital signalling and train control within the next 25 years and create credible options to upgrade the railway to next generation technology as it becomes available. The programme itself is enabling the delivery of benefits to the industry by embedding new technologies and operational methods to enable greater integration across track and train

[5] Greater London Authority (2018). *Mayor's Transport Strategy*. [online] London. Available at: https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf [Accessed 9 Jan. 2019].
[6] HM Government (2018). *Beyond the Horizon: The Future of UK Aviation*. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/698247/next-steps-towards-an-aviation-strategy.pdf [Accessed 9 Jan. 2019].

operations. In terms of future mobility, the Digital Railway Strategy refers mainly to the introduction of interventions relating to enhancing connectivity and increasing automation on Britain's railways. Examples of the technologies facilitating the movement of data between rolling stock, track infrastructure and operating systems include:

- 'European Train Control System (ETCS), which allows trains to run closer together and travel at their optimal speeds and provides enhanced train protection;
- Connected Driver Advisory System (C-DAS), which provides decision support to drivers in the cab to improve timetable adherence and therefore overall performance;

In turn, those interventions relating to automation and the replacement of human tasks with technology include:

- 'Supervised Automatic Train Operation (ATO), which provides the ability to control trains to a finer resolution in order to run to the maximum capability of the infrastructure in a more consistent way; and
- Automatic Route Setting (ARS), provides the ability to optimise traffic flow, even under disrupted conditions.[7]

With regards to the progress of the transformation and the extent of the technology implementation and associated outcomes, the programme is currently still in the preliminary stages of delivery, with an ongoing commitment to learning lessons from select projects. This is despite that fact that the Digital Railway Programme has been in existence in various forms for over 15 years.[8] For example, the report recounts that 'sound progress' has been made in fitting trains with some digital capability (ETCS in-cab equipment) such as on the Cambrian Line but that the transition from location-specific signalling to an integrated whole-system is a complicated endeavour.

- **Four Grand Challenges within the Industrial Strategy, Department for Business, Energy and Industrial Strategy (June 2018)** –The 'Future of Mobility' Grand Challenge outlined in the Industrial Strategy outlines the Government objective to keep the UK at the forefront of transport innovation, stating that 'we will become a world leader in the way people, goods and services move'. Opportunities to dramatically reduce congestion, carbon emissions, improve customer experience, drive efficiency and enable access for all through innovation in engineering, technology and business models will be encouraged by a flexible regulatory framework, testbed funding and research & development investment.[9]
- **Future Mobility Call for Evidence, Department for Transport & Centre for Connected and Autonomous Vehicles (July 2018)** – The Government sought views and evidence on the

[7] Network Rail (2018). *Digital Railway Strategy*. [online] Available at: https://cdn.networkrail.co.uk/wp-content/uploads/2018/05/Digital-Railway-Strategy.pdf [Accessed 8 Jan. 2019].
[8] Institution of Railway Signal Engineers (2017). *Making a Success of the Digital Railway*. [online] London. Available at: http://www.irse.org/events/publicdocuments/IRSE%20White%20Paper%20on%20Digital%20Railway%20(final%20-%20December%202017).pdf [Accessed 8 Jan. 2019].
[9] Department for Business, Energy and Industrial Strategy (2018). The Grand Challenges. [online] GOV.UK. Available at: https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges [Accessed 7 Dec2 Dec. 2018].

'Future of Mobility' to inform the Future of Urban Mobility Strategy in addition to the Future of Mobility Grand Challenge. Analysis of the responses is expected to be published early 2019.[10]

- **Last Mile Call for Evidence, Department for Transport (July 2018)** – In addition to the Future Mobility call for evidence, 'The Last Mile' call for evidence was also launched in July 2018. The call aimed to ascertain evidence on the opportunities available to deliver goods more sustainably as well as some of the barriers.[11]
- **National Infrastructure Assessment, National Infrastructure Commission (July 2018)** – The report makes recommendations on the infrastructure needs and priorities of the UK. In relation to the future of mobility, the commission commends the Government for positioning the UK as a leader of connected and autonomous vehicle innovation however recommends that 'the implications of technological innovation in long term transport planning processes' are addressed.[12]
- **Road to Zero, Department for Transport (July 2018)** –The Government outlined its ambition to see at least 50% of new cars and 40% of new vans to be ultra-low emission by 2030 and end the sale of new conventional petrol and diesel cars and vans by 2040. The strategy also sets out plans to enable massive expansion of green infrastructure and reduce extant vehicle emissions in order to help the government achieve elements of the Industrial Strategy.[13]
- **Draft Road Investment Strategy 2: Government Objectives, Department for Transport (October 2018) -** The Second Road Investment Strategy (RIS2) covers the years 2020 to 2025 and aims to support the economy, as well as being safe, more reliable, greener, more integrated and smarter. In relation to future mobility, the Draft RIS2 Government Objectives publication states that the SRN needs to be able to accommodate today's demands but also those in the future and that the UK has the opportunity to become a world leader in responding to and implementing technological developments. The report recognises that Highways England has already responded to the increasing digitisation of society 'with a combination of innovation and flexibility' but also outlines some objectives to continue this preparation for technological change including:

  - 'Be empowered to develop the infrastructure standards of the connected and autonomous era, by identifying how new technology can be effectively rolled out across the network in a way that is both safe and speedy. This is likely to include:
    - Supporting vehicle manufacturers as they work to create the right flows of data and information to and from connected and autonomous vehicles.
    - Making smart motorways suitable for regular use by automated vehicles as soon as possible in RP2, to meet the Government's ambition to see fully self-driving cars, without a human operator, on UK roads by 2021.

[10] Department for Transport (2018). Future of mobility call for evidence. [online] GOV.UK. Available at: https://www.gov.uk/government/consultations/future-of-mobility-call-for-evidence [Accessed 7 Dec. 2018].
[11] Department for Transport (2018). The Last Mile – A call for evidence. [online] GOV.UK. Available at: https://www.gov.uk/government/consultations/the-last-mile-a-call-for-evidence [Accessed 7 Dec. 2018].
[12] National Infrastructure Commission (2018). National Infrastructure Assessment. [online] National Infrastructure Commission. Available at: https://www.nic.org.uk/our-work/national-infrastructure-assessment/ [Accessed 9 Jan 2019].
[13] Department for Transport (2018). Government launches Road to Zero Strategy to lead the world in zero emission vehicle technology. [online] GOV.UK. Available at: https://www.gov.uk/government/news/government-launches-road-to-zero-strategy-to-lead-the-world-in-zero-emission-vehicle-technology [Accessed 3 Jan. 2019].

- Making all-purpose trunk roads suitable for regular use by automated vehicles without the need for major upgrades to their physical infrastructure.
- Creating guidance or standards that local authorities can use to bring autonomy to their network.

- Continue with existing provision of data, and ensure an open architecture that allows software developers to provide users with new services.'[14]

- **Technology and Road Investment Strategy (RIS) 2, Department for Transport (October 2018) –** The paper discusses several developments in technology that affect mobility, stressing that the resulting policy environment is highly uncertain and that this uncertainty will persist despite championing research in the area. The report also highlights the importance on being flexible and setting a vision, with a focus on outcomes.[15] Key technology developments outlined in the report are grouped into five key areas, which match the five pillars of Future Mobility previously cited by WSP[16] and include:

  - Connectivity – The number and capabilities of connected vehicles is expected to grow rapidly; however, it is not yet clear which applications will prove. Exact network architecture and merits of the potential telecoms technologies that support increasingly connected vehicles is also an ongoing matter of debate. Highways England are aware that there may be a need for future digital infrastructure on the network though and have accounted for this in the National Roads Telecommunications Service (NRTS) contract. Testing of some of the new technologies has also started such as the A2/M2 Connected Corridor between London and Dover.
  - Automation – Sophisticated driver assistance car features are already emerging and 'most observers now accept that the technology required to deliver fully automated vehicles is achievable'. Manufacturers have in turn committed to launch vehicles with level 4 automation capabilities by the early 2020s and the Government been encouraging of on-road trials in addition to making headway with legal frameworks. However, the report also recognises how dependent progress is on the speed of technology development, legislation, public acceptance, infrastructure requirements and insurance amongst many other things.
  - Sharing – The report recognises that there has been a rise in new shared-access mobility models, such as 'dockless' bikes, which have been enabled by digital innovations and highlights how planners are beginning to investigate potential implications on road utilisation and layout of a more widespread shift from private vehicles to shared transport. The Department for Transport has in turn commissioned research to inform a 'Future of Urban Mobility Strategy' however evidence collected thus far suggests that people do not change their behaviour as soon as new technology becomes available and therefore a complete paradigm shift in how transport is used is a longer-term possibility.

[14] Department for Transport (2018). *Draft Road Investment Strategy 2 - Government Objectives*. Moving Britain Ahead. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/752066/draft-road-investment-strategy-2-governments-objectives.pdf [Accessed 8 Jan. 2019].
[15] Department for Transport (2018). *Technology and RIS2*. Moving Britain Ahead. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/752168/technology-and-ris2.pdf [Accessed 9 Jan. 2019].
[16] WSP (2017). *New Mobility Now*. London.

- Electrification & Alternative Fuels – Already several types of electric vehicles are on the market and there is debate surrounding which will prove to be the most effective, with different OEMs backing different technologies. Sales of electric vehicles are increasing year on year and the Government has the objective to end the sale of conventional combustion engine vehicles in the UK by 2040. Measures such as Government subsidies and research competitions are aiding the progress of this aspect of future mobility, however it is highlighted that sufficient rollout of public charging infrastructure will be key to meeting the Government's target. Collaboration between public and private stakeholders is essential in bringing this to fruition.
- Business Models - There has been advances in payment mechanisms with a general move away from cash, in addition to digitally enabled shared access business models and device enabled applications providing real-time information. These in turn are cited as an early manifestation of 'mobility as a service', whereby passengers can access many different modes through an integrated transport network. The uncertainty relating to 'service provision' models of transport however, is also recognised, stating that they are most likely to initially take off in dense urban centres.

- **Taking Flight: The Future of Drones in the UK Government Response, Department for Transport (January 2019) –** The Government ran a consultation between July - September to develop policy and regulation surrounding drones and other unmanned aircraft to foster responsible usage. Government action to date on drones has included updates to the Air Navigation Order (ANO) and Aviation & Maritime Security Act stating that a person much not use a device to endanger people or operations, height and aerodrome restrictions, drone size requirements which require Civil Aviation Authority (CAA) registration, product standards enhancement and development of geo-fencing capabilities and data availability. Government responses to the key aspect of the consultation included:

  - Foundation of Future Flights: The Air Navigation (Amendment) Order 2018 – Despite welcoming the interim introduction of a 1km restriction around airports, the report informs of a strong consensus from airports and airlines that the current restriction does not extend far enough and thus the Government is acting to amend the zone size. The consultation responses also supported the Government intentions to impose a minimum operator age on drones but not for remote pilots so not to hinder the positive early learning benefits of such devices. The report however outlines that the decision to place a minimum age for drone operators has been deferred due to contrasting proposals from the European Aviation Safety Agency (EASA).
  - A Draft Drones Bill – The consultation response outlines several new police powers the Government is taking forward to better enforce drone misuse, inclusive of drone and operator/pilot information procurement and seizure of drones. Notably consultation responses also state that police powers are not deemed to solve drone misuse alone, but that education and communications of regulations is an essential facet of the endeavour. The Government will also take forward the proposition to give police the power to issue Fixed Penalty Notices (FPN). The Government proposition to implement Flight Information Notification Systems (FINS) however was generally resisted in the consultation and therefore the Government has decided not to mandate it at present.
  - The Future: Counter-drone technology and modelling the uptake of drones – The consultation feedback supports the Government's view that frameworks for testing and use of counter-drone technology are required. Concerns of technology misuse were also raised and it was

agreed that safeguards are also required. The Home Office has in turn been tasked with advancing the policy work in this area. In terms of the number of commercial operators and drones estimated in the UK up to 2050, respondents (who were mainly leisure users) indicated that they thought the Department's estimations were overestimated, with market saturation occurring more rapidly than expected. Responses will be used by Department for Transport's analysts to update forecasting scenarios and assumptions.[17]

- **Clean Air Strategy, Department for Environment, Food and Rural Affairs (January 2019) –** The report outlines the UK strategy to tackle sources of air pollution and reduce emissions, highlighting how the priority has shifted from large individual sources of pollution to the contribution of smaller, more diffused sources of air pollution.[18] The report complements the Industrial Strategy, the Clean Growth Strategy and the 25 Year Environment Plan and will be underpinned by new England-wide legislation and local powers. The report highlights the key role that transport must play in reducing emissions, with the sector (inclusive of road transport, domestic shipping, aviation and rail) currently being responsible for 50% of nitrogen oxides, 16% of fine particulate matter ($PM_{2.5}$) and 5% of non-methane volatile organic compounds (NMVOCs).[19] Actions to reduce emission from transport are summarised as follows:
  - Road Transport – Immediate challenge is to reduce roadside concentrations of nitrogen oxides of which roads transport is responsible for 80%. By 2040 sales of conventional petrol/diesel cars and vans will be ended, with progress reviewed in 2025. For buses the Government is in the process for providing over £345 million for the purchase and retrofitting of bus fleets in the UK, with the winners of the most recent round of funding due to be announced in January 2019. Levies on HGV Road Users by vehicle type have in turn been designed to incentivise cleaner commercial fleets and funding has been allocated to tackle air quality concerns associated with road infrastructure though the Road Investment Strategy. Particulate emissions from non-exhaust sources resulting from friction also require attention, with responses to a Call for Evidence on tyre and brake wear currently being reviewed.
  - Maritime – The UK has played a leading role in negotiating international emission limits in the North Sea Emissions Control Area (ECA) and International Maritime Organisation (IMO) for sulphur, nitrogen oxide and greenhouse gases, sending clear messages that a switch to zero emission technologies is looming. 'Maritime 2050' in turn is the UK long-term strategy that is currently in development and will be followed by a number of further actions in Spring 2019 including the publication of a 'Clean Maritime Plan' outlining domestic emission reducing, publishing of a Call for Evidence to explore options for standardising environmental regulations for vessels operating domestically, consult on options for extending the current ECAs in UK water and publish guidelines advising ports on effective Air Quality Strategies.

[17] Department for Transport (2019). *Taking Flight: The Future of Drones in the UK Government Response*. Moving Britain Ahead. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/769128/future-of-drones-in-uk-consultation-response-web.pdf [Accessed 9 Jan. 2019].

[18] Department for Environment, Food and Rural Affairs (2019). *Clean Air Strategy*. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770715/clean-air-strategy-2019.pdf [Accessed 15 Jan. 2019].

[19] Department for Environment, Food & Rural Affairs (2018). UK Emissions inventory submission under NECD and CLRTAP. London: UK Government. Available at: http://cdr.eionet. europa.eu/gb/eu/nec_revised/inventories/envwnwqzg/Annex_I_Emissions_reporting_template2018_ GB_v1.0.xls

- Aviation – Aircraft themselves emit air pollution at all stages of their journeys but are not the only sources of emissions at airports, with land journeys by passengers, workers and freight transport also contributing. Internationally, the Government has endeavoured to improve standards on emissions and domestically has recently published a consultation on a new domestic aviation strategy, Aviation 2050. Industry in turn has acted through introducing lower-emission technology and practices, improving public transport and operating aircraft more efficiently. The Government plans to take a more collaborative approach in order to make the vision outlined in Aviation 2050 a reality.
- Rail – An industry taskforce has been set up to consider how energy sources can power trains and other network Rail infrastructure. This includes examining how to remove all diesel-only trains by 2040 (passenger and freight traction). There is activity already ongoing by both Government, such as Innovate UK competitions and Transport Systems Catapult research projects, and in industry such as collaboration with educational institutions e.g. Porterbrook Leasing Company with the University of Birmingham. With regards to electrification, the report states that as battery technologies improve, that the replacement of diesel engines for electrical storage systems (to provide power to train between electrified sections) would be expected.
- Modal Shift:
  - Freight: Between 2014-2019 the Government invested £235 million in the Strategic Freight Network to improve the capacity of the freight rail network and will continue to work with Network Rail between 2019-2024 to develop a programme for freight enhancements. Freight mode-shift grants helped remove 800,000 lorry journeys from Britain's roads per year with particular opportunities for further mode-shift in major construction project e.g. HS2.
  - Active Transport: Nearly £2 billion is being invested by the Government as part of the Cycling and Walking Investment Strategy to double cycling and walking by 2025 and reverse the decline in walking. Additionally, train operating companies have been provided with £34 million since 2010 to improve cycle facilities. This has translated to the provision of 22,000 new cycle parking spaces at stations in England, more than tripling the number of spaces and increased cycle trips to stations by 40%. In 2018 the Prime Minister also announced that a £2million fund to support e-cargo bikes will also be available.
  - Public Transport: The 2017 Bus Services Act, funding from the Transforming Cities Fund and the Bus Service Operator Grants all aim to improve bus-based infrastructure and increase public transport usage to reduce emissions. Mode shift to rail has been encouraged by franchising (increasing length and frequency of trains), journey time reductions from investments such as HS2 and making the rail network more accessible for those with disabilities.
- Non-Road Mobile Machinery – This includes agricultural machinery, construction equipment, non-sea faring boats, watercraft, industrial equipment (such as off-road trucks, road resurfacing machines and transport refrigeration units) and household machinery. Sulphur emissions are controlled by setting a maximum sulphur content on the fuel and other emissions from regulations setting maximum emissions levels on engines. The Government in turn is reported to be implementing more stringent emission standards across a wide range of engines from 2019 to reduce emissions. For the use of red diesel, the Government published

a Call for Evidence into red diesel use in 2018 and is currently developing options for encouraging a transition to cleaner technologies which will be published in Spring 2019.

- **Foresight Future Mobility Report (February 2019) –** Data is already driving change in the system. Using and sharing data securely and in ways that benefit both companies and public authorities is key. Transport for London's shared data generates around £130 million per year for the economy.
    - Closer to real-time understanding of systems is possible, improving understanding of trends and making it easier to design more integrated systems, spot disruptive trends sooner, and improving decision-making.
    - The movement of goods continues to be critical to our economy. Two billion tonnes of goods were moved in the UK in 2016, 89% by road. There are opportunities out to 2040 for technology in freight. A growing population and demand for quicker deliveries in narrower windows, puts pressure on urban freight deliveries. This, combined with the changing nature of work, increases the number of vans.
    - Hard and soft measures are likely to be key to achieving change, linked with clear goals. This means that the potential of technologies such as self-driving vehicles (be those buses, droids, cars or trains) to support wider objectives can be realised. In Stockholm, through a combination of investing in separate cycling lanes and campaigns, the proportion of cycling trips increased from 5 to 9% between 2004 and 2015.
    - The right solution is needed for each place. Urban, sub-urban and rural areas all require different responses. In rural areas 87% of trips are by car/van and 78% in urban areas, in London the figure drops to 53%.
    - There has been profound social change over the last 20 years. For example, commuting trips are down 20% per person, shopping trips are down 20% per person. Since 2002 the annual distance driven by each car driver is down about 12%.
    - The nature of work, retail, and leisure are changing. People's and businesses responses to this are shaping new travel patterns and behaviours. For example, in 2018, 17.9% of all retail sales were internet sales, compared to 3.3% in 2007.
    - Behavioural and social science can help us better design our built environment and its transport system around users, and allow technology to improve the lives of individuals and society. For example, mostly for societal reasons, the percentage of young people with driving licences fell between 1992 and 2014 from 48% to 29% among 17-20 year olds. This trend of lower car use continues throughout their lives.

Below are the policy perspectives from the report:

1. Consider transport as a system, rather than loosely connected modes.
2. Consider the wider objectives that the transport system can help to achieve.
3. Outline a clear long-term national vision and goals that are mindful of diverse local priorities.
4. Understand that geography is key to ensuring outcomes are practical at local and regional levels.
5. Examine the challenges and opportunities by rural areas.
6. Integrate passenger transport with freight, alongside housing priorities, when making planning decisions.
7. Use a scenarios approach to explore different futures, identify opportunities, and help mitigate the unintended consequences of new transport modes, technologies and/or trends.
8. Use both hard and soft measures to achieve the scale of change needed.
9. Consider the impacts of future technologies on revenues and costs.
10. Consider prioritising walking and cycling when allocating land use for transport, to promote wider social benefits.

- **Invitation to Comment: Code of Practice – Automated Vehicle Trailing (February 2019)** – In 2015 the Government published 'The Pathway to Driverless Cars: A Code of Practice for Testing in 2015' in order to establish the UK as a global leader for trials of automated vehicle technology. Since the publication, the code has now been updated and the Department for Transport have issued a document requesting feedback. The code will then be revised and the guidance updated. The guidance includes information on vehicle requirements, engagement and safety among other topics.
- **A Review of Freight and the Sharing Economy – Foresight, Government Office for Science (February, 2019)** – The report aims to provide a holistic review of freight and the shared economy whilst also providing evidence to help the UK Government think systematically about the future in this sector. The report indicates that freight sharing is becoming increasingly prevalent in modern logistics due to easier access and advances in technology. Additionally the report focuses on four key areas of logistics: transport, warehousing, last-mile and data sharing. Finally the report anticipates that freight sharing will increasingly become a feature of business logistics practice in the UK.
- **Mobility as a Service, Transport Committee (March 2019) –** In November 2017, the Transport Committee launched an inquiry into the 'transformative potential of integrated, multi-mode MaaS (Mobility as a Service) apps and overcoming barriers to implementation in UK cities and regions'. Following the inquiry, the Mobility as a Service Report was published in March 2019. The report was intended to increase public awareness of MaaS and highlights why it could be important and is worth investing time and effort to understand; and clarifies the Department for Transport's (DfT) role in shaping its development in the UK. The report recommends steps for the government to take in terms of leadership, support and legislation in order to enable the role of MaaS in transforming mobility.
- **Future of Mobility: Urban Strategy – Department of Transport (March 2019) -** The 'Future of mobility: urban strategy' outlines the government's approach to maximising the benefits from transport innovation in cities and towns. It sets out the principles that will guide government's response to emerging transport technologies and business models. The document also presents the 6 high-level 'key changes' that are fuelling the evolution of transport, which are:
    - Cleaner Transport: There is an increasing trend that transport is becoming cleaner. This is in part due to decreasing battery prices, improvements in energy density and the developments of alternative fuels. The UK has plans to be at the forefront of the design and manufacturing of zero emission vehicles, aiming for all new cars and vans to be zero emission by 2040.
    - New Modes: Technology is enabling new ways of transporting people and goods; drones, new forms of micro mobility and light electric freight vehicles are just a few of the ways in which technological advancements are impacting transport.
    - Data & Connectivity: The increasing availability of data and improved connectivity is enabling travellers to have access to more information related to their journeys as well as enabling vehicles to communicate with each other and provide information to network providers. Additionally, advances in machine learning could provide a number of opportunities in the transport sector, such as self-driving vehicles, improved reliability of transport services, and identifying congested areas etc.
    - New Business Models: New digitally enabled business models are emerging with regards to transport provision. For example, ride-hailing and mobility as a service are both digitally enabled models that have impacted the transport sector.

- Automation: Improved sensor technology and computing power/software is enabling increasing levels of automation in transport across a number of modes. UK companies are at the forefront of this field with several projects expected to deploy self-driving vehicles on public roads and spaces by 2021.
- Changing Attitudes: Road travel demand across England and Wales is expected to increase over the coming decades, however this is mainly driven by population growth. When looking at travel per person, people are actually travelling less. This is due to a decline in commuting driven by flexible working and working from home, as well as decreases in leisure trips such as trips for shopping (these have decreased by 30% over the last decade).

Additionally, the report outlines the following nine principles that will underpin the Governments approach in facilitating innovation in urban mobility for freight, passengers and services:

1. New modes of transport and new mobility services must be safe and secure by design.
2. The benefits of innovation in mobility must be available to all parts of the UK and all segments of society.
3. Walking, cycling and active travel must remain the best options for short urban journeys.
4. Mass transit must remain fundamental to an efficient transport system.
5. New mobility services must lead the transition to zero emissions.
6. Mobility innovation must help to reduce congestion through more efficient use of limited road space, for example through sharing rides, increasing occupancy or consolidating freight.
7. The marketplace for mobility must be open to stimulate innovation and give the best deal to consumers
8. New mobility services must be designed to operate as part of an integrated transport system combining public, private and multiple modes for transport users.
9. Data from new mobility services must be shares where appropriate to improve choice and the operation of the transport system.

Finally the report concludes by highlighting the need to effectively manage the technological changes associated with the transport sector in order to boost productivity and investment, increase export opportunities, and create high quality jobs. If these changes are not managed, undesired effects such as increasing congestion or reducing sustainable travel could occur. Therefore the report states that " the Government is committed to managing this transition to maximise the benefits and mitigate the risks of changes in mobility".

2.2.5. In parallel with the above policy and strategy work, pioneering live projects in the Transport for the South-East area such as that of the A2/M2 connected corridor project are underway. The high-tech corridor is being created in Kent between Dover and the Blackwall Tunnel and aims to connect vehicles and infrastructure wirelessly promising enhanced journey safety and reliability. Kent County Council are at the forefront of this pioneering activity and are contributing substantially to the wider collective body of evidence-based future mobility learning, grounded in technology and its applicability to places in the UK and elsewhere.

3 MEGA TRENDS

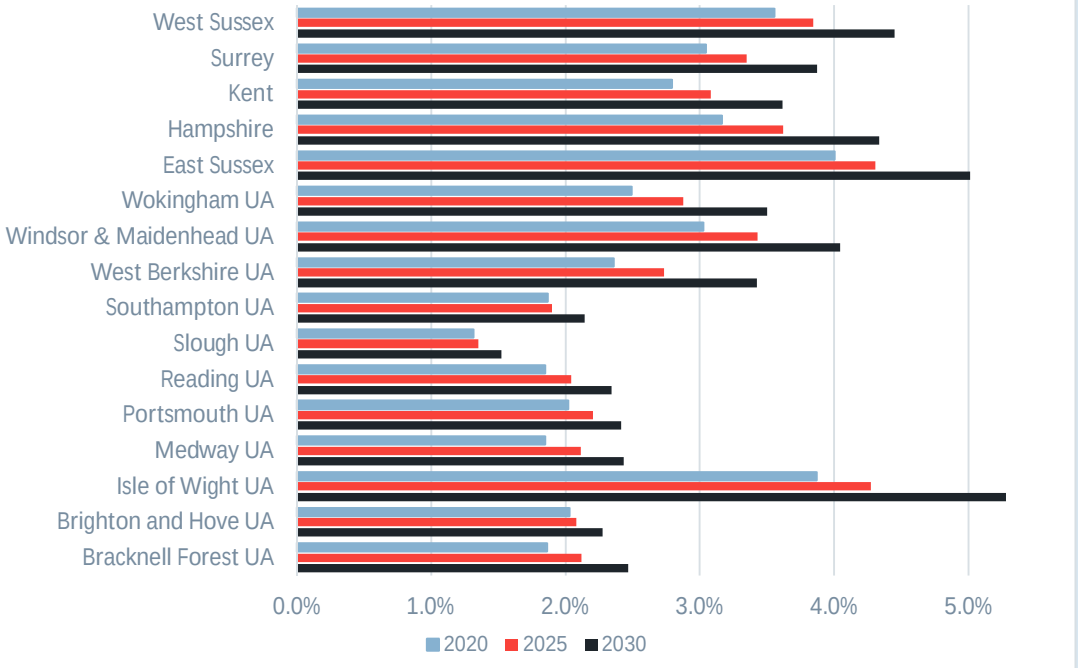
3.1.1. The access and mobility needs of our society are increasingly influenced by mega trends that are shaping many aspects of society which in turn influence how, when and where people will need to travel. These can be categorised broadly as follows and detailed below in the following tables;

- Demographic challenges
- Social change
- Environmental focus
- Economic shift
- Political landscape

3.2 DEMOGRAPHIC CHALLENGES

Table 1 - Demographic Challenges

TRENDS	IMPACTS ON ACCESS AND MOBILITY
Growing & Ageing Population ***Maturity:*** Emerging	**Headline:** *An increasingly ageing population will have different transport needs and expectations* Across the UK our population is growing and indications from ONS data is that it is ageing. In 2019 the over-65 population resident in the TfSE area is predicted to account for 19.7% of the population (based on the 2011 census), however by 2030 this is set to increase to 23.5%. The extent of this trend however is not homogenous across the area as illustrated by Figure 2, which shows the proportion of the population expected to be aged above 65 in 2020, 2025 and 2030. Although the populations of the Isle of Wight and East Sussex are predicted to have the highest proportion of residents over 65 by 2030, the two unitary authorities predicted to observe biggest increase in the proportion of over 65-year olds as a proportion of their populations from 2019 is the Isle of Wight and West Berkshire (5.6% and 4.8% respectively). An ageing population will have different expectations and needs of all modes of transport and we will have to consider their vulnerability in design.



Source: ONS 2016-based subnational population projections for LAs and higher administrative areas

Figure 2 - Predicted Proportion of Population Aged over 85 in 2020, 2025 and 2030 in the TfSE Area

Ageing Economically Active Population ***Maturity:*** Emerging	**Headline:** *Increasing retirement age and taking on larger financial burdens later in life means that people will need to work for longer* By 2020, the retirement age for both men and women, will be 66 and this is planned to increase to 67 by 2028 and to 68 by 2039, thus delaying the age at which one can claim their state pension. Additionally, people in the UK are increasingly having to take on larger financial burdens as housing affordability reduces for first-time house buyers. In most local authorities in the South East specifically, an average first-time buyer spent more than five times their income on buying a property with a mortgage in 2017, compared to the increasing national average of 4.3 times. [20] Subsequently in 2017, the average age of someone buying their first home in the UK was 30 years old, seven years older than the 1960s. [21] Longer mortgage terms are also becoming increasingly popular, with 60% of first-time buyers choosing mortgages longer than 25 years which is double the proportion of a decade ago.[22] Consequently, this could mean homeowners are paying off mortgages till a later age and therefore need to continue working for longer in order to do so. Mortgage debt held by 65 years olds in turn is projected to nearly double by 2030 from 2014 levels.[23] An increasingly financially burdened ageing population who still need to commute to work will have different expectations and needs of all modes of transport and we will have to consider their vulnerability in design and other assumptions.
Health & Wellbeing ***Maturity:*** Emerging	**Headline:** *Less people are undertaking physical activity and many are suffering ill effects of an unhealthy, inactive lifestyle* It has been suggested that a combination of factors is leading to a reduction in walking and cycling in some areas. Figure 3 illustrates the proportion of adults in TfSE Local Authorities who walk or cycle at least once a month between the years 2012-2017, and confirms that this trend is present in the area, although not homogenously. All Local Authorities in the TfSE area have seen a reduced level of walking and cycling activity in their adult populations between 2012-2017 with Slough reporting the biggest decrease of 17.5% followed by Wokingham of 8.4%.[24] [25] Poor levels of walking and cycling, coupled with concerns over obesity levels, which has increased from 15% of the UK population to 26% since 1993, has led to an increased focus on growing sustainable travel.[26] An increasing reliance of motorised transport, even for shorter trips, could lead to the danger of widespread 'fitlessness' and increased car dependency. Conversely there is a trend towards the 'quantified self' with people measuring their daily steps, miles cycled and calories consumed as part of an interest in maintaining a healthier lifestyle.

[20] Office for National Statistics (2017). *First-time buyer housing affordability in England and Wales - Office for National Statistics*. [online] Ons.gov.uk. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/firsttimebuyerhousingaffordabilityinenglandandwales/2017.
[21] UK Finance (2017). *UK and Irish Housing Markets: A First-Time Buyer Perspective*. [online] London. Available at: https://www.cml.org.uk/news/cml-research/uk-and-irish-housing-markets-a-first-time-buyer-perspective/ [Accessed 3 Jan. 2019].
[22] Pickford, J. (2016). *Mortgage terms lengthen as house prices rise | Financial Times*. [online] Ft.com. Available at: https://www.ft.com/content/eefcc9aa-11e7-11e6-91da-096d89bd2173 [Accessed 10 Jan. 2019].
[23] Intermediary Mortgage Lenders Association (2018). *Bridging the gap: Developments in later life lending to an ageing population*. [online] Available at: http://www.imla.org.uk/resources/publications/imla-white-paper-developments-in-later-life-lending.pdf [Accessed 10 Jan. 2019].
[24] Department for Transport (2014). *Local area walking and cycling in England: 2014 to 2015*. [online] GOV.UK. Available at: https://www.gov.uk/government/statistics/local-area-walking-and-cycling-in-england-2014-to-2015 [Accessed 11 Jan. 2019].
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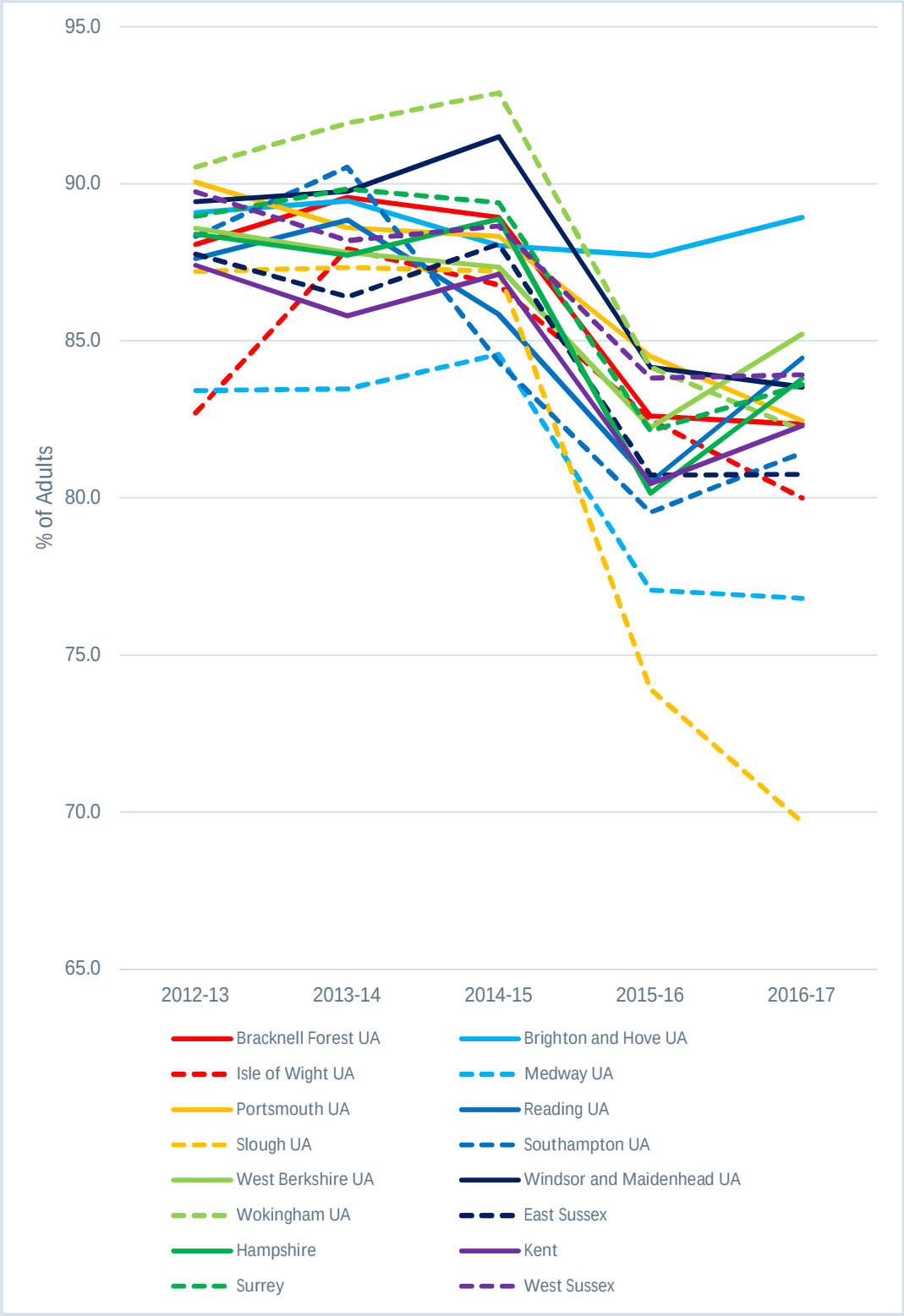


Source: Department for Transport, Table CW0301, 2012-2017

Figure 3 – Proportion of Adults who Walk or Cycle at least Once a Month in the TfSE Area 2012-2017

Loneliness ***Maturity:*** Emerging	**Headline:** *Increasing numbers of people, across ages all ages and socioeconomic groups, are living alone with adverse effects* The impacts of loneliness, particularly in the elderly, is beginning to be understood. Isolation from family and community can result in poor mental and physical health, with studies indicating that lonely people are more likely to suffer from dementia, heart disease and depression.[27] A recent survey by the British Red Cross found that 51% of adults in the South-East feel lonely always, often or sometimes, highlighting that it's not only older people who feel isolated at times.[28] Severance in communities can also lead to physical isolation. Driven by concerns over an increasing, ageing population, the needs of the lonely (of all ages) will need to be addressed through the changes to the built environment and with specific mobility interventions.
Urbanisation ***Maturity:*** Emerging	**Headline:** *Cities are growing at a rapid pace* Residential populations are growing with knock on positive impacts for both daytime and night-time economies but put pressures upon healthcare and education needs. Generally, this expansion has been driven by younger people. Growing resident populations place particular internal pressures on networks however.

[27] Valtorta, N., Kanaan, M., Gilbody, S., Ronzi, S. and Hanratty, B. (2016). Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. Heart, [online] 102(13), pp.1009-1016. Available at: https://www.ncbi.nlm.nih.gov/pubmed/27091846 [Accessed 7 Dec. 2018].

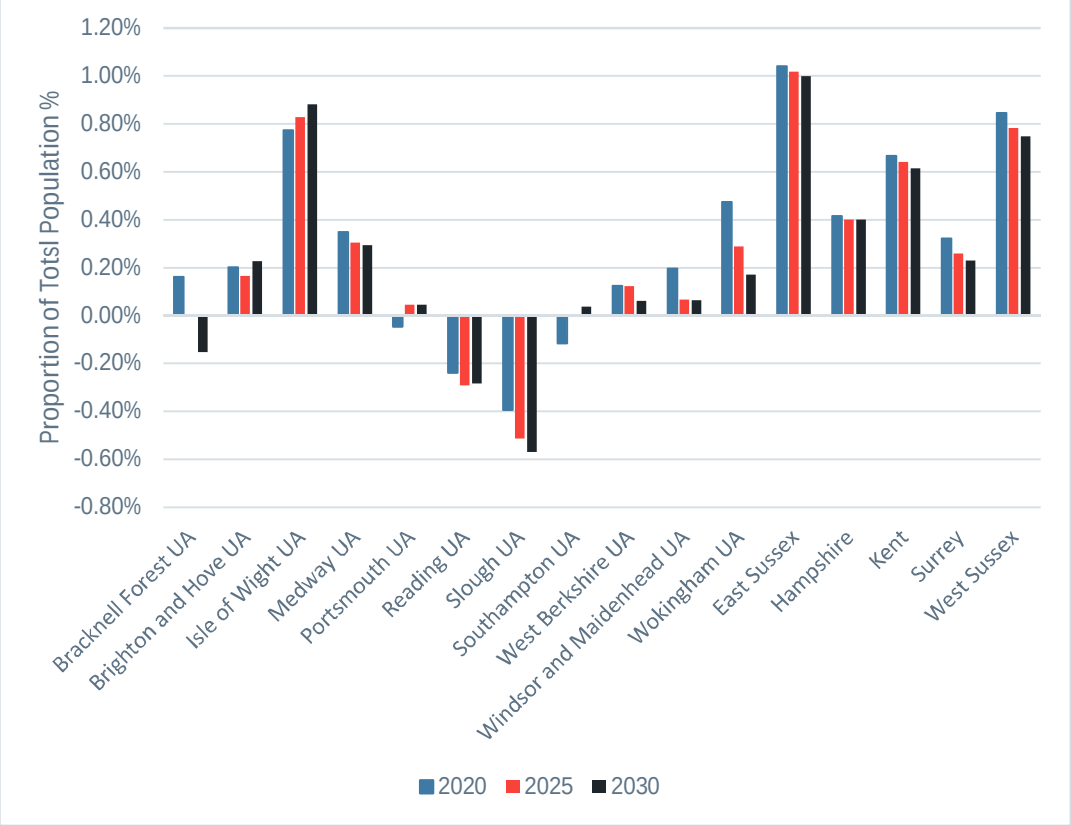
[28] Tijou-Smith, B. (2018). *Alarming figures highlight loneliness in the South East*. [online] UNIfied News. Available at: https://unified.org.uk/2018/12/south-east-loneliness-figures-released/ [Accessed 10 Dec. 2018].

Net Migration

Maturity:
Established

Headline: *Net migration will continue to fluctuate, region by region, conurbation to conurbation*

In recent years, the population of the South East of England has been shaped by net in-migration from within the UK as well as from abroad. ONS data predicts this net migration to the TfSE area to continue, with populations increasing by 385,700 between 2020 and 2030 due to positive net migration.[29] Figure 4 below shows that East Sussex, West Sussex and the Isle of Wight are predicted to experience the largest increases in net migration between 2020 and 2030 compared to other Local Authorities in the area as a proportion of their total predicted populations, with the maximum proportion being 1%. Slough and Reading in turn are expected to see a net reduction in migration, with 0.5% and 0.3% people expected to move out of each local authority in the period. Ongoing political uncertainty however could see this change with particular impacts in certain towns and cities where migrant labour has been relied upon.[30] These changes may have impacts upon labour markets and associated mobility needs particularly where cost is a driver.



Source: ONS Table 5: 2016-based subnational population projections with components of change (births, deaths and migration) for local authorities and higher administrative areas in England

Figure 4 - Net Migration in 2020, 2025 & 2030 as a Component of Total Population in TfSE Local Authorities

[29] Analysis using: Office for National Statistics (2018). *Population projections incorporating births, deaths and migration for regions and local authorities: Table 5*. [online] Ons.gov.uk. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/componentsofchangebirthsdeathsandmigrationforregionsandlocalauthoritiesinenglandtable5 [Accessed 11 Jan. 2019].

[30] Nygaard, C. and Francis-Brophy, E. (2014). Profile of migrant labour in the South East of England: skills, industry and occupation. [online] Reading: University of Reading.

Social Inequality

Maturity: Established

Headline: *Social inequality still exists within and between areas*

The investment in, and expansion of cities centres, has put pressure on smaller conurbations as well as less desirable areas within city centres and city regions. Any social inequalities impact transport choices with a dependency on traditional public transport modes even though costs may represent a large portion or expenditure.

There is also an argument that the dawn of smart technologies and the requirement for new energy infrastructure has the potential to polarise areas further. Research by Localis highlights that despite smart technologies having the potential to result in more equitable outcomes for all (e.g. predicting energy use and bills), those people in higher income areas could be more willing and able to invest in smart technologies, in turn encouraging wider area re-investment in energy infrastructure. Thus the location of upgrades to energy distribution networks could deepen existing socioeconomic differences if areas characteristics are not taken into account.[31] Figure 5 shows the gross disposable income per person in TfSE area, indicating that despite the average disposable income per person in the TfSE area as a whole being higher than the England average, that people in Portsmouth, Southampton, Isle of Wight and Medway on average have less disposable income that the English average.[32] These communities could potentially miss out on the benefits of the technology if the infrastructure is only rolled out reactively rather that proactively.

Source: ONS Regional gross disposable household income (GDHI)

Figure 5 - Gross Disposable Household per Person by TfSE Local Authorities in 2016

[31] Localis (2019). *Smart Cities: Fair Investment for Sustainable Growth*. [online] London: Localis. Available at: http://www.localis.org.uk/wp-content/uploads/2019/01/026_SmartCities_WEBAWK.pdf [Accessed 11 Jan. 2019].

Changing Family Compositions ***Maturity:*** Emerging	**Headline:** *Motherhood is increasingly occurring later or not at all and competing with employment which is having impacts on family compositions, roles and intergenerational mixing* In 2017, the average age of mothers in UK was 30.5 years compared to 26.4 years in 1975. A number of reasons for this increase in age have been cited, however an antiquated world of work and cost of childcare are reoccurring themes. The age of mothers in TfSE Local Authorities follows the upward national trend, with 57% of mothers aged 30 or older in 2016, above the UK average of 54%. ONS data shown in Figure 6 shows that the trend is not uniform across the area, with 71% of mothers in Windsor & Maidenhead aged 30 or older in 2016, compared to just 43% in the Isle of Wight. Between 2010 and 2016 in Slough and Southampton the proportion of mothers who were aged above 30 rose by 12%, whereas the proportion fell in Wokingham by 3%.[33] The trend has the potential to have a range of knock on effects if it continues across generations, altering the natural chronology of life and making extended families more fragile.[34] Childcare requirements for example could increase if grandparents are too elderly to help with childcare; at present 40% (5 million) of grandparents in the UK are estimated to provide regular childcare for their grandchildren.[35] This in turns risks reducing intergenerational mixing which itself has huge benefits for society, from helping to tackle the like of poor health, loneliness and ageism and could place more pressure on mothers/fathers who may have to look after young children and elderly parents concurrently.[36] In addition to the increasing age of mothers, the proportion of couples with children with only one adult in employment has halved from 47% to 27% between 1985 and 2015 in the UK, meaning is a decreasing proportion of stay-at-home parents and increasing the reliance of families on childcare services furthermore.[37] Future mobility offerings need to cater for these changing family configurations and norms.

[32] Office for National Statistics (2016). *Regional gross disposable household income - Office for National Statistics*. [online] Ons.gov.uk. Available at: https://www.ons.gov.uk/economy/regionalaccounts/grossdisposablehouseholdincome/datasets/regionalgrossdisposablehouseholdincomegdhi [Accessed 11 Jan. 2019].
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[34] Roberts, Y. (2018). *Late motherhood is on the rise, but as one who knows, it has its downsides | Yvonne Roberts*. [online] The Guardian. Available at: https://www.theguardian.com/commentisfree/2018/mar/31/late-motherhood-is-on-the-rise-but-as-one-who-knows-it-has-its-downsides [Accessed 14 Jan. 2019].
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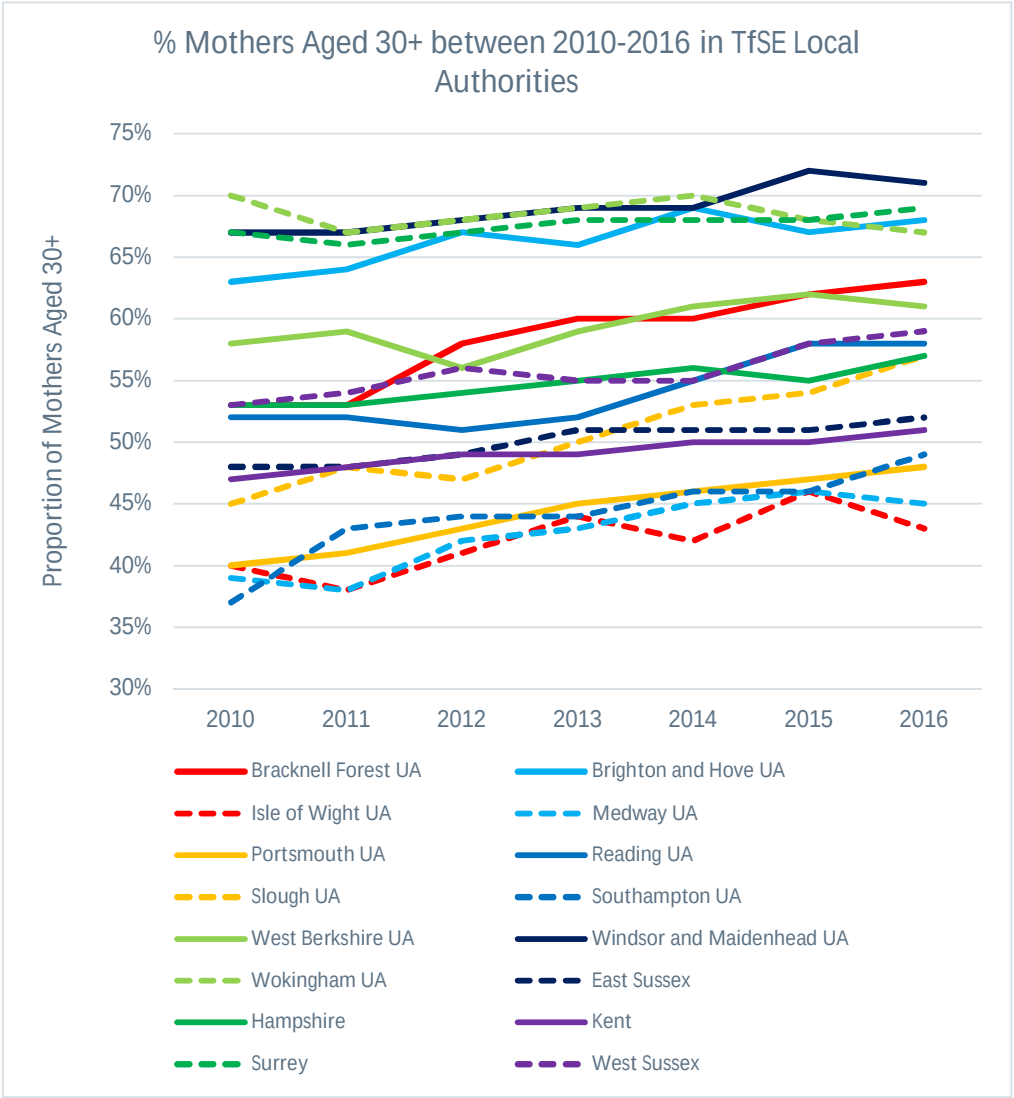
[36] Coughlan, S. (2019). *Overstretched 'sandwich carers' trying to help parents and children*. [online] BBC News. Available at: https://www.bbc.co.uk/news/education-46866341 [Accessed 15 Jan. 2019].
[37] Institute for Fiscal Studies (2018). *The rise and rise of women's employment in the UK*. [online] Institute for Fiscal Studies. Available at: https://www.ifs.org.uk/uploads/BN234.pdf [Accessed 14 Jan. 2019].



Source: ONS Live births by mothers' usual area of residence

Figure 6 - Proportion of Mothers Aged 30+ between 2010-2016 in TfSE Local Authorities

3.3 SOCIAL CHANGE

Table 2 - Social Change

TRENDS	IMPACTS ON ACCESS AND MOBILITY
Acceptance of 'sharing' ***Maturity:*** Emerging	**Headline:** *Many people are increasingly happy to share assets and services if it is convenient and the price is right* The rise of shared, on demand transportation services such as bike hire, car hire, lift sharing and 'UberPool' type services have tapped into a willingness for people to share assets and services for financial benefit. There is evidence that there is a willingness to experiment with a number of these shared mobility services in the TfSE area, despite not having any performance statistics. This is demonstrated by the BTN Bikeshare in Brighton & Hove, Blablacar carpooling, Enterprise car club in Southampton, Woking, Portsmouth and Maidstone, however other services such as 'UberPool' are not yet available, potentially a reflection of the market readiness or geographical feasibility in the area. At a wider geographical scale, a global survey carried out by Dalia Research in 2017 documented that 30% of the UK population have used a mobility app to hail, rent or share a ride in some form.[38] Whilst some business models are in their infancy this willingness to 'access' rather than 'own' has the potential to dramatically reduce car dependency in certain conurbations in some use cases.
Expectation of 'immediacy' and always being 'on' ***Maturity:*** Maturing	**Headline:** *People want everything on-demand* With the rise of the internet and increasing levels of almost real-time consumption of everything from information to food, there is an increasing expectation for immediate access to products and services. Online sales for example, accounted for 21.5% of all UK retailing sales in November 2018, increasing from 19.9% in November 2017.[39] With 'Just Eat' and 'Deliveroo' type fast food deliveries and 'Amazon Prime' type 1-hour deliveries, there are a myriad of extra transportation trips meeting demand. Although technology has brought about many workplace benefits such as physically freeing employees from desks, it has also brought with it the expectation of immediacy and always being 'on' to the workplace. A report by Deloitte highlights that technology eliminates the natural breaks employees would previously have taken during the workday and that the freedom given to employees by technology leads to the merging of work and leisure time and more working hours.[40]

[38] Dunn, J. (2017). Most people in America still don't use ride-hailing apps like Uber. [online] Business Insider. Available at: http://uk.businessinsider.com/uber-lyft-ride-hailing-apps-car-ownership-chart-2017-3 [Accessed 7 Dec. 2018].
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[40] Chung, H. (2017). *Flexible working is making us work longer*. [online] Quartz. Available at: https://qz.com/765908/flexible-working-is-making-us-work-longer/ [Accessed 14 Jan. 2019].

'Customer' centricity ***Maturity:*** Established	**Headline:** *The customer is always right* Transportation has been late in recognising users of networks as customers but with the rise of feedback and sentiment analysis via social media (Twitter and Facebook) and other channels (such as the GrumpNow app), customers now have near real time relationships with network and service operators across all modes. The Department for Transport has realised the great benefits of real-time mapping at times of major incidents and disruption and has announced it is investing £10 million to create a real-time map of traffic jams, however they will have to overcome the challenge of providing consistent information and messaging.[41] The Highways England Customer Strategy in turn aims to develop their relationship with customers through building strong dialogues with users and improving the quality of information reaching the customer through the provision of real-time traffic updates through channels such as the Variable Message Signs (VMS).[42]
Rise of the 'experience' economy ***Maturity:*** Emerging	**Headline:** *People are buying less 'stuff' but spending more doing things* A number of retailers have described a shift from customers consuming products to more disposable income being spent on 'experiences'. This is resulting in a shift within our retail centres, towns and cities with a focus on leisure rather than shopping activities with an associated rise in food, drink and leisure activities. The 2018, PwC analysis of high street composition in turn revealed that the South East suffered a net loss of 197 retail stores on the high street between January and June of 2018. The report highlights that retail closures vary geographically, with the likes of Bracknell actually seeing significant growth but with Reading experiencing a significant decline. Booksellers and coffee shops were the type of units which saw the most uplift in the time period, bucking the overall downward trend.[43] As customers choose to spend their money on experiences, retailers have started to react. Some stores have started offering more immersive retail experiences, branded 'retailtainment' a mix of retail and entertainment, which aims to entice customers back into stores.[44] At Bluewater shopping centre in Kent for example, customers to the Virgin Holidays store can try premium class seats, use virtual reality to research holidays destinations and make use of the free 'Taste Your Holiday Bar'. Virgin executives maintain that people do not want to do everything online and by offering customers fun and unique in-store experiences, they do not only leave a store with a product or service but also a memory. A new trend called 'reverse showrooming' has also been cited to be benefiting stores, where customers research products and services online first before going into the shop to try products or receive tailored advice, challenging 'death of the high street' testimonies.[45] The evolution of retail trends like those mentioned above, have the potential to disrupt transport networks if not monitored, whether that be through person trips or logistics, posing questions as to the extent to which people are content with buying online.

[41] French, K. (2018). Drivers will beat traffic jams through new app which maps UK's most congested roads, minister vows. [online] The Telegraph. Available at: https://www.telegraph.co.uk/news/2018/09/01/drivers-will-beat-traffic-jams-new-app-maps-uks-congested-roads/ [Accessed 3 Jan. 2019].
[42] Highways England (2016). *Customer Service Strategy*. [online] London: Highways England. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/490538/S150470_Customer_Service_Strategy.pdf [Accessed 14 Jan. 2019].
[43] PwC (2018). Store openings and closures - H1 2018. [online] PwC. Available at: https://www.pwc.co.uk/industries/retail-consumer/insights/store-openings-and-closures-report-h1-2018.html [Accessed 10 Dec. 2018].
[44] Storefront (2018). *7 Case Studies That Prove Experiential Retail Is The Future*. [online] Storefront. Available at: https://www.thestorefront.com/mag/7-case-studies-prove-experiential-retail-future/ [Accessed 14 Jan. 2019].
[45] Hemsley, S. (2018). *Why the high street is the home for holidays*. [online] The Telegraph. Available at: https://www.telegraph.co.uk/business/business-club/consumer-retail/in-store-shopping-experience/ [Accessed 14 Jan. 2019].

Need for Life-Long Learning ***Maturity:*** Emerging	**Headline:** *Changes in technology mean a career for life may not exist* With rapid changes in digital technologies and automation there may be a need for learning to be undertaken throughout or at regular intervals during an elongated (due to trends described above) work life. Employees are increasingly aware of the rapidly changing, impermanent nature of jobs and the need to make oneself indispensable. A survey by Investec in turn found more than half of British employees were planning a career change in the next five years.[46] This may result in changes to how, when and where learning is undertaken with subsequent impacts upon digital and physical access. Educational institutions are also expanding their course offerings to include courses focused on the changing mobility ecosystem such as 'Smart, Connected and Autonomous Vehicles (SCAV)' at the University of Warwick.
Trend to Simplicity ***Maturity:*** Emerging	**Headline:** *Real demand for cutting out the complexity and making it as easy as possible to carry out the essentials* New technologies are making it possible to reduce the complexity in products, services, procedures and communications. Consumers in turn are no longer willing to accept complexity, instead demanding transparency, simplicity and availability in everything. In the context of transport, new mobility business models, enabled by innovative digital technology, have challenged long-established transport players and are increasingly offering personal simplified user experiences.[47] However, despite technology being able to offer access and simplification to many aspects of life, it has also been the source of a barrage of notifications and content that many people have deemed to clutter their daily existence. There is an increasing awareness of personal technology usage, fake news and privacy concerns amongst other issues that has led to growing numbers of people disconnecting from the digital world. Recent digital wellbeing updates to popular smartphone software reportedly surprised many by putting a numerical figure on the amount of time they spend on their phone, with the average British person checking their phone every 12 minutes. [48] Emerging mobility companies must in turn put human value at the forefront of their innovation so to develop 'technology with respect for users' time, attention and privacy'. Digital wellbeing needs to be central in thinking around the future of mobility to make sure technology improves lives rather than distracting from them; so to not inhibit the digital mobility revolution and the opportunities for society that come with it.[49]

[46] Barrett, H. (2018). Plan for five careers in a lifetime. [online] Ft.com. Available at: https://www.ft.com/content/0151d2fe-868a-11e7-8bb1-5ba57d47eff7 [Accessed 7 Dec. 2018].
[47] Deloitte (2015). *Transport in the Digital Age: Disruptive Trends for Smart Mobility*. [online] London: Deloitte. Available at: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/bps/deloitte-uk-transport-digital-age.pdf [Accessed 15 Jan. 2019].
[48] Hymas, C. (2018). *A decade of smartphones: We now spend an entire day every week online*. [online] The Telegraph. Available at: https://www.telegraph.co.uk/news/2018/08/01/decade-smartphones-now-spend-entire-day-every-week-online/ [Accessed 14 Jan. 2019].
[49] Fjord Trends (2019). *Trends 2019*. [online] Accenture. Available at: https://trends.fjordnet.com/Trends_2019_download.pdf.

3.4 ENVIRONMENTAL FOCUS

Table 3 – Environmental Focus

TRENDS	IMPACTS ON ACCESS AND MOBILITY
Climate Change ***Maturity:*** Established	**Headline:** *Climate change and associated weather events will increasingly impact the UK* Major weather events such as extreme heat waves and flooding, impact the reliability and resilience of our digital, energy and transport networks and services. With a predicted increase in extreme weather events in the attributed to climate change, impacts of events such as heatwaves on vulnerable areas are likely to be exacerbated.[50] For example if global temperatures rise by 2°C or less, the Committee on Climate Change predict between 700-1000 more heat-related deaths annually in the South-East of England, many of which will be linked to the resilience of local infrastructure.[51] The relationship between weather and road, rail and air (high and low level) network operations is well established but designing-in resilience may be required to avoid disruptions and closures of key links or in those areas prone to flooding for example, not just during prolonged rainfall but at times of extreme events.
Air Quality ***Maturity:*** Established	**Headline:** *Air quality is impacting urban areas and at key locations on the network* Road based transport is one of the biggest contributors to poor air quality, the recent opening of smart motorways demonstrates how increasing capacity and air quality demands currently compete. Emerging trends away from diesel and petrol propulsion (as seen through policy initiatives in places like Paris and London, the consideration of Low and Ultra Low Emission Zones, the phasing out of diesel rail vehicles and increasing levels of research into greener fuels and technologies for ships) coupled with commercially viable environmentally alternatives could see reductions start to occur as the fleet changes. Between August 2017-2018 there was a 32.6% increase in the number of electric vehicle registrations in the UK, indicating an increasing preference for alternative propulsion vehicles.[52] Particulate emissions from non-exhaust sources resulting from the friction required for braking are also harmful to the environment and human health, and the UK is working with international partners to develop regulation for particulate emissions.
Scarcity of Resources ***Maturity:*** Emerging	**Headline:** *There won't be enough rare earth metals to sustain technological need.* With the rise of smartphone and battery propulsion commentators have speculated about the availability and cost of the constituent materials needed for the technology. A single tesla for example, requires about 15lbs of lithium and thin solar panels require tellurium which is one of the rarest elements on Earth.[53] Many companies are examining their supply chains to allow for the repurposing of batteries and other items from heavy duty to lighter duties over their lifespans as well as the recycling of materials. Whilst such concerns aren't unique to the South East they will influence supply and demand for new solutions.

[50] Bourke, I. (2018). A new age of extreme weather: the dangerous consequences of Britain's heatwave. [online] Newstatesman.com. Available at: https://www.newstatesman.com/politics/uk/2018/07/new-age-extreme-weather-dangerous-consequences-britain-s-heatwave.
[51] Committee on Climate Change (2016). UK Climate Change Risk Assessment 2017. [online] London: Committee on Climate Change. Available at: https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Synthesis-Report-Committee-on-Climate-Change.pdf [Accessed 11 Dec. 2018].
[52] SMMT. (2018). August - EV registrations. [online] Available at: https://www.smmt.co.uk/2018/09/august-ev-registrations.
[53] Than, K. (2018). Critical minerals scarcity could threaten renewable energy future. [online] Stanford Earth.

Low Carbon Energy ***Maturity:*** Emerging	**Headline:** *Adoption of low carbon energy sources reduces reliance on other geographies.* Since 2008, reducing the carbon emissions from electricity generation has been the focus of Government, picking up much of the burden for decarbonisation in the UK. The UK Committee on Climate Change in turn reports that progress in cutting emission in the transport, industry and buildings sectors however has effectively stalled.[54] A variety of low carbon energy sources for transportation are being developed, electric vehicles are described above, and hydrogen propulsion is also gaining interest and investment. Small Modular Reactors for example, similar in form to the nuclear reactors used to power submarines could power local communities and the technology is expected to be commercially available for construction within 10 years.[55] Decentralisation of power generation through the deployment of energy technologies for generation and storage has the potential to give public bodies, businesses and industry the opportunity to take control of their own energy use, possibly offering new revenue streams and boosting competitiveness.[56] The Gyle Premier in Edinburgh for example has a five-tonne lithium ion battery that is charged from the national grid in off-peak periods and powers the hotels for several hours during the day and is predicted to save the hotel £20,000 annually in bills.[57] These alternative energy sources require changes to distribution infrastructure and delivery models which will impact mobility take-up and efficiencies.

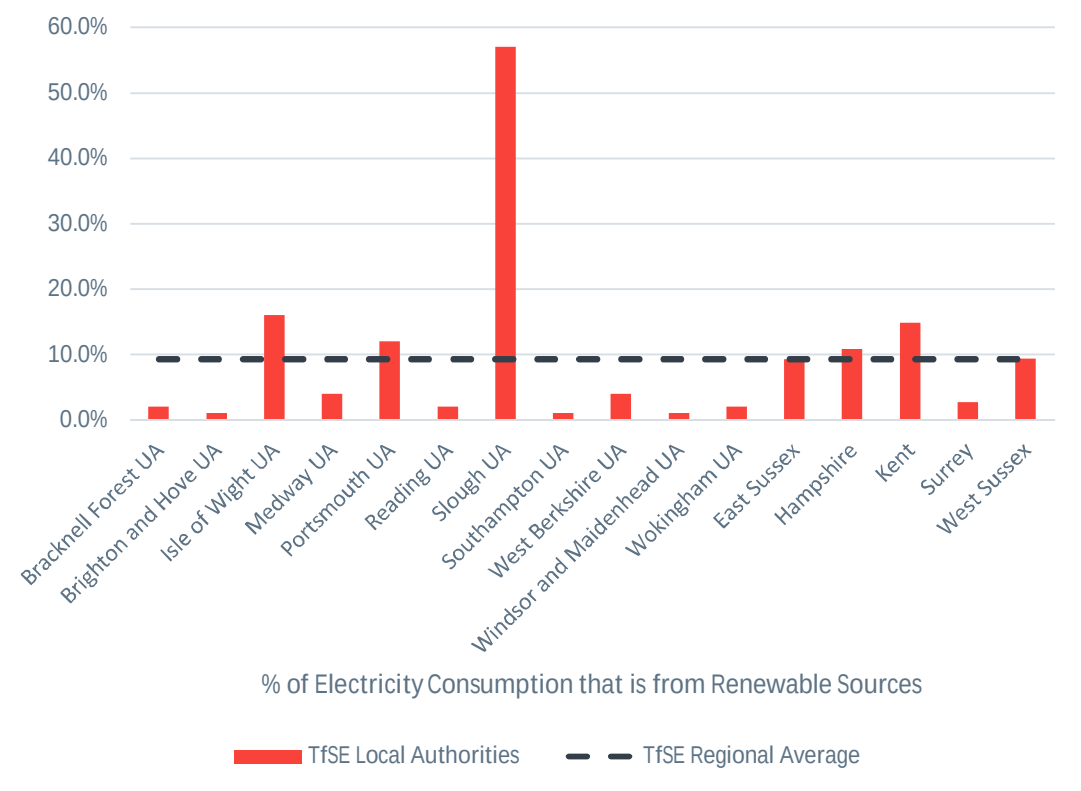
[54] Committee on Climate Change (2018). *2018 Progress Report to Parliament*. Reducing UK Emissions. [online] London. Available at: https://www.theccc.org.uk/wp-content/uploads/2018/06/CCC-2018-Progress-Report-to-Parliament.pdf [Accessed 4 Jan. 2019].
[55] Hicks, M. and Miller, J. (2018). Small Modular Nuclear Reactors. PostNote. [online] London: Houses of Parliament: Parliamentary Office of Science & Technology. Available at: https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0580.
[56] Ross, K. (2018). *Centrica says distributed energy tech could slash UK emissions*. [online] Power Engineering International..
[57] BBC News (2019). *Hotel to operate on battery power*. [online] BBC News. Available at: https://www.bbc.co.uk/news/uk-scotland-edinburgh-east-fife-46749022 [Accessed 15 Jan. 2019].

Role of Renewables

Maturity: Maturing

Headline: *Wind, wave and solar power will reduce reliance on carbon derived fuels.*

Alternative forms of electricity generation, storage and consumption are undoubtedly having an impact on the energy market and whilst electric propulsion is commercially viable for cars and vans, small goods vehicle technology is in its infancy and HGVs even less developed. On the railways hybrid, battery and hydrogen technologies are being tested to supplement areas of electrification. Policy interventions such as planned bans on petrol and diesel road and rail vehicles will potentially accelerate renewable alternatives but growth will result in challenges to energy generation, storage and distribution networks. In 2016, the South-East region had the second highest renewable energy capacity in England and Wales, with the highest proportion of installed renewable capacity coming from solar photovoltaics.[58] Approximately 9.3% of the electricity consumed in local authorities in the TfSE area in 2016 was generated by renewable sources, with some authorities having larger proportions of the electricity consumption generated by renewables than others. Figure 7 shows that Slough exceeds the area average considerably, with 57% of consumed electricity generated by renewables (mostly biomass), in turn only 1% of electricity consumed in Windsor & Maidenhead, Southampton and Brighton & Hove is from renewable energy sources.



Source: https://renewablelocator.green-alliance.org.uk/

Figure 7 - Proportion of Electricity Consumption that is from Renewable Sources in TfSE Local Authorities

[58] Green Alliance (2016). Renewable Energy Locator. [online] Green Alliance. Available at: https://renewablelocator.green-alliance.org.uk/area/302 [Accessed 11 Dec. 2018].

3.5 ECOMOMIC SHIFT

Table 4 – Economic Shift

TRENDS	IMPACTS ON ACCESS AND MOBILITY
Rise of the 'gig' Economy ***Maturity:*** Emerging	**Headline:** *People may have multiple jobs being paid for the tasks they undertake* Over recent years there has been a rise in the 'gig' economy where individuals are paid for the tasks they undertake rather than being traditionally 'salaried'. It is estimated that 2.8 million people in the UK currently work within it, 11% of which are in the South East, the region with the second highest proportion behind London (24%).[59] Data outlining the estimated proportion of adult employees working within the gig economy in each local Authority however is not yet available. This shift, which is the subject of political challenge at the moment, may result in increased trip making depending upon the location and type of 'gigs' undertaken. An obvious example is the rise in home shopping deliveries which are undertaken by white and 'grey' vans ('grey' being cars being used as vans) with drivers paid by the item. These single item short trips are impacting local areas, shifting what might have been walk, cycle or short car trips to commercial trips.
'New' Business Models ***Maturity:*** Emerging	**Headline:** *Disruptive business models will change the way businesses and markets work* The rise in digital technologies has seen numerous disruptive business models emerge in everything from fast food, to holidays and hotels, to the taxi trade. For example, since February 2016 aggregator delivery companies such as Deliveroo, Just Eat and UberEats, have increased the number of takeaway orders by more than 20% in the UK.[60] Whilst impacts in the mobility space have been limited thus far, it is reasonable to expect further new entrants with different offers and ideas as to how mobility can be provided. Some business model solutions may be only applicable for a short period of time or adapt to provide additional functionality or services.
On-demand Manufacturing ***Maturity:*** Emerging	**Headline:** *Products will be made on demand to meet customer needs on a just in time basis* As an extension of the above the capabilities of 3D printing and on-demand manufacturing are rapidly increasing. Plastics, metals and even food can now be 3D printed, some products such as books are produced on demand. More than two-thirds of house-building companies in the UK are investing in industrial pre-fabrication and modular techniques using off-site factories for rapid production. The UK Government has also created a new £72million Core Innovation Hub to help transform the construction industry, making it more productive and create new high-value jobs. These developments could alter the traditional movements of raw materials and products but could also lead to re-manufacturing where logistics and high-speed digital networks converge.

[59] Department for Business, Energy and Industrial Strategy (2018). *the Characteristics of those in the Gig Economy*. [online] London: Department for Business, Energy and Industrial Strategy. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/687553/The_characteristics_of_those_in_the_gig_economy.pdf [Accessed 16 Jan. 2019].

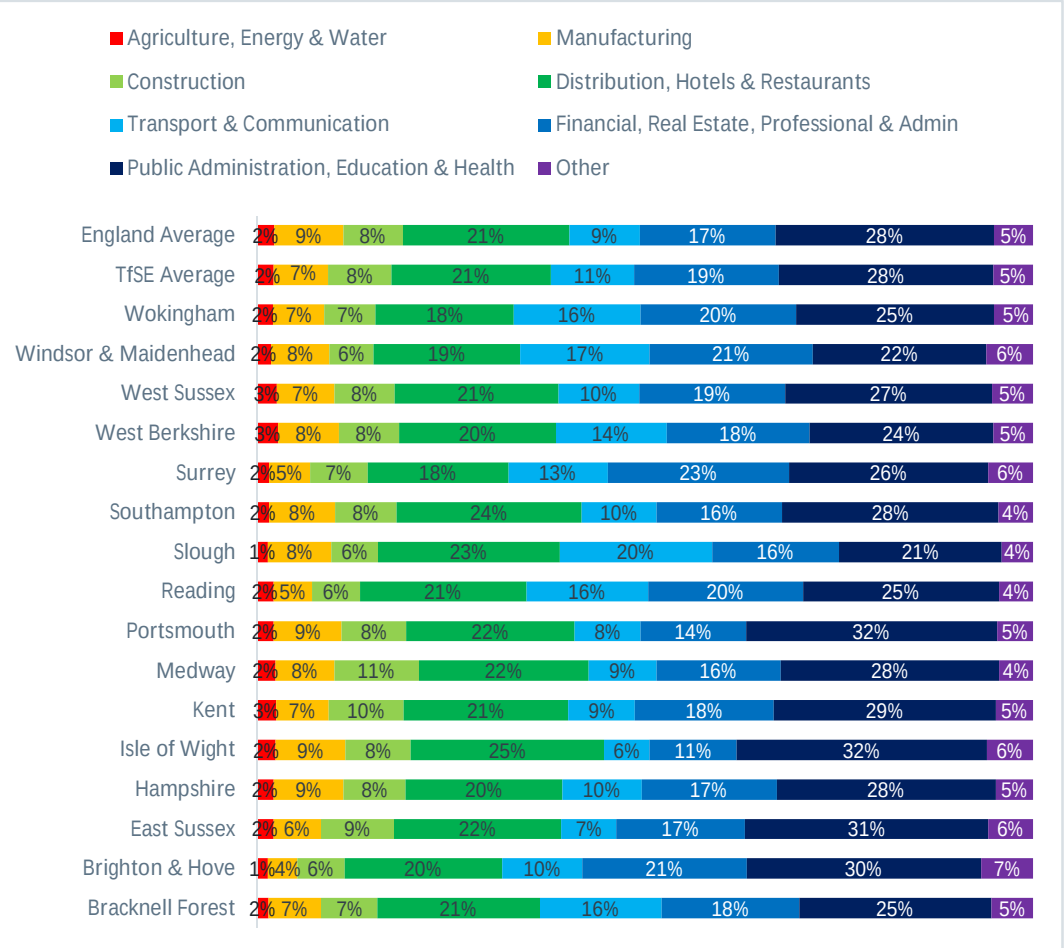
[60] The NPD Group (2018). The unstoppable rise of the takeaway delivery phenomenon means the market is now worth £4.2 billion. [online] The NPD Group. Available at: https://www.npdgroup.co.uk/wps/portal/npd/uk/news/press-releases/the-unstoppable-rise-of-the-takeaway-delivery-phenomenon-means-the-market-is-now-worth-4-2-billion-up-73-in-a-decade/ [Accessed 3 Jan. 2019].

Impact of Automation

Maturity: Emerging

Headline: *Automation will hollow out manufacturing and administrative jobs*

There have been several studies and projections over the last year estimating the impacts of automation (both robotic and digital artificial intelligence) on the existing jobs market, such as PwC's analysis that over 30% of existing UK jobs are susceptible to automation.[61] In the short term data-driven industries such as financial services are likely to be most affected by algorithmic developments however in the long run, those industry jobs in transportation & storage, manufacturing and construction are at a higher risk of automation. Those less at risk in turn include education, human health & social work and accommodation and food services. Research indicates that this risk to jobs is not spread evenly across the country, with jobs in southern cities threatened less than cities elsewhere.[62] 2011 Census data also reveals that local authorities in the TfSE area are more dependent on risk industries than others, such as Slough which has 20% of its workforce employed in transport and communications, which proportionally is much greater than the 9% average for England. The next generation of robotic solutions are already displacing manufacturing and warehousing jobs and AI is undertaking decision based tasks in the financial and legal sectors. Projections estimate that these changes could be significant in some sectors, directly impact land use and associated trip making.



Source: ONS LC6602EW - Industry by economic activity

Figure 8 - TfSE Local Authority Employment Industries

3.6 POLITICAL LANDSCAPE

Table 5 – Political Landscape

TRENDS	IMPACTS ON ACCESS AND MOBILITY
Devolution of Decision Making ***Maturity:*** Established	**Headline:** *More decisions will be made at the regional or city level* Devolution could have positive impacts where powers are granted. The Government is increasingly supportive of Sub-National Transport Bodies (STBs) as outlined in the Transport Investment Strategy and aims to 'open up government decision making to ensure that infrastructure investment takes account of regional transport strategies'.[63] It should be noted however that no STB exists in isolation and each has relationships and dependencies which need to be acknowledged and integrated in decision-making. For the TfSE area, there are strong existing links with England's Economic Heartland and Greater London which need to be at the forefront. Transport also must be considered in concert with energy, healthcare, education and other primary needs as the mobility will become facilitators (or inhibitors) to economic and social prosperity.
Globalisation of Markets ***Maturity:*** Established	**Headline:** *Markets will become increasingly global* With an increasingly global marketplace and consumer desire to have near instant access to products (including food), fast, reliable and resilient connectivity to ports and airports will be crucial. The South East provides key access points to international markets including the UK's second busiest airport (Gatwick), the Port of Southampton deep-sea port on the main international shipping line, the Port of Dover (Europe's busiest ferry port and where 7th of all UK trade passes through) and also the Channel Tunnel high speed rail link.[64] In 2017, less than half of the food consumed in the UK was supplied domestically, revealing the deep routed nature of the global marketplace.[65] As conurbations expand it will be essential that those flows are kept moving, particularly in relation to food and critical heath related consumables, will be essential.
Protectionism of Markets ***Maturity:*** Established	**Headline:** *An increasing desire to shop and trade locally* Conversely there is a growing movement relating to production and consumption of products and services at a local level as part of a desire to consume 'artisanal' or 'different' products from those supplied within an increasingly global market place. These local supply chains may be small and diverse with variable supplier and customer trip making needs. It should be noted however that the British Independent Retailers Association reported that although more independent shops opened in the first 6 months of 2018, compared to the same period in 2017, that a record number of stores were also closed over the same period. Most of these were located on high streets across the country. In the South East specifically, there was a 0.52% net change in the number of independent shops, which equates to 190 store closures and highlights the uncertainty in the market.[66]

[61] PwC (2018). *Will Robots Really Steal our Jobs?*. [online] London..
[62] Centre for Cities (2018). The rise of the robots could compound Britain's North/South divide – 1/4 jobs at risk in cities outside the South.
[63] Department for Transport (2017). Transport Investment Strategy. Moving Britain Ahead. [online] London: Department for Transport..
[64] Transport for the South East (2018). Economic Connectivity Review. [online] Available at: https://transportforthesoutheast.org.uk/wp-content/uploads/2018/07/FINAL-Economic-Connectivity-Review.pdf [Accessed 11 Dec. 2018].
[65] Department for Environment Food and Rural Affairs (2018). Food Statistics in your pocket 2017 - Global and UK supply. [online] GOV.UK. Available at: https://www.gov.uk/government/publications/food-statistics-pocketbook-2017/food-statistics-in-your-pocket-2017-global-and-uk-supply.
[66] British Independent Retailers Association (2018). Independent retail hit by a loss of -1,554 units in first six months of 2018. [online] Available at: https://bira.co.uk/openings-closures-h12018/ [Accessed 11 Dec. 2018].

3.6.1. The rate of change of some of these trends will vary enormously from place to place and whilst some may induce significant change others will not. Many if not all on the trends described above either directly or indirectly influence the mobility agenda and decisions by communications providers, vehicle manufacturers, network operators and service providers.

3.7 TAKING A CITIZEN AND BUSINESS CENTRIC APPROACH

3.7.1. Traditionally transportation has primarily considered the needs and demands of the AM and PM peak periods, considering the 'commute' as being the key concern. With TfSE's aspiration that transport is an enabler to the economy it is therefore an imperative that we consider all areas where access and mobility contribute to fundamental economic and social activities, namely;

- Employment opportunities;
- Educational attainment;
- Healthcare needs;
- Goods and services, retail and leisure;
- Raw materials, crops, products & waste;
- Tourism; and
- Social interactions.

3.7.2. The mobility needs of these various segments vary greatly and technology will have a role to play in meeting both digital and physical access needs to them all. By adopting a people and business centric approach to the overall needs of the transport network right through the week we can truly consider the expectations and demands placed upon it. Generational priorities will also vary between people undertaking activities in these areas and this is a key consideration in enabling mobility equity, this being of vital importance considering future economic needs and activities of an ageing population.

3.7.3. Considering these areas within a wider mobility agenda there will be opportunities to not only improve access and mobility through the use of technology but to also improve place-making and the built environment through careful and considered planning. The following paragraphs outline the potential mobility needs, challenges and opportunities for each of the areas listed in the context of ongoing change in the TfSE area and enabling economic activity and growth.

3.7.4. **Employment Opportunities:** Access to employment, the commute, will continue to have the largest impact across all modes however 'digital as a mode' will have an increasing role to play in some sectors of the job market, offering the opportunity to not commute for at least part of the time although this may result in other trips making use of additional time. Between 2012 and 2016 the proportion of employees working flexi-time in the UK rose by over 12% and some projections predict that half of the UK workforce could be working remotely in some respect from 2020.[67] A relaxation of traditional '9 to 5' working hours is already starting to result in longer 'peak hours' with a lengthening of the 'shoulders'. Looking ahead working from home (or hub), virtualisation and digital collaboration

[67] Gough, O. (2017). Half of the UK workforce to work remotely by 2020. [online] Small Business. Available at: http://smallbusiness.co.uk/half-uk-workforce-remotely-2020-2540827/ [Accessed 7 Dec. 2018].

will all have a role to play in providing alternatives to the commute but it will continue to be driven by the location and form of jobs which are governed by national and global trends and needs.

3.7.5. **Educational attainment:** Access to education is vital in equipping people with the skills they need to meet the needs of the South East's economy. With ongoing changes in the education sector offering digital access to courses and course modules, such as through the Online Learning platform at MidKent College, the need to travel to facilities is changing. With projected changes in the jobs market due to automation and AI there will be a potential need for life-long learning with regular re-skilling becoming the norm for some people. Digital and physical access to educational opportunities will be ever more vital with particular needs for those unable to travel or in areas of lesser physical connectivity.

3.7.6. **Healthcare needs:** Our growing, ageing population is going to need access to quality healthcare. As previously mentioned, the number of people aged 65 or over in the South East region for example is estimated to increase by 20.7% between 2016 and 2026.[68] There are already pressures on the social care system in terms of care provision which provides an impetus for digital and remote healthcare provision for some conditions. The use of automation, sensors and AI in caring will help in part reduce the need for human intervention but there will still be considerable transportation needs for social, patient care and home visit needs. The role of healthcare technology and mobility solutions working collaboratively will be a key part of the solution.

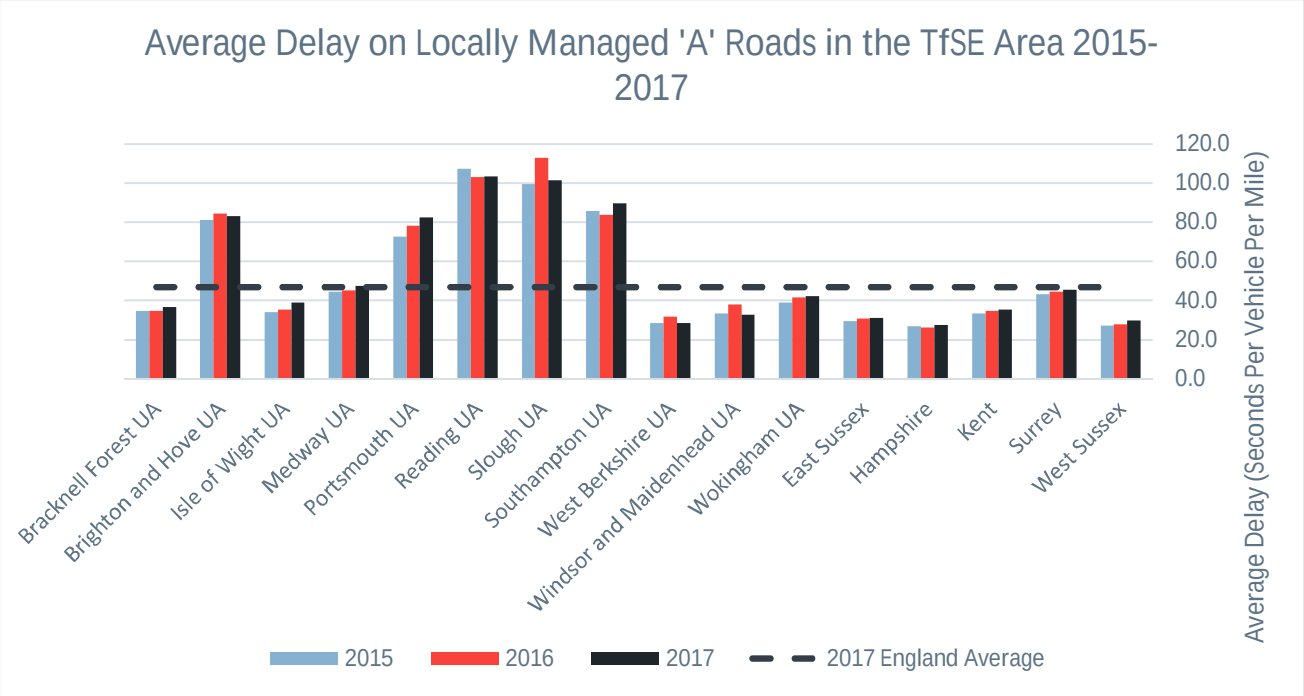
3.7.7. **Goods and services, retail and leisure:** Reliable, resilient and timely access to goods and services (particularly food) is crucial to economic performance. The retail and services sectors have seen seismic shifts of the last two decades with the advent of home shopping (home delivery, click and collect) and digital access to services (banking, local authority services etc.). These changes have seen significant behavioural change by consumers with convenience being a key factor in decision making. Trip making has been impacted with a shift from consumer trips to retailer led trips however this revolution hasn't negated the need for people to visit 'bricks and mortar' retail establishments to browse, compare and in many cases still purchase. Retailers have recognised this trend with a move to a more 'experience' led approach where food, drink and other activities are embedded within the 'shopping' experience. Within the service sector online access has impacted the need for a 'high street' presence in many places but human interactions are still crucial for many transactions especially for those uneasy or unable to engage with online solutions. Trip making will continue to evolve particularly as retailers move to longer opening hours with ever more diverse offers. It should also be noted that the logistics industry is evolving rapidly to meet demands with 24/7 operations, locational trends and automation in warehousing impacting trip making.

3.7.8. **Raw materials, crops, products and waste:** Although only 9% of residents in the TfSE area are employed in agriculture and manufacturing, the sectors are key to economic performance.[69] The movement of crops from field, to processing to retailers is essential in maintaining food resilience and is increasing reliance on a complex supply chain extending well beyond the TfSE area and the

[68] Office for National Statistics (2018). *Subnational population projections for England - Office for National Statistics*. [online] Ons.gov.uk. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/subnationalpopulationprojectionsforengland/2016based [Accessed 23 Jan. 2019].

[69] Office for National Statistics (2011). LC6602EW - Industry by Economic Activity. [online] Nomisweb.co.uk. Available at: https://www.nomisweb.co.uk/query/construct/submit.asp?menuopt=201&subcomp= [Accessed 11 Dec. 2018].

UK via our ports and airports. Similar manufacturing supply chains are complex bringing together remotely sourced raw materials together for product and onward transhipment. Changes in manufacturing may impact where, when and how manufacturing takes place. Access to a reliable and resilient network is essential in keeping supply chains, many of which operate on a just-in-time basis, functioning effectively. Figure 9 shows the average delay experienced per vehicle per mile on 'A' road managed in the TfSE area, illustrating the range of network efficiencies in the area. Between 2015 and 2017, the average delay increased in all the local authorities in the TfSE besides Reading and Windsor & Maidenhead. Additionally, in 2017 there were five local authorities in the area that had average delays larger than the 46.9 second country average highlighting that the levels of disruption to journeys in the area are comparable.



Source: Department for Transport Table CGN0502

Figure 9 - Average Delay on Locally Managed 'A' Roads in the TfSE Area 2015-2017

3.7.9. **Tourism:** Tourism is an essential part of the economy. Major cities, national parks and world heritage sites attract people from across the globe. Hassle free access to tourist attractions such as Windsor Castle, the White Cliffs of Dover and Canterbury Cathedral by all modes is vital in maintaining competitive advantage. Key airports and ports in the South East, such as Gatwick, Southampton and Dover, provide outward journey opportunities not only for tourism but for business purposes and international connectivity is well established. How the area's network serves these needs is important and technology will have a role to play in simplifying wayfinding, ticketing and payments as well as enabling access.

3.7.10. **Social interactions:** It is important not to forget the inherent need for social interactions when considering mobility. The human need to be with family and friends, to share, learn and gossip is a factor that drives ad-hoc trip making. Whilst social media and digital technologies can replace face-to-face interactions, they also streamline planning, community cohesion and allow people to come together more easily than ever before. Mobility is crucial for social interaction whether it be via digital, sustainable or motorised modes.

4 MOBILITY TRENDS

4.1.1. As described above, many mega trends are having a direct bearing on changes within the mobility sector capitalising upon technological trends that are rapidly emerging within the sector itself. In turn some of the anticipated changes and benefits with these technology trends will have wider impacts on society and the economy. We have broadly grouped these trends into 5 principles as illustrated below.

4.1.2. The following pages provide an overview of the primary trends in technology change that are expected over the coming decades within the TfSE area and beyond. The rate of success with these solutions will vary, the applicability to different socio-geographic areas will also vary and the rate at which they penetrate the market has yet to be determined or fully understood. Some trends are already established in the market place but have yet to reach maturity, others are at the beginning of their gestation and ultimately deployment.

4.1.3. These key trends are already delivering changes through widespread commercial application, selective deployment through trials or academic and industrial research. The UK government is investing in many of the areas to encourage innovation, R&D, and enable positioning and differentiation within the global marketplace.

4.1.4. It should be noted that these trends are all occurring in their own right. In some use cases they are developing interdependently, in others they are not. The market is moving fast with long established and new entrants pushing the boundaries not only of technological possibility and also how they might be deployed and commercialised.

4.2 CONNECTED TECHNOLOGY TRENDS

Table 6 – Connected Technology Trends

CONNECTED – *movement of data between people, other people, vehicles, assets and systems*	
Digital connectivity is already underpinning many of our daily activities where access to communications networks (fixed or mobile) is possible. Music, video and other services are now available on the move and journey planning is readily available to all. Equipping the transportation network (road, rail and potentially low-level air) with high quality, continuous digital connectivity will aid the delivery of capacity, safety and productivity benefits. Continuous connectivity also provides the foundations (in some use cases) for autonomous functionality. Digital connectivity will be essential in providing the digital backbone that will allow many other innovations to be fully developed in both mobility and wider applications across the economy.	
Rate of change	▪ Digital connectivity continues to progress with faster broadband speeds over copper and fibre connections ▪ The progression from 3G to 4G (although this is incomplete in many corridors) ▪ Emerging 5G technology and roll out to 2025, and ongoing thereafter
Applicability	▪ All areas, urban, inter-urban and rural ▪ Homes, hubs, businesses and people on the move
Benefits	▪ Improved safety through sharing of traffic / movement data ▪ Using 'big data' to manage supply and demand ▪ Improved productivity on the move ▪ Enhanced customer and user experience on the move ▪ Access to goods, services and activities irrespective of location ▪ Improved personal and community connectivity ▪ Reduced 'traditional' infrastructure needs (information, signals, signage etc.)
Dis-benefits	▪ Cost of access / functionality precludes those with low incomes ▪ Danger of digital inequity, particularly in hard to reach and/or rural areas ▪ Potential reduction in face-to-face human interactions ▪ Resilience of digital networks, key to maintaining service ▪ No escape from always 'being connected' ▪ Dependence upon (in some cases) 3rd party communications infrastructure ▪ High level of data confidence and integrity essential
Interdependencies	▪ Roll out and priorities largely dictated by private companies and commercial drivers ▪ Land and access to Local Authority, Highways England and Network Rail estates to achieve full coverage in all corridors
Risks	▪ Public acceptance of a 'connected' culture ▪ Privacy concerns and the right to 'opt-out' ▪ Cyber security particularly in relation to payments ▪ Resilience of networks and 'up time' ▪ Risk of underserved 'dark' places and areas ▪ Fragmentation along national boundaries and between operators ▪ Market development outrunning regulation

Impetus	▪ Communications agenda driven by public expectations and met by telecommunications companies ▪ Vehicle manufacturers driving connected vehicle agenda to differentiate in the market place, to deliver bundled services (for instance infotainment) and to deliver safety benefits, but with a primary focus of increasing and sustaining sales.
Mode Applicability	**Road:** ▪ A2/M2 Connected Vehicle Corridor, Department for Transport - Project aims to create a 'wifi road' between the Blackwall Tunnel and Port of Dover in Kent that connects vehicles and infrastructure wirelessly to improve driver awareness of road closures and congestion. ▪ 5G Trials, Centre for Connected & Autonomous Vehicles e.g. • AutoAir: 5G Testbed for Connected and Autonomous Vehicles – Aim to make 5G technologies available for the validation and development of CAVs **Rail:** ▪ European Train Control System (ETCS), Cambrian Line - Allows trains to run closer together and travel at their optimal speeds and provides enhanced train protection. ▪ Connected Driver Advisory System (C-DAS), South Western Railway– System provides decision support to drivers in the cab to improve timetable adherence and therefore overall performance.

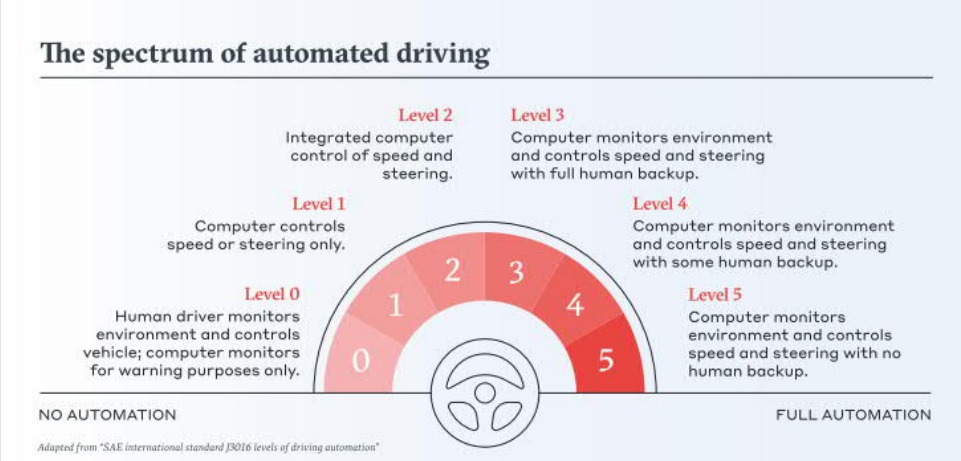
4.3 AUTOMATED TECHNOLOGY TRENDS

Table 7 – Automated Technology Trends

AUTOMATED *- replacement of 'mundane' human tasks with technology*

The automated agenda is gathering pace with advances in computing power and sensor capabilities having led to well publicised advancements in road, rail, water and aerial technology. Automation in the transport sector will significantly impact how they function and perform as well as having potential impacts on place-making and utilisation of space.

The spectrum of automation for road vehicles is illustrated in the illustration below, as defined by SAE International. Whilst full autonomy of road vehicles (Level 5) may well be some way off (2030 and beyond), lower scale applications (Autonomous Emergency Braking, self-parking, lane follow/keep etc.) are available now and manufacturers are suggesting commercialisation of Level 3 vehicles (autonomy with human supervision) in the next few years. Freight vehicle platooning trials are due to commence on the Highways England network and autonomous 'droids' are delivering groceries in South London.



Increasingly autonomous trains in turn have been commercially viable for some time (Dockland Light Rail and Thameslink central core being UK examples) and present the opportunity to make trains more predictable, improve energy optimisation and increase passenger safety to name a few of the potential benefits. The grades of train automation (GOA)[70]:

- GOA0: Manual operation without automatic train protection
- GOA1: Manual operation with automatic train protection
- GOA2: Automatic train protection and automatic train operation with driver
- GOA3: Driverless train operation with attendant for door closure and in event of disruption (e.g. Docklands Light Railway)
- GOA4: Unattended train operation (e.g. Dubai metro)

Significant investment is also going into the construction and trialling of increasingly automated maritime vessels. The world's first electric autonomous containership, Yara Birkeland for example, is expected launch in early 2020 in Norway, becoming incrementally automated by 2022. The stages of automation for maritime vessels that are broadly adopted by the shopping industry are[71]:

- Degree one: Shop with automated processes and decision support
- Degree two: Remotely controlled ship with seafarers on board
- Degree three: Remotely controlled ship without seafarers on board
- Degree four: Fully autonomous ship

Automation is also impacting other sectors, the use of Artificial Intelligence for decision making in service, financial and legal sectors could potentially see the elimination of certain types of jobs which will inevitably impact mobility needs. The use of autonomous vehicles and robotics in warehousing is helping drive the home shopping revolution and robots are being developed and deployed in many hazardous environments to improve human safety.

Rate of change	▪ The Government has stated an expectation of autonomous vehicles being on UK roads by 2021, a date confirmed by some manufacturers. However, it is likely that large scale fleet penetration will occur in the period of 2025 to 2035 and in the case of HGVs and trunk haul freight probably beyond 2035 ▪ Artificial Intelligence in service industries is already starting to develop and is expected to gain pace in the period to 2025 ▪ Automation and robotics in industrial applications will continue over the coming decades
Applicability	▪ Pilot deployments of autonomous technologies will take place in urban areas an on the Strategic Road Network (SRN) ▪ It is likely that the first large scale autonomous deployments will be in urban areas where a commercial case can be made for the investment in vehicles ▪ Use cases will be varied however the role for autonomy on long distance journeys (SRN and Major Roads Network (MRN)) will appeal to some drivers and applications for shared transit solutions in urban and perhaps rural (where costs could be reduced) are likely to emerge. ▪ Autonomous private vehicle technology is being largely driven by vehicle manufacturers and enthusiastic early adopters with the means to engage, situated over a diverse geography (in a similar way to hybrid and more recently electric vehicles).

[70] Powell, J., Fraszczyk, A., Cheong, C. and Yeung, H. (2016). Potential Benefits and Obstacles of Implementing Driverless Train Operation on the Tyne and Wear Metro: A Simulation Exercise. *Urban Rail Transit*, [online] 2(3-4), pp.114-127. Available at: https://eprints.ncl.ac.uk/file_store/production/230330/1ABA7AEA-8AFD-4465-8317-1A1E6DC84A31.pdf.

[71] World Maritime News (2018). *IMO MSC Identifies 4 Degrees of Ship Automation*. [online] World Maritime News.

Benefits	▪ Potential safety benefits (between 80% and 95% of vehicle collisions are due to human error, depending on source) as a result of autonomous systems ▪ Productivity benefits on the move (with high levels of automation) ▪ Capacity benefits once large-scale fleet penetration is established ▪ Removal of humans from undesirable industrial applications ▪ Improved access to independent mobility for those currently excluded (the young, the elderly, the disabled) ▪ Improvements to the built and highway environment due to reduced need for space
Dis-benefits	▪ Inequality and social exclusion due to cost of access / ownership of AVs and service models ▪ Disparity between city and non-city take-up and deployment for 'public transport' solutions ▪ Potential trend to sole-use vehicles and resultant increased traffic ▪ Potential to reduce active transport
Interdependencies	▪ Some AV solutions dependent upon digital connectivity, others are self-sustaining ▪ Considerable legislative, regulatory and policy issues for wide-scale deployment ▪ Rate of development of detectors / sensors and commercial cost ▪ Public trust and acceptance
Risks	▪ Safety ▪ Cyber security ▪ Pace of legislation ▪ Insurance issues and liabilities ▪ Testing and homologation ▪ Public perceptions
Impetus	▪ The autonomous agenda (vehicular, AI and robotics) is largely being driven by commercial entities with their own agendas and needs. ▪ UK Government is investing heavily in the sector with an aspiration to lead globally
Mode Applicability	**Road:** ▪ Four Cities Trials – GATEway Project, UK Autodrive and Venturer are all completed trials however demonstrated that passenger cars could operate part of the time on UK roads without driver control. ▪ Centre for Connected and Autonomous Vehicle Competitions 1-4 **Rail:** ▪ Supervised Automatic Train Operation (ATO), Thameslink Central Core - Technology provides the ability to control trains to a finer resolution in order to run to the maximum capability of the infrastructure in a more consistent way; and **Low-level Air:** ▪ Automated UK drone-tracking system under development – Developed by Air Traffic Control service NATs and start-up Altitude Angel **Maritime:** ▪ Marine & maritime autonomy test bed, Southampton - £1.5 million invested by The Solent Local Enterprise Partnership to create an environment in which unmanned boats, air vehicles and autonomous sensors can be tested. ▪ Norwegian & Finnish autonomous ferry trials in December 2018 - Can navigate independently and dock

4.4 ELECTRIC (& ALTERNATIVES) TECHNOLOGY TRENDS

Table 8 – Electric (and Alternatives) Technology Trends

ELECTRIC & ALTERNATIVES - *decarbonisation of energy production, storage and consumption*	
Alternative propulsion systems in transport are rapidly expanding. Hybrid, self-charging and plug-in electric cars are readily available, hybrid, electric and hydrogen buses are on the UK roads and hybrid and battery trains have been tested on the rail network and battery shipping is being trialled. Fuel cell vehicles (FCV) or fuel cell electric vehicles (FCEV), which generally use hydrogen instead of a battery or in combination with a battery, are due to be available in the next few years and advances in LGV and HGV technologies will see wider deployment of alternative fuelled freight including on railway. E-bike sales are on the increase with electric bikes being used for personal and commercial cargo use, and the UK has also experienced the initial trialling of shared e-scooters in Queen Elizabeth Olympic Park, London. This seismic shift away from fossil fuels, driven in part by policies such as taxation, low emission zones and the planned phasing out of petrol and diesel will lead to new infrastructure needs in terms of electricity generation, distribution and storage (particularly for high load vehicles such as freight) and in the case of hydrogen, new distribution and filling networks. There may also need to be different service operating patterns to allow for difference in fuelling frequencies. Whilst the benefits are obvious there will be challenges for rapid and wide scale deployment.	
Rate of change	▪ Alternative fuelled vehicles account for 4.7% of sales in 2017, a rise of 36% year in year ▪ The range of EVs will continue to expand over the period to 2025 and beyond; ▪ Hydrogen vehicles will come to market in the early 2020s but like EVs in their infancy will be dependent upon availability of re-fuelling facilities
Applicability	▪ Private car EVs will be leased / bought by those who can afford them (costs remain higher than regular vehicles) and have access to or can make access to charging facilities at home and or work ▪ Commercial fleet take up will be dependent upon duty cycles and the availability of charging infrastructure and in the case of LGV/HGV a suitably resilient grid connection
Benefits	▪ Zero emissions at point of use and associated air quality improvements ▪ Reduced noise at point of use ▪ Recued maintenance cycles and consumables
Dis-benefits	▪ Inequality due to cost and access to charging / fuelling infrastructure ▪ Street clutter with EV charging infrastructure ▪ Impacts on and capabilities of local electricity grids ▪ Need for new hydrogen fuelling infrastructure ▪ Taxation impacts and associated incentives
Interdependencies	▪ Public perception – range anxiety etc. ▪ Home / workplace / parking charging infrastructure (until all ranges are increased) ▪ Grid capacity, capabilities and means of payment for energy used for private and commercial use cases ▪ A network of hydrogen fuelling stations
Risks	▪ Public perception and take up ▪ Commercial availability – vehicles and charging / fuelling infrastructure ▪ Electrical resilience and capacity in some areas

Impetus	▪ Policy move from fossil fuels ▪ Urban air quality concerns ▪ Some vehicle manufacturers capturing an early market share ▪ 'Green' credentials personal and corporate

4.5 SHARED TECHNOLOGY TRENDS

Table 9 – Shared Technology Trends

SHARED – *the sharing of services vs. traditional 'ownership'*	
Sharing of assets between users has been a developing and disruptive trend in transportation over the last few years. Facilitated by digital connectivity solutions match demand (customers) with supply (available assets or journeys) generally via app-based solutions. Many feature on-account payment systems streamlining the customer experience and some encourage feedback or incentivise positive customer behaviours. Shared access to mobility solutions in the form of bike hire, car hire, taxi or pooled transit and bus offer people alternatives to 'owning' a car particularly in urban areas where services are accessible most of the time. Many shared mobility solutions are blurring traditional transport modes and testing existing regulatory and other frameworks.	
Rate of change	▪ There are numerous new entrants in this space and this is expected to continue over the period to 2025
Applicability	▪ It is expected that shared solutions will be deployed in urban areas where large customer bases exist or people willing to share assets and services ▪ That said there is potential for shared services to tackle rural challenges with flexible, on-demand type services ▪ Shared and digital-enabled access to homes and cars will provide flexibility and support new e-commerce delivery services
Benefits	▪ Provides alternative to low utilised vehicles (2nd and 3rd cars) ▪ Reduced dependency on the private car and could potentially reduce overall numbers ▪ Provides a suite of choices for different mobility needs and circumstances ▪ Provides sustainable solutions (in the case of bike hire)
Dis-benefits	▪ Impact of 'parked' assets on the built environment ▪ Competing suppliers in some areas confuses the overall offer ▪ Ease of engagement for new or traditional customers ▪ Dependency of app-based technology may exclude some
Interdependencies	▪ Smartphone and app-based access ▪ Underlying communications and data – assets, systems and customers ▪ Availability of 'parking' during periods of low utilisation
Risks	▪ Public acceptance and trust ▪ Local regulation and licensing ▪ Demand meeting supply or vice versa
Impetus	▪ The market is driving innovation with significant investment by 3rd parties

Mode Applicability	**Road:** ▪ Expansion of car clubs such as DriveNow and ZipCar Flex, London ▪ Arriva Click, Sittingbourne – Demand responsive, flexible minibus service ▪ CityMapper Smart Ride, London – Shared hybrid bus-taxi service operating like a ride-hailing app and limited to a specific catchment area. ▪ Launch of ViaVan, London - On-demand shared transit service It should be noted that some early movers have experienced failures: ▪ Bikes – Ofo UK wide, MoBike Manchester; theft and vandalism ▪ Micro transit – Ford Chariot London, RATP Slide Bristol; failing to compete with other transport modes and not getting sufficient ridership

Table 10 – Business Model Trends

BUSINESS MODELS – *new consumer models of access, consumption and payment*	
With the trends above disrupting the traditional models of booking, paying for and access transport and mobility new business models are starting to emerge offering improved customer choice, flexibility and experience. Largely driven by underlying data aggregation such solutions not only simplify ticketing but also proved tailored and personalised travel information. In addition, bundled energy generation and storage solutions are being offered with new electric vehicles offering a completely different mobility model.	
Rate of change	▪ New models are emerging, it is expected that some of these will be commercially mature in the period to 2025
Applicability	▪ It is expected that new business models are likely to be most relevant to the urban and inter-urban markets particularly into the city regions
Benefits	▪ Truly seamless and integrated access to a choice of mobility solutions ▪ On account, single payment across multiple (or ultimately all) modes ▪ Improved operator understanding of customer choices ▪ Potential ability to balance supply and demand across all modes
Dis-benefits	▪ Public acceptance and willingness to use ▪ Privacy and data concerns ▪ Cyber security and fraud
Interdependencies	▪ Digital communications and energy networks ▪ Open access to fares, timetable and other data ▪ Access to banking and payment systems
Risks	▪ Consistency of deployment ▪ Ease of use for customer and subsequent uptake ▪ Willingness of operators to engage
Impetus	▪ From private sector mobility disruptors looking to offer something new ▪ From local authority promoters looking to improve public transport uptake
Mode Applicability	**Road:** ▪ Whim MaaS pilot, Birmingham – App-based platform that allows users to subscribe to monthly transport packages (including bus, train, tram, taxi, hire car and cycle) ▪ Citymapper – Public transport app and mapping service ▪ Vamooz – App-based bus crowd funding bidding platform, being used to develop new school contracts etc.

4.5.1. Transportation in all its guises is likely to go through considerable change over the coming decades. It is impossible to predict with any degree of certainty when and where these changes will first occur, whether they will ultimately be successful and how long they will take to become the norm. What is clear though is that significant amounts of investment are being made in both the private and public sectors to examine the potential impacts, challenges and opportunities so that networks and services are 'future ready'.

5 TRAJECTORIES OF CHANGES IN THE TFSE AREA

5.1.1. Considering the above potential changes in the future mobility realm it is important to consider the fact that many of the 16 transport authorities and five local enterprise partnerships have been supportive of and involved with technological and policy driven mobility solutions. Investments and forward thinking, and the area's proximity to UK research centres and London have provided the conditions for innovation

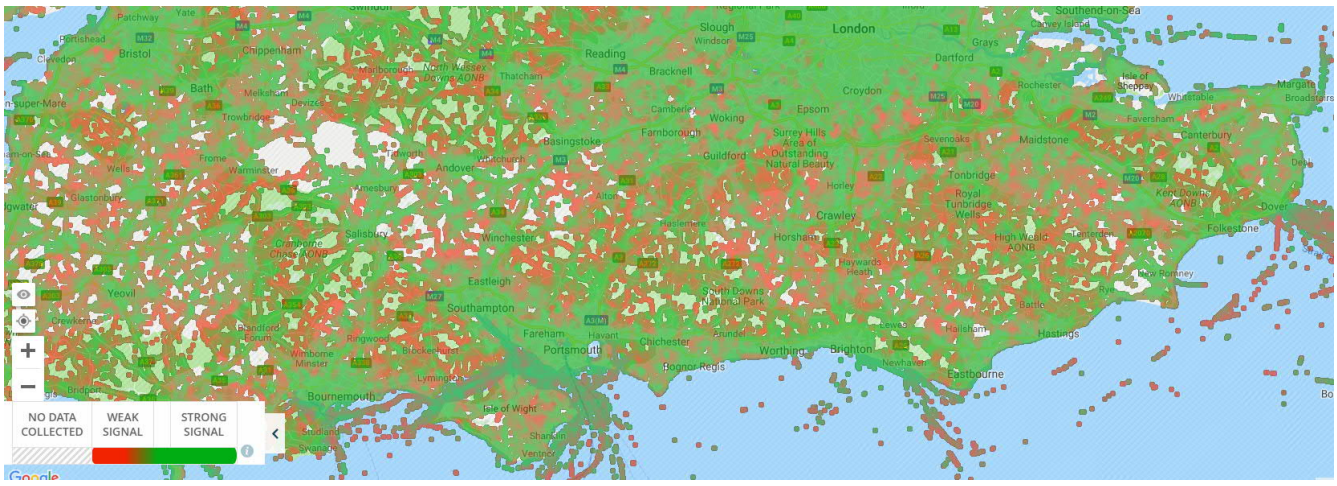
5.1.2. The following pages provide an overview of the broad trajectories of change within the primary pillars of future mobility as well as a commentary on the emerging models.

5.2 CONNECTED

5.2.1. Like many places in the UK the TfSE area has seen significant investment in its digital communications over recent years. Future combinations of 4G, broadband and emerging 5G connectivity will provide the foundations for many technologies and associated services which will gather pace over the coming years.

5.2.2. The following map provides an overview of current 4G connectivity across the city, with green denoting strong signal and red weak. It should be noted that whilst mobile connectivity overall is very good that are still patches where signal is weak potentially being a future restriction to the use of mobile communications for both services and assets.

5.2.3. Whilst next generation 5G is being explored in various geographies at the moment (the first commercial roll outs starting in major UK cities) it is more infrastructure heavy and potentially costly, certainly in the early days, to implement. However, with its low latency (speed of connection and data transfer) and high capacity, 5G promises to herald a step-change in connectivity, enabling the Internet of Things and for some applications, facilitating autonomous modes. It should be noted that for autonomous applications varies approaches exist and it is not yet clear if ubiquitous digital connectivity is a necessity.

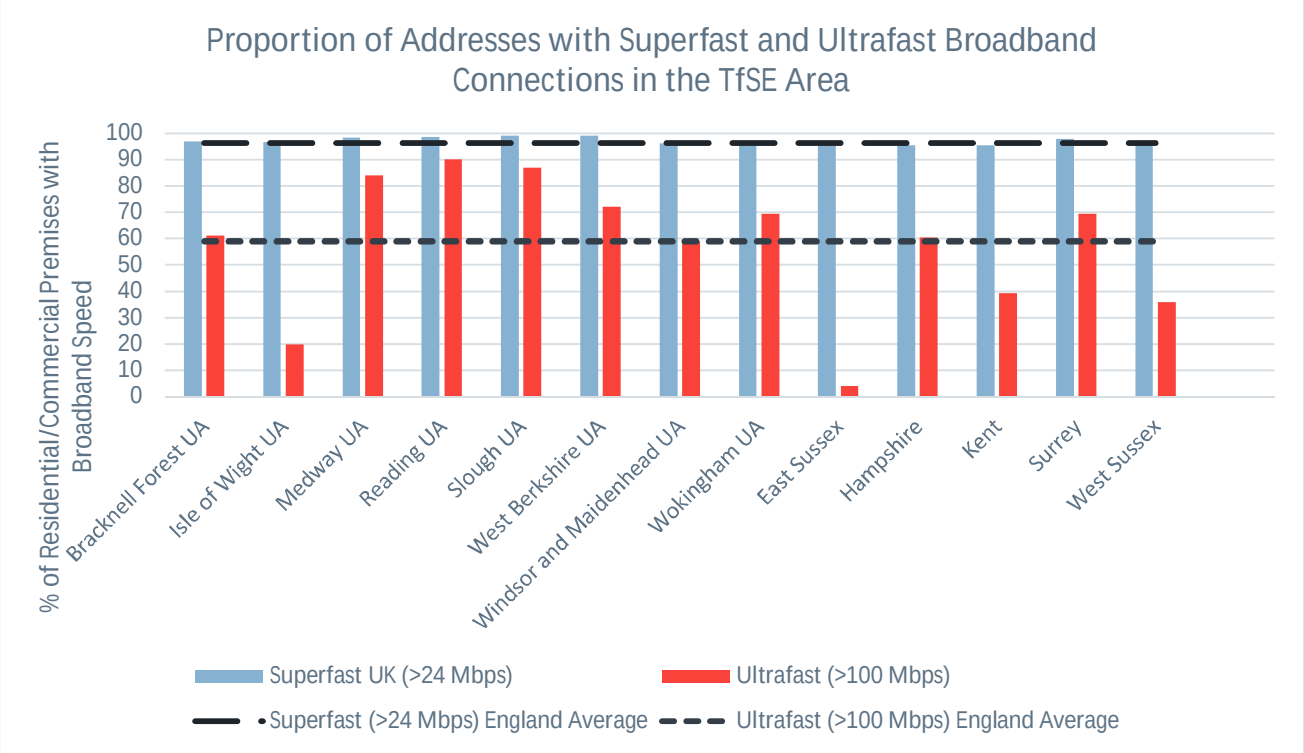


Source: https://www.which.co.uk/reviews/mobile-phone-providers/article/mobile-phone-coverage-map

Figure 10 – 4G Network Coverage, TfSE Area

5.2.4. With regards to broadband coverage Figure 11 provides a snapshot of current broadband speeds in the TfSE area. Of the Local Authorities for which there was available data, over 95% of residents and commercial premises experience Superfast broadband speeds of over 24Mps, with four falling

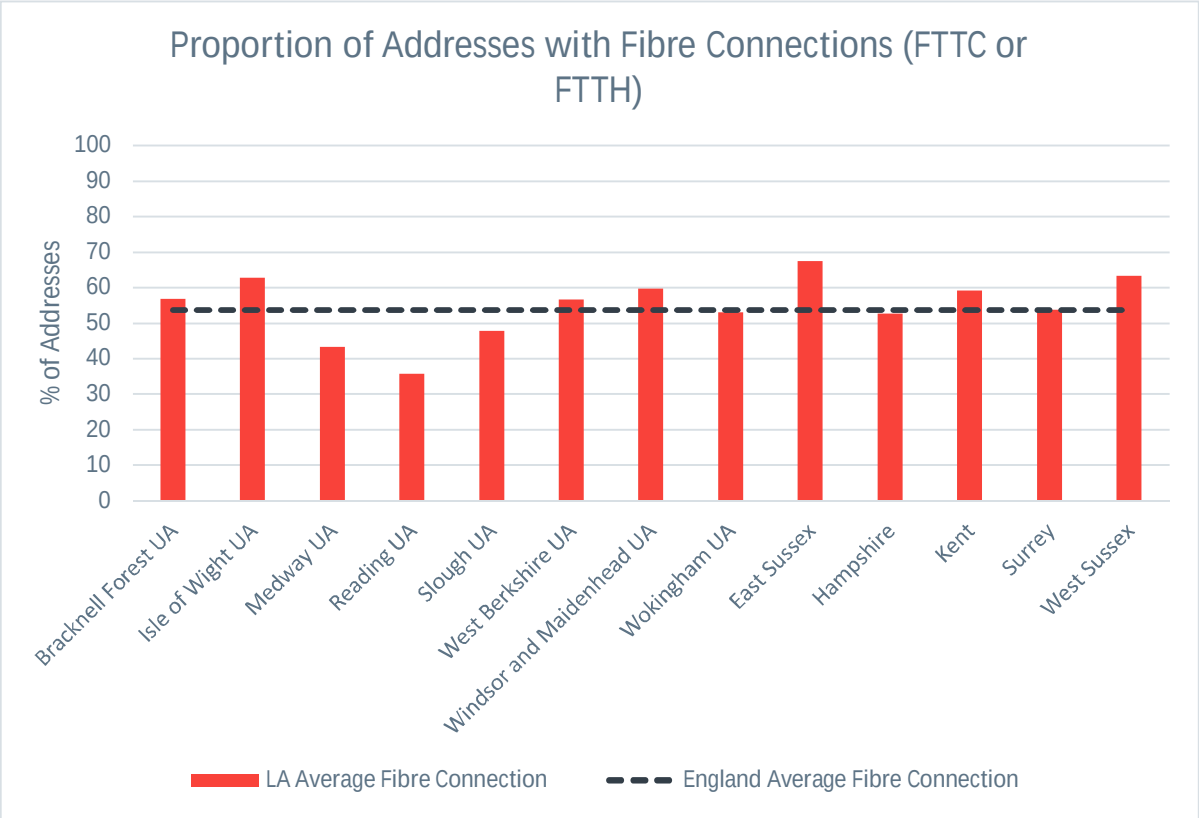
slightly short of the average for England of 96.3%. However, the data shows that the proportion of residents experiencing ultrafast broadband speeds of over 100Mbps varies more widely geographically, ranging from nearly 90% in Reading UA to just 4% in East Sussex (well below the average for England at 58.9%).



NB. Data for Brighton & Hove UA, Southampton UA and Portsmouth UA was unavailable.
Source: http://maps.thinkbroadband.com/ retrieved January 2019

Figure 11 – Percentage of Residents Experiencing Superfast & Ultrafast Broadband Speeds in the TfSE Area

In turn, Figure 12 shows the proportion of addresses that have some form of fibre connection, Fibre to Cabinet (FTTC) or Fibre to Home (FTTH), by local authority in the TfSE area. Fibre optic cables are able to deliver high speed data across large distances which can result in much faster download speeds compared to other types of connectivity delivery such as ADSL broadband, Cable or Wireless. Reading UA is the local authority in the area that ranks lowest in the proportion of residents with access to fibre connections whilst East Sussex ranks highest. When compared to the UK average of 57.7%, East Sussex is 9.7% above the UK average whilst Reading UA is 14.4% below the UK average in relation to the percentage of addresses with some form of fibre connection.



NB. Data for Brighton & Hove UA, Southampton UA and Portsmouth UA was unavailable.
Source: http://maps.thinkbroadband.com/ retrieved January 2019

Figure 12 – Proportion of Addresses with access to Fibre Connectivity in the TfSE Area

5.2.5. Fast, reliable and resilient digital connectivity will be essential in the home, businesses and centres of education and healthcare to enable new access models to services both physically and digitally. Digital connectivity coupled with Internet of Things (IoT) devices could be a major element in catering for an ageing population enabling people to remain in their homes for longer with medical interventions happening only when planned or detected as needed.

5.2.6. With regards to vehicle connectivity many new models of cars, vans, trucks and buses are now equipped with always-on digital connectivity allowing them to share and receive data on the move. The ability to link vehicles to networks and to each other provides potential benefits in terms of network operations and safety as well as providing enhanced customer and user experience.

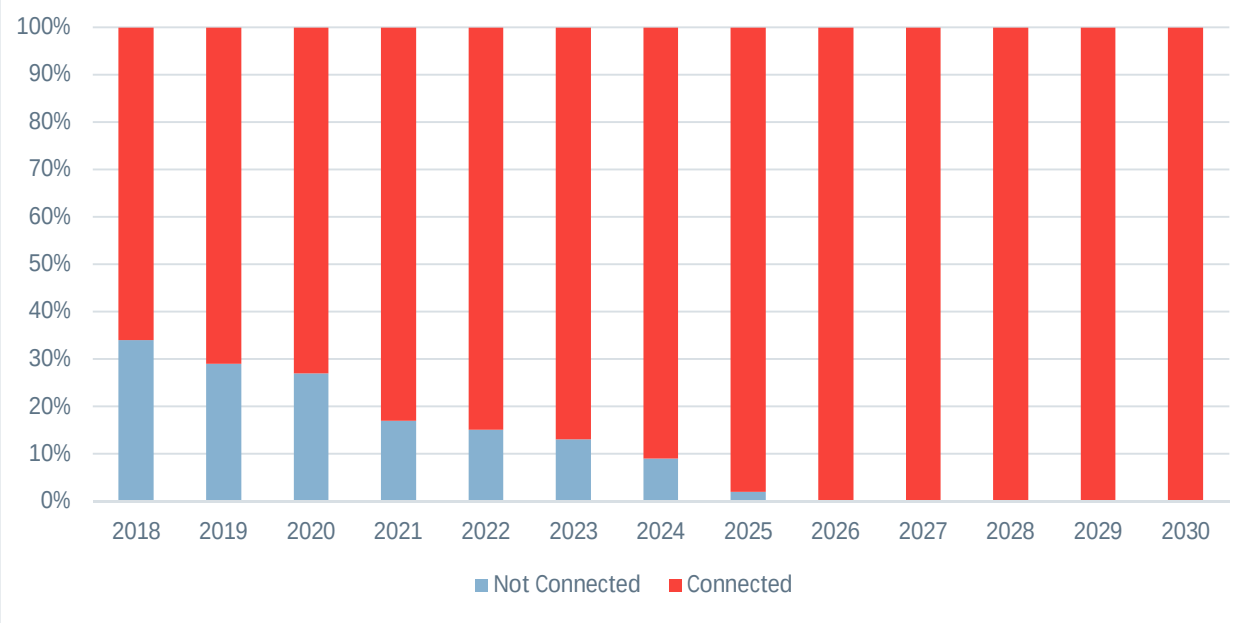
5.2.7. The A2/M2 Connected Corridor project, which is a collaboration between the Department for Transport, Transport for London and Kent County Council between London and Dover, aims to enable vehicles and road infrastructure to communicate through cellular networks and ITS-G5 networks on road corridors. The goal is to enhance journey safety and reliability. As part of the A2/M2 connected corridor the following services will be tested:

- In-vehicle signage: Information such as speed limits displayed on drivers' screens. In the future could potentially lead to the removal of some roadside infrastructure e.g. gantries when functionality has been demonstrated as being possible and accurate in-vehicle.

- Green light optimal speed advisory (GLOSA): Drivers informed of likely time it will take for traffic lights to change from green to red, with the vehicle displaying safe speed to ensure they get through. Could potentially reduce emissions.
- Roadworks warning: Drivers warned of approaching roadworks inside their vehicle to allow drivers to pre-emptively change lanes. Potential safety benefits for roads users and workers.
- Probe vehicle data: Location and speeds of vehicles connected to a central system to enable traffic flow analysis to be undertaken. Could improve smart motorway algorithms and help understand requirements for customer data requirements.

5.2.8. Other connectivity projects in the area include the incident detection tested installed in the Southwick Hill Tunnel between Brighton and Worthing on the A27 between 2017-2018. The project is allowing Highways England to improve their knowledge of detector performance and improve the quality of infrastructure installed in tunnels.

5.2.9. Estimates suggest that there are at least 3 million vehicles with internet connectivity on UK roads at present, accounting for 7.6% of the 39.6 million vehicles licensed on UK roads.[72] [73] Figure 13 provides a projection of anticipated uptake of Connected Vehicle technology between now and 2030 for new vehicles; reflecting a normalisation of the technology in new vehicles and gradual fleet penetration.



Source: SMTT Connected and Autonomous Vehicles 2019 Report (2019): https://www.smmt.co.uk/wp-content/uploads/sites/2/SMMT-CONNECTED-REPORT-2019.pdf

Figure 13 – Predicted Uptake of Connected Vehicle Technology in the UK

[72] Transport Technology Forum (2018). *Connected Roads, Vehicle and People: A Key National Opportunity*. [online] London. Available at: https://www.ttf.uk.net/wp-content/uploads/2018/03/Connected-VP.pdf [Accessed 16 Jul. 2019].

5.3 AUTOMATED

5.3.1. The investment and implementation of automation in its widest sense is observed across the South East; from Govia Thameslink Railway implementing driverless train services in March 2018[74], to an increasing level of automation within Gatwick airport through the likes of Stanley Robotics valet parking service[75].

5.3.2. Automation, as it applies to vehicle technology that can be observed on the transport network, is of an early maturity. There is limited evidence of the levels of testing CAVs under specific conditions on the public road network given commercial sensitivities. However, a self-driving vehicle trial is currently being undertaken in London, more specifically Bromley and Croydon, by FiveAI (an autonomous technology firm). The trial, which began in April 2019, will involve up to 10 FiveAI vehicles being driven for 10 months by fully trained, safety drivers to collect data on road layouts and driver behaviours[76]. Additionally, a number of trials in the vehicle automation space are underway within the South East area:

- The University of Surrey, as part of a successful Innovate UK funding bid, are exploring the performance of localisation systems for autonomous vehicles with Technics[77].
- Gatwick Airport are trialling a fleet of self-parking robots provided by Stanley Robotics that improve the efficiency of the parking layout thereby creating dynamic capacity for the airport operator[78].

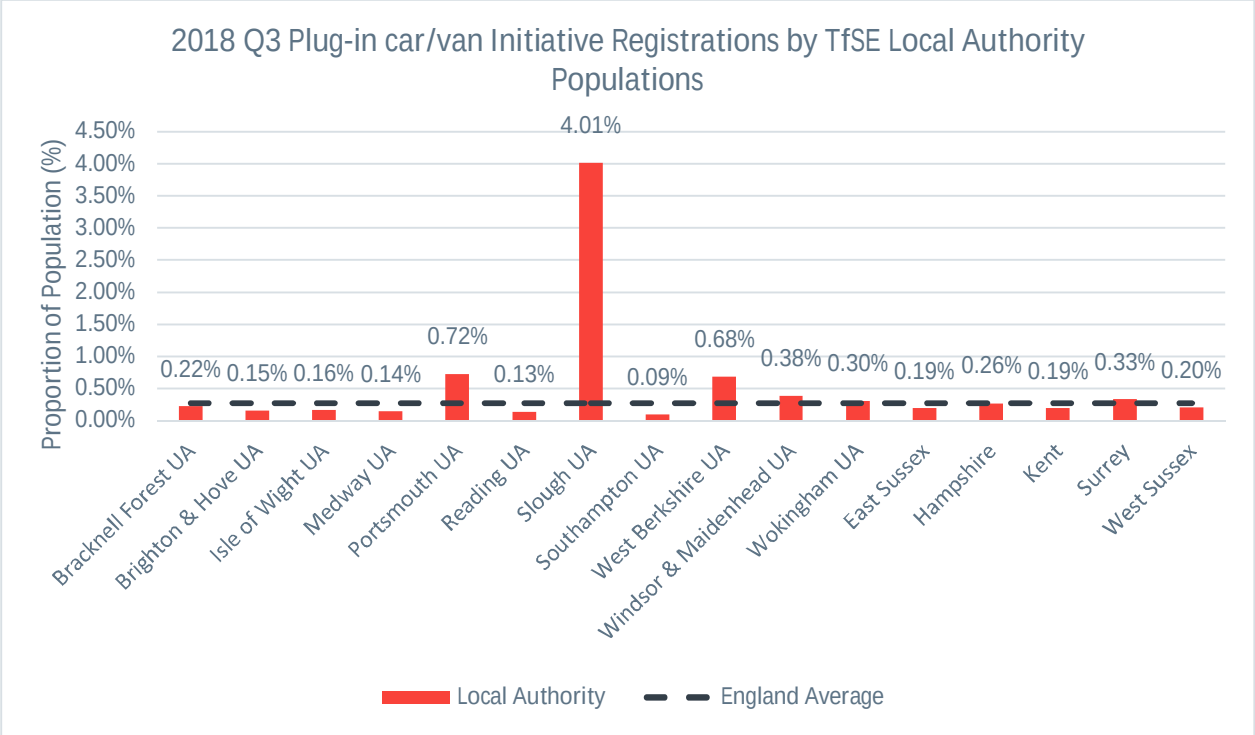
5.4 ELECTRIC (AND ALTERNATIVES)

5.4.1. The electrification agenda is gathering pace across the UK but few places have seen as dramatic an uptake as the South East. New registrations of pure electric and hybrid vehicles in the first half of 2018 were higher than any other region, accounting for 36% of the total.[79]

5.4.2. Over the last year an additional 7,660 plug in EV cars and vans have been registered in the TfSE area with the current overall fleet of 24,848 vehicles representing 16.2% of the total in England. Figure 14 illustrates new eligible vehicles under the plug-in car/van initiative registered in Local Authorities in the TfSE area from the end of 2011 to Q3 2018 by population. Unlike many other areas in the UK, the South East has seen sustained investment in its electric charging infrastructure providing the ideal conditions for an influencing of the local fleet. Investment, however, has not been uniform across the area and nor have areas been consistently reactive to such investment, which arguably has resulted in differentiated electric vehicle uptake. In both absolute numbers and as a

[74] The Guardian (2019). *First self-driving train launches on London Thameslink route. [online]* guardian.co.uk. Available at: https://www.theguardian.com/business/2018/mar/26/first-self-driving-train-london-thameslink-rail [Accessed 23 Jan. 2019].
[75] The Independent (2019) *Have your car parked by a robot at Gatwick airport. [online]* https://www.independent.co.uk/travel/news-and-advice/gatwick-airport-robot-valet-parking-stanley-robotics-a8751716.html [accessed 5 June 2019].
[76] Computing (2019). *Five AI Driverless car trials begin today on roads in London. [online]* computing.co.uk. Available at: https://www.computing.co.uk/ctg/news/3073547/fiveai-driverless-car-trials-begin-today-on-roads-in-london [accessed 5 June 2019].
[77] University of Surrey (2019). Surrey teams up with Technics to explore autonomous vehicle radar technology | University of Surrey. [online] Available at: https://www.surrey.ac.uk/news/surrey-teams-technics-explore-autonomous-vehicle-radar-technology [Accessed 23 Jan. 2019].
[78] Evening Standard. (2019). *Gatwick airport is to trial robots that park your car for you*. [online] Available at: https://www.standard.co.uk/tech/gatwick-airport-trial-for-valetparking-robots-will-cut-hassle-for-travellers-a4046406.html [Accessed 23 Jan. 2019].
[79] Fleet News (2018). *Electric car registrations grow 25% in first half of 2018*. [online] Fleetnews.co.uk. Available at: https://www.fleetnews.co.uk/news/manufacturer-news/2018/07/13/electric-car-registrations-grow-25-in-first-half-of-2018 [Accessed 11 Dec. 2018].

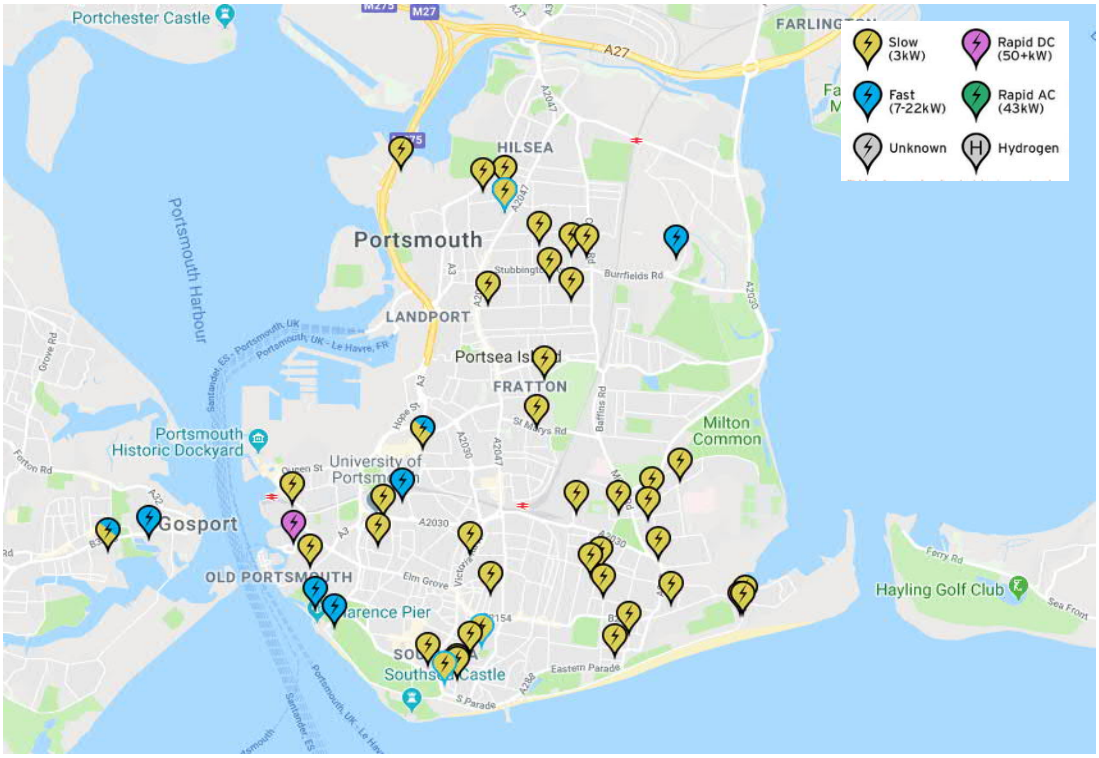
proportion of the population, 6,009 plug-in vehicles and 4% of the population, Slough has the most EVs in the TfSE area. However, these results could be somewhat misleading - there are several vehicle fleet/ lease companies whose headquarters are located in Slough meaning that the initial registrations of EV vehicles associated with these companies are addressed to the area. Therefore Portsmouth, with 1,561 plug-in vehicles and 0.7% of the population may in fact be leading in terms of electric vehicle uptake within the TfSE area, whereas Southampton in turn has the lowest proportion of EVs as a proportion of the population.



Source: Department for Transport, VEH 0131, Q3 2018 registered new vehicles, Local Authorities

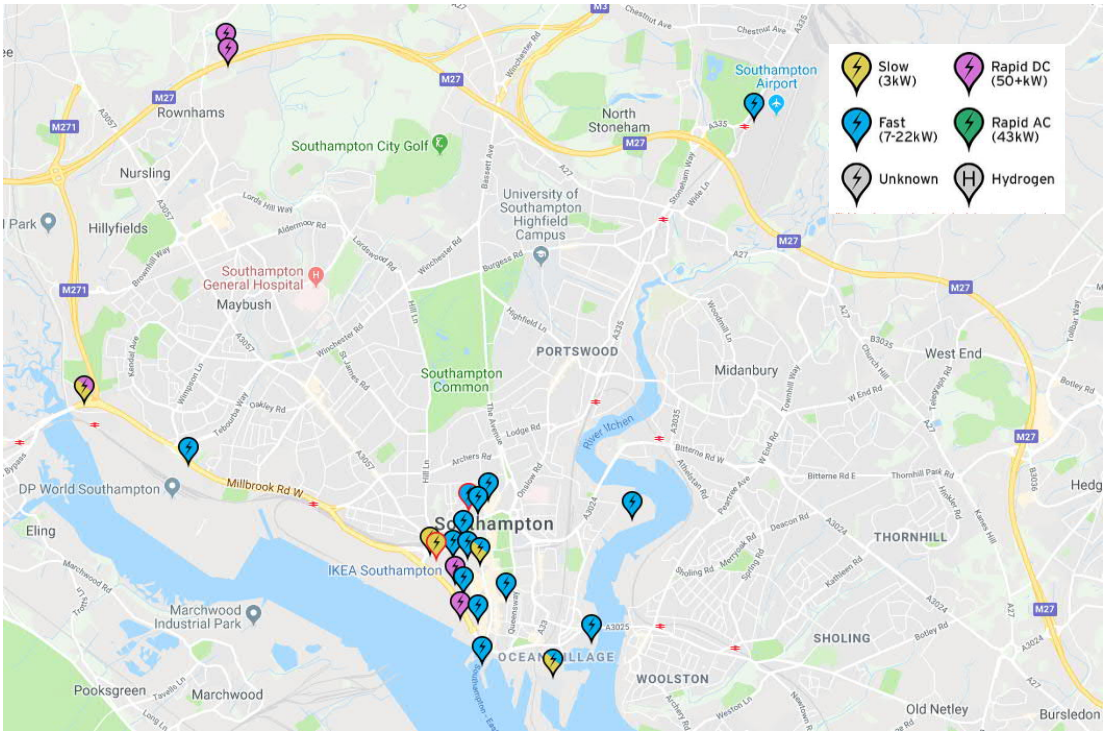
Figure 14 – Plug-in car/van Initiative vehicles registered in TfSE Local Authorities in Q3 2018

5.4.3. Figure 15 and Figure 16 provide overview maps of electric charging facilities for Portsmouth and Southampton and illustrate the density of infrastructure within the city cores in addition to the spread in surround suburban areas.



Source: Zap Map EV Infrastructure https://www.zap-map.com/live/ accessed January 2019

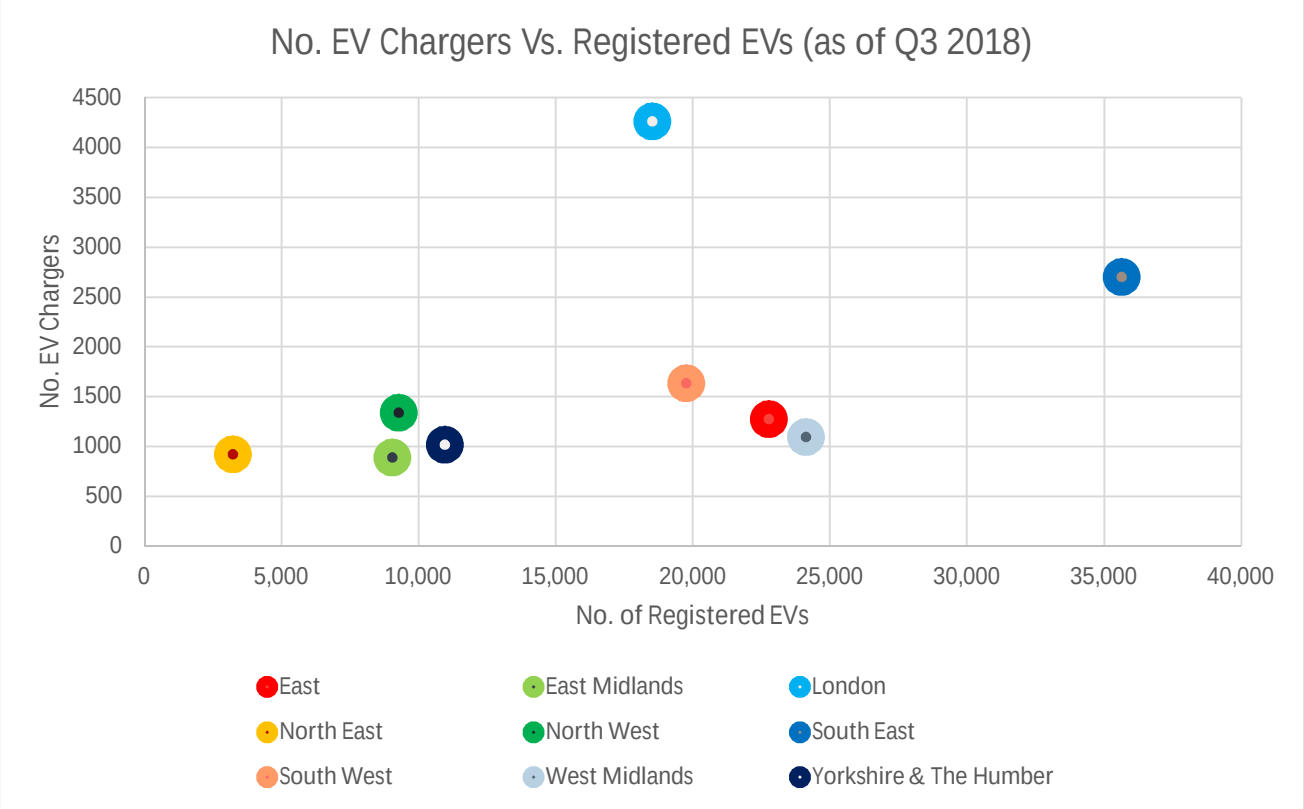
Figure 15 – Electric Vehicle Charging Facilities Portsmouth



Source: Zap Map EV Infrastructure https://www.zap-map.com/live/ accessed January 2019

Figure 16 – Electric Vehicle Charging Facilities Southampton

5.4.4. The prevalence of EV infrastructure has previously been cited as a key determinant of plug-in vehicle uptake. Detailed data regarding the amount of available EV charging in each local authority in the TfSE area is not yet available, however Figure 17 illustrates that the notional relationship between the number of electric vehicle chargers and the number of registered electric vehicles is not so straightforward. There has been a substantial amount of investment in electric vehicle charging infrastructure in London for example however the uptake of plug-in vehicles does match investment in the infrastructure. The South East region of the country in turn has seen much higher uptake in electric vehicles without the number of charging points.



Sources:
- Profile of charging connectors across the UK regions: Zap-Map, January 2019 https://www.zap-map.com/statistics/
- Department for Transport, VEH 0131, Q3 2018 registered new vehicles, Local Authorities

Figure 17 - Number of EV Chargers Vs Registered EVs per UK Region

5.4.5. The relative level of uptake in the TfSE area does not negate the need for interventions in some places. Policy levers such as Surrey County Council's endeavour to work with the country's car club to expand its network of EVs, aiming for 50% of fleet to be electric by 2025 are essential. The policy gives people the chance to use a ULEV without a large personal investment which may accelerate

uptake.[80] The link between air quality, place-making and health is important when considering future interventions and mitigating impacts.

5.4.6. Local Authorities in the TfSE area are also beginning to invest in electric public transport. As of January 2019 nine Stagecoach zero emission battery electric buses are due to be used for Guildford's park and ride service. The initiative is part of a £3million partnership between Surrey County Council and Stagecoach was partially funded by the Government's Low Emission Bus Scheme. The new buses can run for up to 150 miles, replacing the existing diesel fleet and offer a smoother, quieter and greener alternative. Brighton has also been awarded funding from the £11 million Government funding pot.[81]

5.5 SHARED

5.5.1. With regards to the sharing agenda most of the major cities in the TfSE area have a bike sharing scheme in operation. BTN, which is operated by Hourbike in Brighton and Hove, has 450 bikes available across 54 hubs with 120 new bikes in the pipeline, providing turn-up-and-go cycle hire. In the schemes first year 53,591 cyclists made 347,234 trips across the city.[82]

5.5.2. TfSE local authorities have also been proactive in enabling demand-responsive shared models to be tested in the area. With budgets in local authorities under pressure, services such as ArrivaClick being trialled in Sittingbourne, Kent, could offer a cost-effective customer focused complementary public transport service.

5.5.3. ArrivaClick is an on-demand flexible app-based minibus service and the service operates by booking passengers who are heading in the same direction on a shared vehicle. The corner-to-corner services picks up a maximum of 12 passengers at a nearby street corner and drops off a short distance of your requested destination, offering a cashless payment and guaranteed comfortable seat with associated charging points and WiFi. After the first year of service, ArrivaCLick reported that 50% of customers have switched from using private cars to the service with 12% of Sittingbourne's population having downloaded the application. [83]

5.5.4. Uber are providing app based taxi services within large parts of the South East region including Brighton & Sussex, the Home Counties and the South Coast as well as their Uber Eats service. Liftshare and BlaBlaCar, who both match drivers and passengers, both are active in the TfSE area.

[80] Surrey County Council (2018). Electric Vehicle Strategy. Surrey Transport Plan. [online] Kingston Upon Thames. Available at: https://www.surreysays.co.uk/environment-and-infrastructure/electric-vehicle-strategy/supporting_documents/Electric%20Vehicle%20Strategy%20v1%20%20Draft%20for%20Public%20Consultation.pdf [Accessed 11 Dec. 2018].
[81] Strudwick, M. (2018). *Guildford set for first fleet of all-electric buses*. [online] getsurrey. Available at: https://www.getsurrey.co.uk/news/surrey-news/guildford-set-first-fleet-electric-15612957 [Accessed 14 Jan. 2019].
[82] Bastable, B. (2018). *Birthday bash for Brighton and Hove's bike sharing scheme*. [online] Brightonandhoveindependent.co.uk. Available at: https://www.brightonandhoveindependent.co.uk/news/transport/birthday-bash-for-brighton-and-hove-s-bike-sharing-scheme-1-8618098 [Accessed 7 Jan. 2019].
[83] Intelligent Transport (2018). *Arriva's on-demand public transport service seeing results*. [online] Intelligent Transport. Available at: https://www.intelligenttransport.com/transport-news/65899/arrivaclick-on-demand-bus-service-a-success/ [Accessed 23 Jan. 2019].

6 IMPACTS OF NEW MOBILITY ON DEMAND

6.1.1. As identified previously, the way in which people engage and pay for their access and mobility is changing and the way people move, get their goods delivered in addition to where and when they work is altering. Considerable financial and intellectual investment is being made in technological innovations which has, when coupled with wider industry, demographic and preference developments, led to new business models of mobility emerging. Technology advances are enabling a digitisation of transport with a focus on offering personalised, on-demand services that are centred on the journey experience, with increased data availability allowing customers to make more informed choices and ultimately enabling operators to optimise asset use. The emergence of these new business models is blurring the lines between traditional modes of transport that have existed for decades, prompting a shift from separate public and private transport offerings to an integrated multi-modal mobility network.

6.2 EMERGING MOBILITY MODEL DEFINITIONS

6.2.1. As mentioned previously, many actors are investing significantly to deliver market leading, customer centric, seamless mobility propositions and thus there are countless mobility models emerging in different forms and at varying speeds. These mobility model trajectories are variable and exactly if, how, where and when they come to fruition is difficult to predict with certainty. It is however important to consider the likely changes and plan for them, so to fully capitalise on their potential benefits.

6.2.2. Consequently, an in-depth review of emerging business models has been undertaken to assist TfSE in shaping a future vision for the area that takes account of the developments in the field. Extant industrial research, thought leadership, results from pilot studies and market statistics from both primary sources (resulting from ongoing business-to-business discussions) and digital secondary sources, associated with scoped mobility business models informed the review.

6.2.3. Following the review of relevant material, three distinct groups of mobility business models became evident, which categorised the seven mobility business models that were scoped into the assessment:

- People-Based Mobility Models
  - **Ride-sharing:** Ride-sharing schemes match private vehicle drivers with potential passengers (sometimes co-workers) making similar regular or one-off trips.
  - **Ride-sourcing:** Ride-sourcing schemes match customers with available rides using a smartphone app. Users can register their desired trips and pay on account via pre-approved payment methods with prices set according to supply and demand.
  - **Asset Sharing:** Mobility asset sharing allows customers to access and to share use of different mobility modes without having to own them (e.g. car or bicycle). Assets are generally available at permanent or semi-permanent parking locations and booked, paid for and located via an app.

- Service-Based Mobility Models
  - **Mobility as a Service:** MaaS is the integration of multi-modal public and private sector mobility services, delivered through one or more digital platforms. It incorporates travel information, payments, reservation of demand responsive modes and authentication. MaaS is

designed to enable customers to seamlessly access and consume mobility services to undertake end-to-end journeys meeting the individual's quality, cost and time preferences.

- **Parking Platforms:** Parking platforms provide consumers with information and app-based payment functions to reduce the traditional problems associated with finding and paying for parking.
- **Digital as Mode:** The use of digital connectivity to reduce / remove the need to travel can be referred to as 'digital as a mode'. Digital access to work, education and healthcare provides for similar opportunities without physical movement.

- Freight-Based Mobility Models
  - **Digital-Based Freight Models:** Digitally enabled freight models (i.e. accessed online, in-vehicle or through mobile devices) offer customers easier access to real-time and price transparent freight services. In turn, data-driven models improve supply chain visibility and asset utilisation for operators through the likes of integrated fleet management systems.
  - **Service-Based Freight Models:** Digitally enabled services using increasing amounts of data and automated technologies to provide customers with a wider selection of flexible last-mile delivery and collection options.

6.2.4. This list of categorised mobility models, with descriptive models of likely application was discussed and agreed with the TfSE team before undertaking a full qualitative assessment of each.

6.3 MOBILITY MODEL DASHBOARD DEVELOPMENT

6.3.1. Dashboards were developed for each of the new mobility models to summarise wider research into a digestible format. Each dashboard was split into three distinct sections:

- Model Overview
- Existent Mobility Model Analysis
- Potential Future Mobility Model Impacts Analysis

6.3.2. Full copy of each dashboard can be found in Appendix A.

6.3.3. Each element of the dashboards is discussed below:

MODEL OVERVIEW

Definition

6.3.4. A description of the nature of the overarching Mobility Model

Sub Models

6.3.5. New mobility service offerings have not developed homogenously, with innovations targeting different market segments, 'modes' and geographies, attempting to distinguish their offering from competitors in the field. Thus, there are numerous sub-models that can be carved out within the overarching mobility model categorisation. In the future some of these sub-models may have evolved into separate entities but for now they have been grouped together. This is by no means a complete list but covers the foremost sub-models.

Modes Impacted in the UK

6.3.6. Some mobility models are established around a single, traditional, mode of transport (e.g. bus), others are applicable to a variety of modes and further models utilise 'non-traditional' modes that blur the lines between 'traditional' transport modes (e.g. on-demand micro-transit obscuring the lines between taxi and bus).

6.3.7. Only 'traditional' modes that are affected by mobility models that are known to be commercially operational at time of writing. Therefore, although a mobility model could potentially impact additional modes in the future as the model is more widely implemented, these are not referenced.

6.3.8. The icon used to illustrate the traditional modes that are affected by each mobility business model in question are indicated by the following representations in Table 11.

Table 11 - Mode Icon Reference

Icon	Mode Reference
	Car/Van
	Taxi
	Bus/Coach
	Bicycle
	Moped
	Motorbike
	Light Goods Vehicle
	Heavy Goods Vehicle
	Rail
	Tram/Tube
	Maritime
	Air

N.B. Modes such as electric scooter (presently illegal on British pavements or roads), droid (pavement devices - still in early development), drone (still in early development) etc. are not for purposes of this report classed as a 'traditional' modes

Journey Range

6.3.9. An assessment of the typical range (in kilometres) which a mobility model serves.

6.3.10. It should be noted that the range of each sub-model differs and therefore the journey range given to the overarching mobility model is an average of reviewed operations. Also, as many of the businesses operating in the emerging mobility markets are relatively new, the information publicly available to use to make an informed decision about their operational range is limited in some cases due to commercial sensitivities. Thus the most accurate assessment has been made using the information available.

Mobility Model Maturity

6.3.11. Most of the market entrants attempting to commercialise these technology-enabled mobility business models are relatively new in terms of their maturity. That is most companies have only recently begun business operations and launched their services, initially focusing their attention on advertising their comparative advantages and value propositions to their target consumer segments. Whether the models operate sustainably or their predicted outcomes come to fruition is unknown in many cases.

6.3.12. As organisations become more experienced in their market and service offering, developing effective systems to support their activities, they become more mature in their approach. Thus the maturity of each model at the time of writing has been assessed. Using aspects of Auvik's 'Five levels of Operational Maturity'[84] and StartUpCommons 'Startup Development Phases'[85], mobility model development has been simplified and described with a limited number of maturity levels as outlined in Table 12.

6.3.13. It should be noted that the maturity of each sub-model case study differs and therefore the maturity level given to the overarching mobility model is an average of all the reviewed operations. Also, as many of the businesses operating in the emerging mobility markets are relatively new, the information publicly available to use to make an informed decision about their maturity is limited in some cases due to commercial sensitivities. Thus the most accurate assessment of the mobility model maturity has been made using the information that was available.

[84] Networks, Auvik. 2019. "The 5 Levels Of Operational Maturity". *Auvik Networks*. https://www.auvik.com/franklymsp/blog/msp-operational-maturity/.
[85] "Startup Development Phases". 2019. *Startup Commons*. https://www.startupcommons.org/startup-development-phases.html.

Table 12 - Model Maturity Level Criteria

Model Maturity	Name	Description
1	Beginning	▪ Mission and vision with initial strategy and key milestones ▪ Do not know what they don't know ▪ Small scale operations are largely trial and error ▪ Inconsistent service quality
2	Emerging	▪ Discovery of a viable business model ▪ Initial key performance indicators identified ▪ Initial product/service version developed ▪ Attract additional resources (money or workforce) via investments or loans for equity, interest or revenue share from future revenues ▪ Inconsistent service quality ▪ Project level thinking
3	Scaling	▪ Repeatable sales and operations ▪ Begin to track key performance indicators in users, customers and revenues and/or market share ▪ Median key performance indicator based measurable growth ▪ Hiring, improving quality of service and implementing processes ▪ Median service quality ▪ Organisational level thinking
4	Optimizing	▪ High key performance indicator based measurable growth ▪ Focus on operational efficiency; forward budgeting and attainment tracking ▪ High service quality ▪ Organisational level thinking
5	Stable	▪ Established market position ▪ Continuous innovation and optimisation to extend capabilities and offerings ▪ Achieved great growth of key performance indicator metrics and this can be expected to continue ▪ High service quality ▪ Organisational level thinking

Geographical Applicability

6.3.14. The geographical typology that the mobility model is currently operational within in the UK.

6.3.15. Mobility models have commercial and operational dependencies which they rely upon to establish themselves. In some cases these dependencies, such as the requirement of a critical mass of users, impact the geographical application of the model.

6.3.16. Table 13 shows the icon used to illustrate the four geographical applicability typologies and the corresponding explanatory reference. These have broadly followed the Office for National Statistic's

Rural/Urban Classifications for the 2011 census and the corresponding categories are also outlined in the Table 13 (excluding the 'Corridor' typology). [86]

6.3.17. It should be noted that the geographical applicability of each sub-model differs and therefore not all the contexts illustrated will be relevant to all sub-models. Instead the icons indicate the potential geographical applicability of all the sub-models within the overarching mobility model.

6.3.18. It should also be noted that as many of the businesses operating in the emerging mobility markets are relatively new, the information publicly available to use to make an informed decision about geographical applicability is limited in some cases. Thus, the most accurate assessment has been made using the information available.

Table 13 - Geographical Applicability Icon Reference

Icon	Geographical Context Reference	2011 Census Rural-Urban Classification
	Urban	▪ Major Conurbation (A1) ▪ Minor Conurbation (B1) ▪ City and Town (C1) ▪ City and Town in a Sparse Setting (C2)
	Peri-urban	▪ Town and Fringe (D1) ▪ Town and Fringe in a Sparse Setting (D2)
	Corridor / Inter-urban	▪ N/A (SRN or MRN routes that link major centres of economic activity)
	Rural	▪ Village (E1) ▪ Village in a Sparse Setting (E2) ▪ Hamlets and Isolated Dwellings (F1) ▪ Hamlets and Isolated Dwellings in a Sparse Setting (F2)

[86] Office for National Statistics. 2013. "The 2011 Rural-Urban Classification for Small Area Geographies". London: Government Statistical Service.https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/239478/RUC11user_guide_28_Aug.pdf

6.4 EXISTENT MOBILITY MODEL ANALYSIS

UK Best Practice Examples

6.4.1. Examples of commercial operations in the UK, with a focus on the South East, at the time of writing.

6.4.2. Case studies provide an overview of the specific service offering, geographical availability and key performance information if available (such as uptake).

6.4.3. Examples have been selected objectively as there is significant media hype around many of the commercial applications of the new mobility models, yet limited publicly available operational outcome figures. This is particularly the case for operations in their infancy due to commercial sensitivities.

Major Market Failures

6.4.4. Several of the mobility business models are in their infancy and although appear to be offering a sustainable transport solution through utilisation of evolving technologies, in many cases robust business models are not yet established.

6.4.5. A string of recent mobility market failures, initiated as a result of anticipated benefits not materialising and investment ceasing, emphasises the need to be wary of hype and overpromise of commercial innovators. Proper due diligence is essential before new models enter into the market to reduce the threat of substantial gaps being left in the transport network if operations cease. Consumer opinions, public acceptance, market reaction and technology uptake are key - a seemingly good idea cannot succeed alone.

6.4.6. Examples of significant business model failures have been selected from around the world (priority for UK examples). Any information obtained detailing reasons for the ceasing of operations is documented, however, frequently this is limited due to commercial sensitivities. This information is fundamental for lesson learning and preventing market failures in the future.

Opportunities for Success and Influence

6.4.7. The main opportunities for success and influence that each mobility model could bring about are outlined, informed by findings from published research from academia and industry, general industry news, business reports, thinktanks and business to business meetings.

Barriers to Implementation

6.4.8. The main barriers to mobility model operation and adoption, informed by findings from published research from academia and industry, general industry news, business reports, thinktanks and business to business meetings are outlined.

Wider Implications

6.4.9. Any wider implications for other programmes and interventions including digital, energy and land use are outlined.

6.5 POTENTIAL FUTURE MOBILITY MODEL IMPACTS ANALYSIS

Impact on Baseline Total VKT (Vehicle Kilometres Travelled)

6.5.1. Potential impact of each mobility model on a baseline forecast total vehicle kilometres travelled for the years 2020, 2025 and 2030. The dashboards indicate the potential variation in VKT caused by the mobility models compared to a baseline figure, based on a number of assumptions.

6.5.2. There is a large amount of uncertainty surrounding the impacts of new technology-enabled mobility business models on travel demand. Demand related mobility issues specifically, such as congestion, are high on Government agendas and therefore publicly available information from and about mobility market entrants is limited due to commercial sensitivities. It should also be noted that even available information requires a thorough review. This is because many market entrants are still in their infancy and only operating in limited locations, and therefore information regarding their impacts on travel demand and mode shift could potentially stem from small-scale, location specific operations that may not be scalable.

6.5.3. Despite the uncertainty surrounding the potential impacts of new mobility models on travel demand, findings from academic published research and industry, general industry news, business reports, thinktanks and business to business meetings have been reviewed and critiqued to make an informed qualitative assessment for the years 2020, 2025 and 2030.

6.5.4. The qualitative assessment assumed:

- Vehicle Kilometres Travelled (VKT) is an appropriate proxy for road-based vehicle demand (inclusive of car, taxi, bus, LGVs and HGVs)
- A baseline total VKT to 2030 that extrapolates extant VKT trends through to 2030, broadly considering the impact of externalities such as demographic changes (e.g. population growth, ageing population, urbanisation etc.) and socioeconomic changes.
- The 2019 mobility landscape and market position within the UK remains constant through 2020, 2025 and 2030. This refers to three key influencing factors which heavily influence the growth of/demand for Mobility Business Models:
  - The **regulatory environment** in which the Mobility Business Models operate
  - The **likelihood of users sharing** mobility services (both personal use of a shared asset and shared occupancy of an asset itself)
  - The comparative **affordability of mobility technologies** to existing vehicles (e.g. ultra-low emission vehicles (ULEVs) and increasingly connected and automated vehicles (CAVs))

For the point of this assessment, the factors influencing the mobility market were assumed to be (as a plausible baseline scenario):

- Regulatory environment: **Open market** (limited regulatory intervention and competitive market)
- Likelihood of users sharing: **Low sharing** (public willingness to share low)
- Technology affordability: **High cost** (comparatively new forms of mobility are expensive to traditional modes)

6.5.5. In the context of the assumptions surrounding the mobility ecosystem in 2020, 2025 and 2030 (relating to regulation, willingness to share and technology affordability), the assumptions regarding the development and deployment of Level 4+ connected and automated vehicle (CAV) technology are outlined in Table 14. These assumptions are in line with the 2019 SMMT Connected & Autonomous Vehicle Technology Roadmap.[87] The assumptions regarding CAV technology development and deployment are explained using Technology Readiness Levels; a nine-point scale used as a means of assessing whether an emerging technology is ready for use.[88]

Table 14 - Assumed CAV Technology Readiness Level 2020, 2025 & 2030

Year	Assumed Technology Readiness Level	Technology Readiness Level Description	Assumed wider consequences of CAV development and deployment
2020	Level 6 - Development	Large Scale Development - The technology is undergoing testing at or near full-scale size.	Limited assumed impacts on mobility models as technology still in development
2025	Level 8 – Deployment	Active Commissioning – The technology is undergoing active commissioning	Preliminary introduction of L4/5 connected autonomous vehicles into fleets by operators but not reached critical mass and limited uptake by private individuals due to high cost
2030	Level 9 - Operations	Operations – The technology is being operationally used in an active facility	Preliminary introduction of L4/5 connected autonomous vehicles into fleets by operators but not reached critical mass and limited uptake by private individuals due to high cost

6.5.6. The impact of each mobility model on the baseline VKT was assessed in isolation and therefore impacts of the different models cannot be layered. This is because there are interrelationships between some of the models once increasingly connected and automated vehicles (CAVs) enter fleets (assumed to be 2025+). For example, car-sharing and ride-sourcing are ultimately assumed to merge into a single business model after the establishment of CAVs capitalising upon the functionality of the new technology. This is expected as a result of limited differentiation in service provision, MaaS providing an integrated and seamless mechanism of accessing services and reduction in brand perception associated with travelling in a particular type of vehicle.

6.5.7. Consequently, when considering the potential impact of each mobility model on the baseline VKT for the years 2020, 2025 and 2030, the icons in the dashboard indicate the variation caused by each mobility model on the assumed baseline VKT. Table 15 shows the dashboard icons and their corresponding assessment explanation.

[87] SMMT (2019). Connected and Autonomous Vehicles. Winning the Global Race to Market. [online] London: The Society of Motor Manufacturers and Traders. Available at: https://www.smmt.co.uk/wp-content/uploads/sites/2/SMMT-CONNECTED-REPORT-2019.pdf [Accessed 4 Jun. 2019].
[88] UK Government. 2014. "Guidance On Technology Readiness Levels". *GOV.UK*. https://www.gov.uk/government/news/guidance-on-technology-readiness-levels.

Table 15 - Impact on Baseline Total VKT Icon Reference

Icon	Potential Mobility Model Impact on Baseline Total VKT
	Major increase
	Minor increase
	N/A or no change
	Minor decrease
	Major decrease

Wider Impacts Across All Modes

6.5.8. A concise narrative of the potential impacts on other modes, (inclusive of active modes, road and rail) resulting from the impact of each mobility model in the years 2020, 2025 and 2030 (i.e. justification for VKT impact above) informed by findings from published academic and industry research, general industry news, business reports, thinktanks and business to business meetings.

6.5.9. A summary of the wider impacts for all mobility models across 2020, 2025 and 2030 is available in Appendix B.

Contribution of Mobility Model to achieving TfSE Principles

6.5.10. Each mobility model was qualitatively evaluated against the relevant principles contained in the TfSE Economic Connectivity Review Final Report (July 2018) to assess the extent to which each mobility model could contribute to achieving each principle. The same regulatory, sharing and technology affordability scenario was assumed.

The TfSE principles included in the assessment and the justification for inclusion and exclusion is outlined in Table 16.

Table 16 - TfSE Strategic Priorities Assessment Inclusion Justification

TfSE Strategic Priority	Included/ Excluded	Reason
Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:		
• Supporting partners to meet the current and future housing needs, employment space, and regeneration;	Included	-
• Facilitating improved connectivity between international gateway ports, airports and Eurotunnel Terminals and their markets within the South East and to the wider UK and the rest of the world;	Excluded	Future mobility solutions are not expected to significantly impact this measure
• Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network;	Included	-
• Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally; and	Included	-
• Ensuring a well-maintained transport network is in place that is resilient to incidents and extreme weather events	Excluded	Future mobility solutions will not cover the technologies which could enable improved network management
Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:		
• Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	Included	-
• Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	Included	-
Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the south east's unique natural and historic environment by:		
• Considering the impact of transport on the South East's National Parks, Areas of Outstanding Natural Beauty (AONB), UNESCO World Heritage Sites and other environmental and heritage designated sites;	Excluded	Future mobility interventions will not directly impact this measure, but ongoing electrifications will benefit
• Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	Included	-
• Considering the value of open spaces to the economy, well-being and the importance of tourism to the rural economy; and	Excluded	Future mobility solutions do not contribute to this measure
• Considering the impact of transport interventions on land uses, landscapes, habitats and biodiversity, and ensuring the most appropriate environmental mitigation measures are implemented.	Excluded	Future mobility solutions do not contribute to this measure

6.5.11. Table 17 outlines the varying extent to which the mobility models contribute to the TfSE Strategic Principles as stated in the dashboards.

Table 17 - Extent of Mobility Model Contribution to Achieving TfSE Strategic Principles Reference

Extent	Potential contribution of Mobility Model to achieving TfSE Strategic Principles
Maj.	Major contribution
Med.	Medium contribution
Min.	Minor contribution
N/A	Negligible contribution

6.6 FULL MOBILITY MODEL DASHBOARDS

6.6.1. A full copy of each dashboard can be found in Appendix A.

6.7 IN SUMMARY

6.7.1. The merging mobility sector is extremely buoyant with many new and emerging entrants disrupting traditional public transport, ownership and access models. The landscape can currently be summarised as follows;

- New mobility models are emerging in the UK, and elsewhere, at various levels of commercial maturity
- Most new mobility models are dependent upon underlying digital capabilities and access via smartphones / apps and other emerging digital devices (such as voice activated)
- There have already been notable market failures resulting in risk to local users
- New mobility models are generally focusing on the customer with an intention to reduce / remove 'friction' from the mobility experience
- Access vs. ownership is a common thread with a focus on providing access to mobility on service based models to avoid traditional models of vehicle ownership
- Mobility models and service offerings are changing rapidly
- Commercial viability (in the short and long term) remains to be seen, although some models and operators are now long established
- Innovation is rife influenced by major international initiatives

6.7.2. Turning to the potential impacts on the TfSE network in the future, many of these models could disrupt the local transport particularly in the first mile / last mile market providing new alternatives to bus, taxi and short distance car trips. What constitutes 'public transport' will inevitably change, extending the definition beyond the traditional modes and linear, largely fixed networks. Disruption to the traditional model of 'car ownership' could provide for new fleet models serving communities in different ways. However, it is important that mobility innovation is underpinned by the following principles, as outlined by the Government in the Future of Mobility: Urban Strategy:

- New modes of transport and new mobility services must be safe and secure by design.

- The benefits of innovation in mobility must be available to all parts of the UK and all segments of society.
- Walking, cycling and active travel must remain the best options for short urban journeys.
- Mass transit must remain fundamental to an efficient transport system.
- New mobility services must lead the transition to zero emissions.
- Mobility innovation must help to reduce congestion through more efficient use of limited road space, for example through sharing rides, increasing occupancy or consolidating freight.
- The marketplace for mobility must be open to stimulate innovation and give the best deal to consumers.
- New mobility services must be designed to operate as part of an integrated transport system combining public, private and multiple modes for transport users.
- Data from new mobility services must be shared

7 REVIEW OF EXISTING TFSE FUTURE MOBILITY INITIATIVES

7.1 EXISTING TFSE MOBILITY BUSINESS MODELS OVERVIEW

7.1.1. This section outlines the existing future mobility initiatives underway in the TfSE area. It considers each of the Mobility Business Models that are revealing themselves across the area's place typologies, namely; Urban, Peri-Urban, Rural and Corridor/Inter-Urban.

7.1.2. This review of existing initiatives in the TfSE area has been a desk-based task, without input from stakeholders. It is not therefore a conclusive list of all Mobility Business Models in operation in the area however an effective summary of the extent, types and marketing success of commercial Mobility Business Models, supported by a number of examples.

Table 18 – Mobility Business Model Initiatives in the TfSE Area

Mobility Business Models	Urban	Peri-Urban	Rural	Corridor / Inter-urban	TFSE Initiatives
Ride-sharing	X	X		X	Limited data is available on the true extent of ride-sharing in the TfSE area due to the typically informal nature of how it is arranged and operates but also due to the limited data disclosure by ride-sharing platforms. Multiple platforms however are in operation in the TfSE area, offering both employee-led and peer-to-peer (P2P) ride-sharing schemes such as: ▪ Faxi - In 2018, Faxi partnered with Gatwick Airport to launch the first airport staff ride-sharing service in the world, offering preferential parking (up to 1 mile closer to the airport than other staff car parks) to incentivise drivers. ▪ Liftshare – Liftshare offers a ride-sharing platform to facilitate P2P and employee led ride-sharing across the UK. The platform has over 600,000 members and works with 900 employer clients to provide them with individual car share platforms[89]. Eastleigh Borough Council offices for example have used Liftshare's personal travel plan services to encourage employees to consider alternative travel behaviours including ride-sharing when moving offices. ▪ Others operating in the area Scoop, BlaBlaCar, goCarShare

[89] "Why our members love Liftshare", in Liftshare.com, , 2019, <https://liftshare.com/uk/community/ourmembers> [accessed 31 May 2019].

Ride-sourcing	**X**	**X**			Since ride-sourcing services rely upon high density of travel demand and supply, their initial implementation and usage growth in the UK has occurred in dense urban areas. The TfSE area is no different. Using Department for Transport published Private Hire Vehicle (PHV) licence data as a proxy for ride-sourcing services, the extent of services in the area can be assessed. In the South East between 2017 and 2018, PHV driver licences in the South East increased by +7.9% compared to a -2.1% decrease in taxi licences and vehicle licences increased +2.3%.[90] Although the entirety of this growth cannot be directly attributed to ride-sourcing services, the large increase in demand in licences does correspond to visible, popular services available in the region. Brighton, for example is considered a popular jurisdiction to obtain a private hire licence on Uber's website.[91] However, despite its popularity, Uber did initially have its licence renewal turned down by Brighton & Hove City Council due to 'significant' concerns about a data breach in 2016, highlighting how legislation and regulation can potentially halt services overnight. In 2016 however, Uber won their appeal against the decision and were granted a five-year operating license for the area in late 2018. However, as urban ride-sourcing markets have grown and become increasingly saturated, newer shared ride-sharing models have emerged. The area is home to one of the UK's first 'Demand Responsive (micro) transit services' operating outside a city; ArrivaClick in Sittingbourne. The service, which is an on-demand flexible minibus service, takes multiple passengers heading in the same direction. Having launched in 2017 in Sittingbourne Kent, a survey of Arriva Click customers in 2018 reported that 43% of customers had adopted the service for their daily commute, and 52% of customers had switched from private motor transport (inclusive of own car, taxi and passenger in car).[92] Following the success of the service in Kent, a service was launched in Liverpool in summer 2018 and Leicester April 2019.

[90] "All vehicles (VEH01)", in GOV.UK, , 2019, <https://www.gov.uk/government/statistical-data-sets/all-vehicles-veh01> [accessed 11 June 2019].
[91] "Popular Private Hire Licence Jurisdictions in Greater Brighton | Uber", in Uber.com, , 2019, <https://www.uber.com/en-GB/drive/resources/popular-jurisdictions-brighton/> [accessed 11 June 2019].
[92] "Arriva's on-demand public transport service a success", in Arriva PLC, , 2019, <https://news.arriva.co.uk/news/arrivas-on-demand-public-transport-service-a-success> [accessed 11 June 2019].

Asset Sharing	**X**	**X**			Mobility asset sharing allows users to access and share the use of different mobility modes without having to own them. However, the wider implications and market conditions associated with mobility asset sharing models can vary dependent on the mode. For example, bike sharing schemes are a type of mobility asset sharing model that have faced a number of market challenges over the past few years; lack of take-up and vandalism has contributed to a number of the larger operators pulling out of UK cities, with Ofo (to focus on operations back in China) and Mobike (pulling out of Manchester) being the most notable. However, despite these market failures, bike sharing schemes in the TfSE Area have continued to grow - BTN Bikeshare Brighton & Hove allows residents and visitors to hire bicycles from as little as 3p per minute and return them to any official docking station once their ride is complete. In its first year 53,591 cyclists made 347,234 trips across the city. Currently BTN Bikeshare has 450 bikes available across 54 hubs but is expanding, with 120 new bikes being added to the fleet.[93] Furthermore, Nextbike (which also has a bike sharing scheme in Surrey) has potential plans to open a scheme in Portsmouth, whilst Yobike continues to operate in Southampton and Bristol despite having experienced issues with vandalism and theft. With regards to car based mobility asset sharing schemes, the market has faced less challenges. For example, Co-Wheels is a social enterprise operating the only independently owned national car club in the UK. The car club operates across 60 locations including the Isle of Wight, Eastleigh, Chichester, Horsham, Lewes, Tunbridge Wells, Maidstone, Hastings, Bracknell and Reading in the South East. The service offers members pay-as-you-go access to low-emission cars available by the hour or by day. Each vehicle has its own designated bay which customers can pick them up from and drop them back to the same bay at the end of the reservation. A Report by Big Issue Invest for Co-Wheels indicated that members are less likely to buy a car in the future after joining the club, and that between 2016-17, 42% of members stated that they drive less.[94] Additionally, Turo is a peer-to-peer car sharing platform that launched in the UK in September 2018 and allows private car owners to rent out their vehicles via an online and mobile interface. As of January 2019, the firm had added more than 1,000 privately owned cars and 75,000 users to the UK platform, and is available in locations such as Southampton, Basingstoke, Reading and Brighton.[95] The firm has also recently taken over EasyCar Club's 80,000 strong customer base. Additionally, Enterprise Car Club operates in Brighton and Hove, Southampton, Winchester and Portsmouth, and offers more environmentally friendly vehicles; the company states that over 23% of their fleet are either electric or hybrid.[96]

Mobility as a Service	**X**				Mobility as a service (MaaS) is focused on providing customers with seamless access and consumption of mobility services enabling them to undertake end-to-end journeys based on their individual preferences such as quality, cost and speed. MaaS services are in their relative infancy with Whim being the only commercial service operator active in the UK. However, journey planning applications and travelcard schemes tend to be considered the precursor of MaaS platforms. Citymapper with its anticipated Citymapper card in London, is a key example of how these platforms are progressing towards MaaS. Furthermore, in the TfSE Area, there are a number of journey planning applications and travelcard schemes available; for example, the Key-go and Key Smartcard scheme provided by the Go-Ahead Group (who operate trains and buses in the south east), enables users to store their train and bus tickets on one card allowing for better modal integration. The card also makes it easier for customers to make claims as it automatically works out if a user is owed any compensation for travel delays. The cards can be used on the Southern and Thameslink Network, and are available in locations such as Brighton and Hove, Crawley, the Isle of White and Bognor Regis[97]. Additionally, journey planning applications such as Moovit and Waze are available throughout the area. In addition to the journey planning applications and travelcard schemes currently available in the South East, Visual Atoms Ltd in partnership with The University of Surrey have also been awarded Innovate UK funding to develop a smartphone-based interactive journey planner called ITravel. The app aims to provide users with end-to-end journey planning using traditional map-based navigation methods that are supplemented with visual contextual information. This will involve features such as automatically generated visual routes, location-sensitive visual checkpoints, and a real-time visual search tool. The app therefore provides a personalised and interactive journey planning solution with users able to see an augmented view of their surroundings, aiding them in the navigation process[98].

[93] Brighton and Hove Independent, Birthday bash for Brighton and Hove's bike sharing scheme, in , , 2018, <https://www.brightonandhoveindependent.co.uk/news/traffic-and-travel/birthday-bash-for-brighton-and-hove-s-bike-sharing-scheme-1-8618098> [accessed 11 June 2019].
[94] Big Issue Invest, Big Issue Invest Social Enterprise Investment Fund L.P., in , Big Issue Invest, 2017, <https://images.bigissueinvest.com/2017/04/Big-Issue-Invest-SEIF-I-Annual-Report-2016-2017.pdf> [accessed 11 June 2019].
[95] "Turo expands car-sharing platform by taking on rival rental firms' customers", in Uk.news.yahoo.com, , 2019, [accessed 11 June 2019].
[96] Enterprise Holdings, "Enterprise Car Club - Electric vehicles", in Enterprisecarclub.co.uk, , 2019, <https://www.enterprisecarclub.co.uk/gb/en/programs/promotion/electric-vehicles.html> [accessed 11 June 2019].
[97] Thames Link, The Key Smartcard Customer information, in , Thames Link, 2018, [accessed 11 June 2019].
[98] K Bevis, O Sozcu & R Fenner, Mobility as a Service: Early implementations in the UK, in , Herts, 2018, <http://researchprofiles.herts.ac.uk/portal/files/16167087/EEVC_Paper_Keith_Bevis_Oslo_2018.pdf> [accessed 11 June 2019].

Parking Platforms	**X**	**X**			Parking platforms provide consumers with information and app-based payment functions to reduce the traditional problems associated with finding and paying for parking. The extent of parking platforms in the TfSE area is growing, with services available in locations such as Reading, Slough, Brighton and Hove etc. One example parking platform that is operating in the area is AppyParking; founded in London in 2013 AppyParking provides products such as parking apps and services for drivers that involve software showing on-street and off-street parking (including disabled, electric and motorcycle bays) as well as yellow line and loading rules in major cities in the UK. Additionally, products include digital kerbside maps, cashless parking applications and real-time analytics to monitor on-street and car park occupancy. With regards to the TfSE area, AppyParking is due to install 4,200 sensors as part of a car parking solution across Portsmouth, enabling the city to track utilisation of space over time and analyse bay occupancy and vehicle turnover. The service will also offer a payment solution whereby users are able to pay for their parking after they have used it rather than before. Additionally, AppyParking is available in Reading providing real time information on the availability of disabled parking bays throughout the city. JustPark is another service that is available throughout the TfSE Area; founded in 2006, JustPark enables drivers to find, reserve and pay for available parking spaces. The app boasts over 20,000 reservable parking locations (including those in Slough, Reading, Basingstoke, the Isle of Wight etc.) and 2.5 million registered drivers[99]. Additionally, the service (primarily WebApp) enables space owners to rent out their parking spaces (e.g. driveways) to make profits. The service also offers parking management solutions to help companies with under-utilised car parks. This involves real time reporting on car park performance, online payment platforms and targeted promotion.

[99] "About | JustPark", in JustPark, , 2019, <https://www.justpark.com/about/> [accessed 11 June 2019].

Digital as a Mode	**X**	**X**	**X**	**X**	Digital as a mode is described as the use of digital connectivity to reduce or remove the need to travel. It can be difficult to quantify the impact or prevalence of digital as a mode due to a lack of data and no clear measurement method. Nevertheless, institutions such as The Open University (which enables flexible, distance teaching in the UK and in 157 countries worldwide) and Babylon Health (the UK's leading digital health provider) are clear examples of services that remove the need to travel. In the South East region, there are a number of educational establishments that offer services that enable distance working or working from home. For example, the University of Southampton offers free online courses and MOOCs (Massive Open Online Courses). The MOOCs are intended to be studied online by large numbers of students and in addition to usual course materials, such as videos, lectures, reading materials, coursework and exams, the MOOCs also provide online forums designed to create online communities of tutors and students. Some of the MOOCs offered by the University of Southampton include topics such as Web Science, Contract Management and Digital Marketing[100]. Additionally, The University of Reading also offers "Open Online Courses" whilst The University of Portsmouth offers specific distance learning courses. In addition to educational establishments, workplaces can also offer flexible working and the ability to work from home. In the TfSE Area, some of the companies that actively promote flexible working include American Express which is located in Brighton. For example, all of American Express's employees across the globe are eligible to request a flexible working pattern; as a result when surveyed, 90% of UK American Express employees responded favourably to the question "My leader gives me the flexibility I need to balance my work and personal life". Additionally, BAE Systems (which has an office in Guildford) operates a Smart Working initiative that allows employees to work flexibly creating "a modern working environment" designed to "enhance and improve employees' worklife balance." [101]

[100] "Free online courses & MOOCs | University of Southampton", in Southampton.ac.uk, , 2019, <https://www.southampton.ac.uk/courses/free-online-learning.page> [accessed 11 June 2019].

[101] BAE Systems - Attracting diverse candidates through flexible working, in , Royal Academy of Engineering, 2019, <https://www.managers.org.uk/~/media/Appius/Submissions/Diversity-and-Inclusion-Case-Study-BAESystems.pdf> [accessed 11 June 2019].

Digital-Based Freight Models	**X**	**X**		**X**	Digital-based freight models offer customers easier access to real-time and price transparent freight services whilst improving supply chain visibility and asset utilisation for operators. As models are rarely location specific, assessing uptake in the TfSE area is limited due to a lack of data and insight/ information sharing. Nevertheless, there are a number of models that operate within the UK and thus can be utilised in the region. Uship is an open marketplace running in the UK that connects customers with customer-reviewed service providers who have extra trunk space, specialising in transporting large/bulky items e.g. vehicles, pianos, and animals. The platform does not offer automated matching of supply and demand but allows customers to choose from a variety of different offers and book accordingly. Transportation service providers in turn place competing bids for the right to haul a customer's shipment on uShip. For some categories, customers can select an upfront quote for transport services or enter an acceptable price to be matched with a transporter. Customers can book a shipment immediately from these quotes or opt to wait for auction bids. Transporeon is a global (with European operations) cloud-based transport management system that provides software-as-a-service solutions for multiple freight and logistics players, creating a digital connection between shippers and carriers to achieve smart, transparent and more cost-effective movement of goods around the world. Services include time slot management, transport assignment, real time visibility and mobile order management. The platform has over 100,000 users.
Service-Based Freight Models	**X**	**X**			Service-based freight models use technology to provide a wider selection of flexible last-mile delivery and collection options. Although commercially active service-based freight models are limited in the TfSE area, there is evidence that these services are being developed; DASH (Delivery As a Service) is a Innovate UK funded project by Grid Smarter Cities Ltd in conjunction with IBM Limited in Portsmouth. The platform “combines multiple technology and transport providers to create a collaborative, emissions-reducing delivery proposition” [102], providing customers with multiple crowd-sourced delivery options. This could include options for taxi drivers to multi-purpose vehicles to incorporate deliveries, provide a scalable business opportunity for electric cargo bicycles as well as allowing customers to have variable delivery option (B2B & B2C). Additionally, the application would also provide integrated pricing, payment, routing and customer tracking options.

[102] "DASH - Delivery As a Service for High-streets", in Gtr.ukri.org, , 2019, <https://gtr.ukri.org/projects?ref=102616> [accessed 11 June 2019].

7.2 SUMMARY OF TFSE ACTIVITY RELATING TO DFT SIX 'KEY CHANGES'

7.2.1. This report has already identified a number of initiatives within the TfSE area, described in terms of evolving mobility business models. The DfT's Future of Mobility: Urban Strategy, however, identifies Six Key Changes within Future Mobility (of which New Business Models is one):

- Automation
- Cleaner Transport
- New Business Models
- New Modes
- Data & Connectivity
- Changing Attitudes

7.2.2. Albeit activity relating to the other five 'Key Changes' is encompassed to an extent within the market analysis of New Mobility Business Models in the TfSE area, this section seeks to add further detail to the five other changes. Similar to the review undertaken previously into Mobility Business Models in the TfSE area, a desktop review was also undertaken to examine activity in the area relating to the five other 'Key Changes'.

AUTOMATION

7.2.3. The DfT report outlines that 'improved sensing technology, computing power and software engineering are leading to increasing levels of automation in transport across many modes' and that there are numerous private, public and collaborative projects ongoing in the UK. As highlighted previously, investment and implementation of increasingly autonomous transport technologies is observed across the TfSE area; from Govia Thameslink Railway implementing driverless train services in March 2018[103], Gatwick Airport trialling a fleet of self-parking robots provided by Stanley Robotics in August 2019 and increasing levels of automation in port environments such as Southampton, Portsmouth and Dover.

7.2.4. Automation, as it applies to vehicle technology, that can be observed on the transport network however, is generally of early maturity. Innovate UK funding allocated through Connected and Autonomous Vehicle challenges since 2015, however provides a useful representation of the extent of research and trialling in the vehicle automation space that is underway in the TfSE area.

7.2.5. Table 19 shows the projects which are currently live in the each of the LEPs within the TfSE area and the amount of funding they have been allocated in total. Full details of each of the projects outlined in the table (in addition to those which are now closed or on hold) including the specific companies, organisations or academic institution in each area that is associated with each project is provided in Appendix C.

7.2.6. As can be seen in Table 19, there are numerous overlaps of projects between areas (as most involve multiple partners) and the physical outputs of some projects are not actually located in the TfSE area but companies, organisations or academic institutions based in the TfSE area are contributing to the overall study/trial.

[103] The Guardian (2019). *First self-driving train launches on London Thameslink route. [online]* guardian.co.uk.

Table 19 – Live Innovate UK Connected and Autonomous Vehicle Funding in the TfSE Area

LEP	Total Grants Offered	Project Titles	Description
Coast to Capital	£1,883,836	▪ Smart Mobility Living Lab	Creating a test environment for the development of future mobility solutions in London
		▪ HumanDrive	Build an autonomous vehicle with human like, natural control / path planning.
		▪ 5*StarS: Automotive Cyber Security through Assurance	Developing assurance methodology to assure that CAV components, systems & vehicles are designed & tested to the relevant cyber security standards.
		▪ FLOURISH	Developing innovative products, processes and services associated with CAVs with the user in mind to unlock social benefits. Older people and others with assisted living needs used as an exemplar to develop understanding of needs.
Thames Valley Berkshire	£10,496,574	▪ OmniCAV	Developing a simulator aimed at providing a certification tool for CAVs
		▪ StreetWise	Aims to develop & demonstrate autonomous personal mobility solution targeted at replacing urban commuter car.
		▪ DRIVEN: Insuring, Ensuring and Exporting Fleet Wide Level 4 Connected Autonomy	Trials aiming to test real-time risk assessment frameworks for L4 CAVs in live traffic environments between Oxford & London and provide pro-active connected insurance.
		▪ Smart Mobility Living Lab	Creating a test environment for the development of future mobility solutions in London
		▪ UK Central CAV Testbed (Midlands Future Mobility)	Testing CAVs and related technologies and services in suite of urban environments.
		▪ HumanDrive	Build an autonomous vehicle with human like, natural control / path planning.
		▪ 5*StarS: Automotive Cyber Security through Assurance	Developing assurance methodology to assure that CAV components, systems & vehicles are designed & tested to the relevant cyber security standards.
		▪ UK Connected Intelligent Transport Environment (UK CITE)	Creating a real-world lab for companies to test CAVs can interact with communications infrastructure
		▪ MOVE-UK	Accelerating automated driving by connected validation & big data analysis
Solent	£572,189	▪ OmniCAV	Developing a simulator aimed at providing a certification tool for CAVs
		▪ Feasibility study on polar codes for 5G URLLC	A feasibility study on the application a FEC technology to mitigate communication errors that are inherent to mobile communications.
		▪ 5*StarS: Automotive Cyber Security through Assurance	Developing assurance methodology to assure that CAV components, systems & vehicles are designed & tested to the relevant cyber security standards.
		▪ Secure CAN with Q-PUF	Spoof-proof, hardware-implemented secure CAN Protocol

South East	All projects in South East LEP situated outside TfSE area (i.e. in Essex)		
Enterprise M3	£2,280,513	▪ StreetWise	Aims to develop & demonstrate autonomous personal mobility solution targeted at replacing urban commuter car.
		▪ ROBOPILOT	Aims to develop & demonstrate autonomous driving functionality for electric delivery vans.
		▪ A radical mode SHIFT away from cars to Integrated Mobility-as-a-Service enabled by autonomous pods	Seeks to catalyse mode shift from cars to integrated mobility as a service (MaaS) using autonomous pods. The project will involve 10 Connected Autonomous Vehicles and 10 Families who will have access to a low cost MaaS subscription.
		▪ AutopleX	Aiming to demonstrate enhanced autonomy for complex vehicle manoeuvres at junctions, supporting SAE Level 4+ autonomy.
		▪ Autonomous Valet Parking	Looking to deliver a proof of concept involving an autonomous vehicle that will fulfil the valet function by navigating the vehicle to an open parking space, executing the parking manoeuvre automatically and responding to a summon request back to the driver.
		▪ 5G Above the Cloud (AtC)	Testing the technical feasibility of a proposed system that aims to maintain 5G Quality of Experience (QoE) access to Situational Awareness data specifically tailored to CAVs, particularly when outside of closed environments.
		▪ CAPRI	Aims to design & deliver a complete, market ready, mobility service, deployable in urban scenarios using trusted secure pods and systems, supported with a 'complete package' of viable business cases, legal, regulatory, insurance recommendations to enable quick deployments.
		▪ UK Connected Intelligent Transport Environment (UK CITE)	Creating a real-world lab for companies to test CAVs can interact with communications infrastructure
		▪ FLOURISH	Developing innovative products, processes and services associated with CAVs with the user in mind to unlock social benefits. Older people and others with assisted living needs used as an exemplar to develop understanding of needs.
Total in Area	£15,233,112		

7.2.7. As shown in Table 19 the companies, organisations and academic institutions in the TfSE area have been granted over £15 million worth of Innovate UK funding in Connected and Autonomous Vehicle competitions since 2015 which are attributable to a wide range of projects. This equates to 10.5% of the total amount of CAV funding granted in England over the period. Compared to the other LEPs in the TfSE area, Thames Valley Berkshire has received grants for the largest amount. A large proportion of this funding however is associated with the Transport Research Laboratory in Wokingham, which is a global centre for innovation in transport and mobility.

CLEANER TRANSPORT

7.2.8. The DfT strategy states that companies, cities and individual Local Authorities are getting behind the transition to cleaner transport in the UK. As outlined previously in this report, Local Authorities in the

TfSE area are also beginning to invest in electric public transport. For example, as of January 2019 nine Stagecoach zero emission buses were introduced on the Guildford park-and-ride service. The initiative is part of a £3million partnership between Surrey County Council and Stagecoach. The new buses can run for up to 150 miles, replacing the existing diesel fleet and offer a smoother, quieter and greener alternative.

7.2.9. Local authorities in the TfSE area have also benefited from national Government schemes such as the Ultra-Low Emission Bus Scheme. In February 2019 it was announced that Brighton & Hove buses and The Big Lemon (also in Brighton) would receive £4.3million for supporting bus infrastructure as well as 20 Hydrogen buses and £0.56 million for 5 electric buses respectively.

7.2.10. As with the funding allocated through Innovate UK competitions for Connected and Autonomous Vehicle projects within the TfSE area, Innovate UK funding for cleaner transport initiatives also provides a useful representation of the extent of research and implementation in the TfSE area.

7.2.11. Table 20 shows the projects which are currently live in the each of the LEPs within the TfSE area and the amount of funding they have been allocated in total. Full details of each of the projects outlined in the table (in addition to those which are now closed or on hold) including the specific companies, organisations and academic institutions in each area that is associated with each project is provided in Appendix D.

7.2.12. As can be seen in Table 20, there are numerous overlaps of projects between regions (as most involve multiple partners) and the physical outputs of some projects are not actually located in TfSE area but companies, organisations and academic institutions based in the TfSE area are contributing to the overall study/trial.

Table 20 – Live Innovate UK Cleaner Transport Initiative Funding in the TfSE Area

LEP	Total Grants Offered	Project Titles	Description
Coast to Capital	£348,998	▪ Electric Vehicle Network Extender (EV-NetX)	Aiming to increase the number of charging points, without requiring the installation of additional chargers and the associated cost
		▪ EV-elocity	Focusing on the business models which will enable the sharing of the value Vehicle-to-Grid can bring to the grid, local and regional businesses and the consumer.
Thames Valley Berkshire	£1,935,991	▪ Wireless Charging for Electric Taxis	Investigating the commercial and technical viability of wireless charging for full electric and plug-in hybrid vehicles, with a focus on taxis and private hire fleets
		▪ Charging Hub Buffer Battery Feasibility Study - CHUBBY	Aiming to identify opportunities for medium to large scale public charging hubs, focusing on currently available and upcoming technologies
		▪ Bus2Grid	Will deliver the UK's first e-bus to grid multi-megawatt demonstration at commercial scale.
		▪ EV-elocity	Focusing on the business models which will enable the sharing of the value Vehicle-to-Grid can bring to the grid, local and regional businesses and the consumer.
		▪ Home as a Virtual Energy Network	Examining the value that V2G (vehicle-to-grid) and V2H (vehicle-to-home) enabled EVs can provide to consumers within the context of other energy storage systems

		▪ HYLIGHT – Hybrid Liquefied Petroleum Gas tanker with MAGSPLIT	CVT MAGSPLIT trial to verify the technology, business case and emissions benefits.
		▪ Plasma Removal of Methane from Natural Gas Dual-Fuel Engines (PROMENADE)	Will demonstrate the use of non-thermal plasma, advanced combustion and control techniques and Additive Manufacturing
		▪ Functional Lattices for Automotive Components (FLAC)	To develop and demonstrate a portfolio of lightweight automotive components with increased efficiency and functionality
Solent	£900,350	▪ Kinetic energy recovery for urban logistics applications	Aims to evaluate the energy and emissions benefits of a kinetic energy recovery system (KERS) for urban delivery vehicles
South East	£231,534	▪ Up-Featured Trailers for Future Logistics	Developing a concept that optimally utilises technologies around energy storage, connectivity and light-weighting to maximise their impact for reducing emissions from HGVs.
		▪ Gas Flow/Market Analysis	Developing uncooled ICE-electric powertrains for HGVs
		▪ Wireless EV "Charge on the Go"	Feasibility study and demonstrator to showcase an innovative and viable, wireless EV charging solution with real world benefits for commercial fleets
		▪ Wireless Charging in Micro-Fulfilment Centres for Last Mile Delivery	Analysing vehicle movement data from up to 4 LGV users to assess the share of activity that could already be met with available EVs and quantify the productivity and range benefits of replacing plug-in chargers with wireless chargers.
		▪ Integrated Energy Systems for Commercial Vehicles	Exploring the role that electrification and Vehicle-to-Grid technology can play in tackling emissions from the commercial vehicle sector
Enterprise M3	£2,611,655	▪ Aluminium for Ultra Low Emission Vehicles (Al-ULEV)	Developing high strength aluminium extrusion alloys for use in light weight crash resistant vehicle structures for integration of battery enclosures into (ULEVs)
		▪ Paradigm_Shift - breakthrough Small Lightweight EV Platform	Developing a next-generation Zero-emission Vehicle Platform
		▪ Automotive exhaust muffler incorporating heat recovery	Aims to establish the feasibility of combining the silencing properties of an automotive muffler with a heat exchanger to the reduce weight, space and complexity
		▪ Cost-effective wireless electric vehicle charging for public spaces	Aims to evaluate the benefits of widespread wireless charging infrastructure and to develop business model for public wireless charging
		▪ V2GO	Developing, trialling and evaluating potential business models for Vehicle-to-grid operations.
		▪ Dedicated To Gas	Trialling 81 dedicated gas HGVs ranging from 7.5 tonne to 44 tonnes
		▪ Reduced Emissions Logistics (Red-E-Log)	Deploying three liquid biomethane trucks to promote reintroduction of LBM into the UK market.
		▪ TRIUMPH	Demonstration and study of zero emission capable trucks and refrigeration units in urban environments

		▪ Advanced Lithium Ion Capacitors and Electrodes (ALICE)	Developing lithium ion capacitors (LICs)
Total in Area	£6,029,528		

7.2.13. As shown in Table 20 the companies, organisations and academic institutions in the TfSE Area have been granted over £6 million worth of Innovate UK funding in Cleaner Transport related endeavours since 2015 which are attributable to a wide range of projects. This equates to approximately 6.2% of the total amount of CAV funding granted in England over the period (£96.6 million total). Compared to the other LEPs in the TfSE area, Enterprise M3 has received grants for the largest amount.

NEW BUSINESS MODELS

7.2.14. The DfT strategy outlines that innovative transport technology developments in combination with significant demographic, economic and behavioural trends have led to the development of new mobility business models. Please see analysis of the Mobility Business models in Table 18 for an overview of TfSE activity.

NEW MODES

7.2.15. The DfT strategy states that 'technology is enabling new ways of transporting people and goods' that is leading to the emergence of new modes. Please see analysis of Mobility Business models in Table 18 which incorporates analysis of 'New Modes' such as ArrivaClick (on-demand micro-transit, cited to be a blurring of traditional taxi and bus services) in the TfSE area.

DATA & CONNECTIVITY

7.2.16. The increasing generation, collection and availability of data and improved connectivity are transforming journeys. Whether this be through increasing customer access to travel information, enabling them to make more informed choices and have confidence in multi-stage journey planning, increasing the capability of vehicles to communicate with each other and surrounding infrastructure or enabling new ways to access education and health services, data-led technologies are having a transformative impact.

7.2.17. As outlined previously in this report, like many places in the UK the TfSE area has seen significant investment in its digital communications over recent years. Future combinations of 4G, 5G and broadband connectivity will provide the foundations for many technologies and associated services which will gather pace over the coming years.

7.2.18. Figure 10 provides an overview of 4G connectivity across the TfSE area and illustrates that whilst mobile connectivity overall is very good that are still patches where signal is weak potentially being a future restriction. Despite this, there is also investment in the area into next generation 5G networks, with Vodafone planning to launch its 5G network in Guildford, Newbury, Portsmouth, Reading and

Southampton at the latter end of 2019.[104] The Government funded Digital Catapult is also running a 5G Testbed Accelerator Programme in the region in partnership with WiredSussex, University of Brighton and Coast-to-Capital LEP, as part of the Future Technologies programme, providing businesses with opportunities to develop products and services with 5G technologies.[105]

7.2.19. With regards to vehicle connectivity many new models of cars, vans, trucks and buses are now equipped with always-on digital connectivity allowing them to share and receive data on the move. The ability to link vehicles to networks and to each other provides potential benefits in terms of network operations and safety as well as providing enhanced customer and user experience. Projects such as the A2/M2 Connected Corridor and Southwick Hill Tunnel projects, as indicated previously in this report in Chapter 5, are prime examples of connectivity projects taking place in the TfSE area.

7.2.20. Innovate UK funding for Connected and Autonomous Vehicle projects within the TfSE area, listed previously, also provides a useful representation of the extent of research and implementation in the TfSE area. Most of the new mobility business models are also dependent on data and connectivity; please see analysis of Mobility Business models in the TfSE area in Table 18.

CHANGING ATTITUDES

7.2.21. The DfT strategy highlights how customer attitudes and expectations are changing, which are driving transport and delivery innovations to become increasingly affordable, convenient and personalised. Public perceptions and willingness to engage with new technologies, modes and business models is a fundamental aspect of successful deployment and should not be taken as a given. Although examples of regional initiatives centred around documenting consumer attitudes were found to be scarce, national initiatives such as the National Transport and technology Public Attitudes Tracker are relevant to the TfSE area.

7.2.22. In 2017 the DfT commissioned six waves of research to track public attitudes and behaviours relevant to Transport in England. In December 2018 the third wave of surveys were conducted focusing on four overarching topics. 3,500 adults in England were interviewed in each wave to provide a representative sample (597 from the South East in Wave 3). The following bullets outline a few of the findings from Wave 3 conducted in December in 2018[106]:

- Journey Planning
  - The majority of smartphone users (86%) had used their phone for at least one transport planning purpose (compared with 84% in December 2017)
  - Urban dwellers and people ages under 45 more likely to use smartphone for transport planning purposes

[104] Gibbs, S. (2019). *What is 5G and when can I get it in the UK?*. [online] The Guardian. Available at: https://www.theguardian.com/technology/2019/may/25/what-is-5g-and-when-can-i-get-it-in-the-uk [Accessed 4 Jun. 2019].
[105] Digital Catapault (2019). *5G Testbed Accelerator Programme*. [online] Digicatapult.org.uk. Available at: https://www.digicatapult.org.uk/projects/5g-testbed-accelerator-programme/ [Accessed 5 Jun. 2019].
[106] Department for Transport (2019). Wave 3 Summary Report. Transport and Technology: Public Attitudes Tracker. [online] London. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/803347/transport-and-transport-technology-public-attitudes-tracker-wave-3-report.pdf [Accessed 24 Jul. 2019].

- Mobility as a Service
  - Awareness of public bike share schemes has increased to 45% (from 38% in December 2017)
  - Been no significant changes in awareness of car clubs or internet-arranged or app-based car sharing
  - Since December 2017 there has been in no change in use public bike share schemes, car clubs and internet-arranged/app-based ride-sharing, but usage levels remain at 3% or less
  - 24% of people aware of ride-sharing services (defined as a taxi you share) and 1% had used such services. Cost cited as the biggest advantage of ride-sharing and biggest drawback cited to be safety concerns.
  - 18% used an app-based minicab service in last three months (e.g. Uber)
  - When showed a concept MaaS app, 23% said they would likely reduce their car/van use if available and 7% that they were likely to give up car/van ownership.
- Awareness
  - 80% of interviewees claimed awareness of EVs, drones and AVs however majority said they only know 'a little' or 'hardly anything' about the technologies in question
  - Between 2017-2018 significant increases in the proportions of people aware of driver assistance features e.g. automated parking, automatics emergency braking, in-car wifi
- Public Attitudes to EVs and AVs
  - Top perceived advantage of EVs is the environmental benefit and the top perceived disadvantage is recharging and battery capacity
  - Top perceived advantage and disadvantage of AVs relates to safety. With the advantage being less chance of driver error, few bad/drunk drivers and disadvantage being equipment or system failure. Only 52% of respondents could mention at least one AV advantage, compared with 80% who could think of at least one disadvantage.

7.3 KEY OPPORTUNITIES AND RISKS FOR FUTURE MOBILITY INITIATIVES WITHIN TFSE 2020-2025 (BY TYPOLOGY AND MOBILITY BUSINESS MODEL)

7.3.1. Table 21 shows the key opportunities and risks associated with Mobility Business Models within the TfSE area between 2020-2025.

Table 21 – Key Opportunities and Risks Associated with Emerging Mobility Business Models

Models	Key Opportunities and Risks 2020-2025
Ride-sharing	- Opportunity around key destinations (e.g. NHS sites) and employment sites and the potential to combine ride-sharing and car-sharing initiative to enable assets to be used throughout the day - Opportunity for employers to incentivise positive ride-sharing behaviours through personalised marketing and measures such as preferential parking schemes, competitions and bonuses. - Opportunity for users to get familiar with ridesharing through employee-led ridesharing platforms, potentially making them more aware and comfortable with peer-to-peer ridesharing that in turn can support different journey types. - Opportunity that as peer-to-peer ride-sharing memberships and usage increases, a wider range of services become available in more rural areas. - Opportunity for high occupancy lanes to support dense uptake of initiatives along certain corridors - Risk that models reinforce car dependency and may attract away from public transport and impact active travel - Risk that increasingly flexible working patterns in the TfSE area reduce likelihood of a dependable service - Ride-sharing uptake is difficult to track unless accessed through a digital platform that has the functionality to track usage and behaviour. Therefore, there is a risk that uptake of the model is not properly tracked. - Risk that employers fail to incentivise schemes for the long term - Risk that safety concerns and perceptions of reduced flexibility/freedom continue to hinder model uptake
Ride-sourcing	- Opportunity to take an area wide approach rather than route approach to planning, offering personalised, more flexible services to broader geographies. - Opportunity for operators to form partnership with public sector stakeholders which could potentially support and enhance the reach of public transport (particularly for off-peak journeys). - Opportunity for ride-sourcing services to expand further into peri-urban areas in the form of on-demand micro-transit operations. - Risk that personalised services cause mode shift from public mass transit services and impact active travel - Risk that models reinforce car dependency - Risk that commercial models do not suitably incentivise shared ride-sourced trips compared to single occupancy ride-sourcing trips. Potential parking and congestion issues if large-scale single occupancy trips prevail. - Risk that services are mostly located in areas which already have the greatest provision of mobility options, increasing mobility inequalities. - Risk of regulatory changes that limit availability of services e.g. Brighton & Hove is named as one of Uber's most popular jurisdictions for services however a licence renewal application was initially rejected by the council in 2018 over 'significant concerns' about a data breach. - Long term commercial viability of models yet to be proven and therefore risk that failures may lead to lack of service provision.

Asset Sharing	- Opportunity for asset sharing schemes to be increasingly integrated at key transport hubs e.g. as already being done with Brompton Bikes at Canterbury West Station, Ashford International Station, Three Bridges Station & Guildford Station. - Opportunity for schemes to target second & third car ownership through the implementation of asset sharing models that meets specific trip needs. - Opportunity for operators to engage with each other and wider stakeholders in the TfSE area to understand what is working well where and why (e.g. BTN Bikes in Brighton) and where lessons have been learnt (e.g. ReadyBike in Reading). - Opportunity to stimulate further investment in successful asset sharing schemes through public and private sector partnerships - Opportunities to trial new pricing mechanisms to incentivise the reallocation of assets by users (that reduces the need for operator reallocation interventions). - Opportunity for a variety of asset sharing schemes to be expand further into peri-urban areas. - Risk that the redistribution of assets balances out net gain from asset sharing schemes - Risk of irresponsible asset use by customers - Risk that micro mobility asset sharing (e.g. bikes & scooters) disrupts pedestrian networks and have unintended consequences on public realm - Risk that operators (e.g. dockless bike providers) deploy their services/products without asking permission from the relevant governing authority e.g. scooter deployment in San Francisco in 2018 - Risk that vehicular sharing services support single occupancy car usage - Risk that customers are unfamiliar with the concept or unable to access schemes (through lack of e-payment or technology access)
Mobility as a Service	- Opportunity for operators to use TfSE body as a platform to facilitate the resolution of technical, regulatory and business model issues across transport modes in the TfSE area. - Opportunity to help integrate public and private transport services through MaaS implementation in the TfSE area. - Opportunity for the model to enable wider customer access to travel information, in turn increasing awareness of all available mobility options and giving customers confidence in multi-stage journey planning. - Opportunity to influence travel behaviour (principally away from private car use) through information and pricing mechanisms e.g. mobility credits, to help deliver strategic objectives through MaaS type solutions in the TfSE area. - Risk that no resolution of technical, regulatory and business-model issues across modes between operators and stakeholders is determined. - Risk that wider resistance to large-scale data sharing inhibits model benefits e,g. providing complete real time information so that customers can compare all options available - Risk that the TfSE area is not especially suited to fully integrated MaaS solutions. The biggest commercial market is the 'flexi-traveller', not those who are daily dependent on their car or well provisioned by the current public transport offering, or single mode users. - Risk for ongoing ticketing programmes such as SmartCards which could potentially be leapfrogged by MaaS type solutions rendering investments obsolete e.g. PAYG rail ticketing expansion to a wider South-East region

Parking Platforms	- Opportunity for operators to lobby for and support legislation that enables dynamic usage of kerbsides and dynamic pricing to encourage increased asset efficiency - Opportunity for implementation to reduce parking enforcement costs and improve customer satisfaction e.g. as they only pay for the time they require and know the exact location of their destination reducing time spend looking for a parking space - Opportunity for parking platforms to be adapted and integrated into Connected and Autonomous vehicles as they come to market - Opportunity for parking platforms to partner with ride-sharing services to promote and incentivise use of shared schemes. - Risk that parking platforms reinforce single occupancy car usage and car dependency - Risk that costly implementation of large sensor network to track bay usage and behaviour becomes redundant as technology advances - Risk that unwillingness to share data on a wider scale prevents widespread platform integration and use - Risk that parking platforms are not integrated within wider journey planning platforms and therefore many benefits of platforms are redundant (i.e. a customer plans journey on Google Maps and only uses a parking platform once they have already reached their final destination) - Risk that customers are unfamiliar with the concept or unable to access schemes (through lack of e-payment or technology access)
Digital as a Mode	- Opportunity for TfSE to promote flexible working patterns and facilitate the roll out of digital technologies to improve access to services e.g. health & education - Opportunity for digital service providers to use TfSE as a platform on which to discuss and work through the main barriers to entry - Opportunity to plan access in the TfSE area through partnerships which could potentially redistribute and reduce some peak time trips - Opportunity for services to improve work-life balance in the TfSE area - Risk that increasingly flexible working patterns in the TfSE area reduce likelihood of a dependable shared services e.g. employee led ride sharing schemes - Risk that an increasing focus on digitised services reduces non-digital service provision, potentially impacting most vulnerable members of society the greatest - Risk that time saved using digital services is used making more micro-trips - Risk that digital services reduces personal contact time and brings with it associated issues e.g. increasing loneliness - Risk that digital service provision increases home energy consumption

Digital-Based Freight Models	- Opportunity for service providers to use TfSE body as a platform to facilitate the resolution of technical, regulatory and business model issues across transport modes in the area. - Opportunity to increase efficiency and utilisation of freight services in the TfSE area whilst enhancing supply chain visibility and potentially impacting reducing congestion - Opportunity to give customers an optimised choice of freight services and less administrative burden - Opportunity for new entrants to enter the marketplace with new service offerings - Risk that no resolution of data standards, ownership, confidentiality and protection issues between operators and stakeholders is determined. - Risk that digital-based freight models have non-interoperable standards which inhibit collaboration between service providers. - Risk that there is industry consolidation around major players and platforms which undermine competition and increasing monopoly power.
Service-Based Freight Models	- Opportunity to reduce last mile delivery costs for operators and reducing multi-attempt delivery trips in the TfSE area. - Opportunity to improve delivery flexibility for customers - Opportunity for new entrants to enter the marketplace with new service offerings - Risk that customers will be sceptical of new delivery methods which involve temporary access to private assets. - Risk that regulations prevent new delivery modes from operating (e.g. delivery droids on pavements and drones in air). - Risk that the public realm in the TfSE area is not suited to some of the emerging freight models and therefore models are not commercial viable there.

8 FUTURE MOBILITY STAKEHOLDER ROLES

8.1 TFSE AREA STAKEHOLDER ROLES

8.1.1. Overall, there is significant activity across the UK related to the future mobility agenda and the themes identified throughout TfSE's Strategic Priorities. Activity is being undertaken by central government to understand the disruption and benefit of future mobility, including by gathering evidence and steer individual aspects of change (e.g. the development of autonomous vehicles), while at a sub-regional and local level, authorities are working on delivering individual aspects of future mobility. More broadly, the private sector is taking a lead including developing and delivering all aspects of future mobility but not necessarily considering the wider issues related to TfSE's Strategic Priorities.

8.1.2. However, across the TfSE area there has, to-date been only limited pan-regional activity. TfSE's Transport Strategy will be the first to focus on some aspects of future mobility and to start delivering improvements across the wider TfSE area. Table 22 outlines the relevant stakeholders who will either actively participate or be indirectly involved in the future TfSE mobility ecosystem.

Table 22 – TfSE Area Future Mobility Stakeholder Roles

Stakeholder	Stakeholder Role
Department for Transport (DfT)	With the publication of the Future of Mobility: Urban Strategy, the DfT have set out a useful framework within which to consider the agenda. This encompasses previous statements on CAVs and electrification and provides clarity for those developing policy and strategy, network operators and service providers. DfTs influence in the Future Mobility agenda is significant and whilst government is not always the most agile in anticipating change this document anticipates the key observable trends. Now that Future Mobility is firmly part of the transportation agenda, capitalising upon opportunities and integrating solutions within existing eco-systems may be a little easier.
Network Rail / Highways England	Responsible for our rail and road infrastructure both Network Rail and Highways England will have a significant role to play in enabling and encouraging uptake of new service and technology solutions. Whilst Future Mobility (as defined above) doesn't explicitly feature in both organisations plans, the technology agendas of both cover many of the aspects and those developing improvements to fixed assets are certainly aware of the key trends. As asset owners both have the opportunity to influence the agenda and help build future mobility solutions into longer term plans to help maximise use of existing infrastructure and improving journeys.
Public Transport Operators	Have a significant role to play in piloting, testing and implementing new and future mobility solutions within and as additions to increase the reach of their existing offers. As detailed throughout this report with the changing nature of access to shared assets and services, the traditional definition of public transport may flex and whilst this could be seen as a threat to existing networks it also represents a significant opportunity. Designed correctly, many future mobility solutions could feed into trunk haul public transport networks, potentially increasing ridership and reducing dependency on single occupancy cars.

New Market Entrants	There have been numerous entrants into the mobility market over recent years, some complementary to existing services, some disruptive. They all have the potential to influence and impact mobility across the board particularly as most are dependent upon commercial business models from the outset. The shape and form of many solutions will change making prediction of future states more difficult, but active engagement at the early stages of planning (prior to deployment) could lead to desirable outcomes.

8.1.3. This report has already identified a number of initiatives within the TfSE area described in terms of evolving mobility business models. The DfT's Future of Mobility: Urban Strategy identified 6 Key Changes within Future Mobility:

1. *Automation*
2. *Cleaner Transport*
3. *New Business Models*
4. *New Modes*
5. *Data & Connectivity*
6. *Changing Attitudes*

8.1.4. Using the DfT's 6 Key Changes (as stated in DfT's Future of Mobility: Urban Strategy) as an assessment framework, this section identifies the most influential stakeholder (who are mostly likely to be leading the agenda) with an outline of their likely objectives. Recommendations on the role that TfSE be should adopting are also provided; whether a leadership role, influencing the narrative /setting the enabling conditions (through regulation or policy/strategy, encouraging pilot studies) or at a minimum allocated resource to follow the progression in a particular theme.

8.1.5. The short description of TfSE's role will be categorized as: Lead, Influence, or Follow with an accompanying explanation. The three categories denote:

- **Lead:** TfSE could take an active lead in setting its agenda to define outcomes in subject areas which are within current remit or significantly influence it
- **Influence:** TfSE could actively engage with industry (private sector) and work with local authority partners to shape futures which support TfSE's wider aims
- **Follow:** TfSE retains a watching brief in areas which fringe core responsibilities and only engage when required.

8.1.6. Further recommendations are provided to help TfSE progress towards Future Mobility Ecosystem by finding the right approaches to:

- Collaboration: between the public and private sector in specifying, enabling and operating services
- Business Case Considerations: how to appraise the value of future mobility initiatives
- Funding: the relative need for funding from the public sector to enable new mobility solutions

8.1.7. The recommendations also link to the preferred TfSE scenario of 'Sustainable Route to Growth' by endeavouring to:

- Make the best use of available infrastructure and assets
- Enable the transition to zero carbon at point of use
- Reduce dependency on the private car
- Use a suite of potential interventions to reduce Vehicle Kilometres Travelled (VKT) whilst simultaneously using mobility as a means to improving wellbeing and business success

Table 23 – Stakeholder Opportunities Associated with DfT Six Key Future Mobility Changes: Automation

THEME	Opportunity Narrative
1. Automation	The automated / autonomous agenda includes much more than simply the transport realm. The Government has stated an expectation of autonomous vehicles being on UK roads by 2021, a date confirmed by some manufacturers and operators. However, it is likely that large scale fleet penetration will occur in the period of 2025 to 2035 and in the case of HGVs and trunk haul freight probably beyond 2035. The move towards self-driving networks in the area potentially meets a number of TfSE's Strategic Priorities; ***Improve network efficiency***; automated solutions could improve efficiency and reliability within the network. The widespread adoption of automated / autonomous technologies could reduce accidents thus improving network resilience in terms of the disruption of traffic flows. The risk with this is if the cost saving from automation translates into cheap access to mobility and induces additional travel demand. ***Improved journey time reliability***; while it is the connected element that would significantly improve journey time reliability, autonomous technologies could enable improved personal productivity on the move (for existing car drivers). ***Supporting partners to meet the current and future housing needs, employment space, and regeneration****;* Commercially shared, fleet solutions could impact kerb-space and parking needs allowing for a rebalancing of highway space and potentially enabling freeing up more land for development. ***Improve accessibility for deprived communities****;* shared autonomous service solutions could provide improved access for those presently excluded from private car and/or public transport access (the elderly, infirm and young) and if costs are reduced as a result of automation improved access for the financially disadvantaged. Such solutions have the potential to improve access for remote populations particularly in rural communities.
Lead Influencer	**Fleet operating companies** (existing and emerging); e.g. Uber, National Express, local bus operators, Gatwick Airport, HGV Haulage firms.
Lead Influencer Objective	Such stakeholders hold the largest potential to introduce automation into their existing vehicle fleets. These stakeholders will be attracted by the operational efficiencies of automation. The barriers to adoption will be regulatory (national level), lack of skills, cost of technology and consumer acceptance / willingness to pay.
TfSE Role	**Influence**: The potential for autonomous vehicles to meet the needs of the TfSE area could be significant but these will vary greatly from place to place, particularly between urban and rural areas. To avoid potential different interpretations of deployments and commercial solutions, TfSE has the opportunity to influence from a strategic point of view, considering its objectives, thus potentially enabling a harmonised approach across the TfSE area. It will also need to consider the challenges posed by the transitionary period towards a high vehicle fleet penetration of autonomous vehicles. **Lead**: TfSE (alongside LEPs and other partners) could lead the skills agenda in transport relating to increasingly automated vehicles and services as learning and job opportunities inevitably change. TfSE should also publicise that it is open to business for increasingly automated vehicles, ensuring that use cases directly contribute to TfSE's wider aims and objectives.

Table 24 – Stakeholder Opportunities Associated with DfT Six Key Future Mobility Changes: Cleaner Transport

Theme	Opportunity Narrative
2. Cleaner Transport	The move towards cleaner transport is clear. The falling cost in alternative fuel technology and supporting infrastructure have the potential to reduce emissions across a range of modes. Commitments from the automotive sector and fleet operators are propelling us towards an increasingly clean vehicle fleet. The government's Road to Zero vision sets out practical actions to see at least 50% of new cars and 40% of new vans to be ultra-low emission by 2030 and end the sale of new conventional petrol and diesel cars and vans by 2040. The interrelationship between charging infrastructure, vehicle uptake and public understanding is complex and whilst electric vehicle (car / van) uptake is rising across the country it is hugely variable from place to place. The move towards de-carbonisation of transport (road, rail, air and sea) provides opportunities that align with TfSE's Strategic Priorities; Cleaner Transport directly relates to TfSE's Strategic Priorities of; ***- Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally.*** ***- Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;*** It is reasonable to assume that a sustainable transport network is one that encompasses zero emission vehicles (i.e. that have no greenhouse gas or air pollutant tailpipe emissions). Making the transition to these types of vehicles will help TfSE contribute to tackling climate change and improve air quality. In addition, shared mobility will reduce the air quality (CO2, NOx and PM10) impacts on local places and the wider network. ***- Supporting partners to meet the current and future housing needs, employment space, and regeneration***; The de-carbonisation of transport has obvious benefits right across the TfSE area particularly in terms of air quality impacts in sensitive areas. The benefits of cleaner transport should also be equally distributed so that it is not only those in urban areas that benefit from cleaner air as a result of cleaner transport initiatives. Whilst the electric car / van sector is rapidly expanding, the future needs and opportunities with regards to heavy duty applications (particularly HGVs) are less advanced and provide an opportunity. The impact of infrastructure to support the electrification of transport has the potential to generate harm to the environment, such as visual impacts, and needs partnership working to limit or mitigate such issues.
Lead Influencer	**DfT, TfSE and Local Authority partners.** Secondary influencers will be fleet operating companies and individuals.

Lead Influencer Objective	TfSE can set the strategic vision for Cleaner Transport. This is likely to be understood by the current and future trends for where transport will contribute to poor air quality. Fostering cleaner forms of shared mobility in pollution hotspots through the provision of excellent and accessible electric vehicle charging infrastructure (and will also require an understanding of power demand / supply). Given the intrinsic link between the energy sector (regeneration, distribution and storage) and the needs of the transport / mobility sector there is an opportunity for TfSE to lead, in terms of linking the transportation / mobility agenda needs, and influence from a TfSE perspective. It could also help shape the local generation / storage and use agenda with regards to future land use needs (particularly housing). Energy (including in some instances / use cases hydrogen) will need to be considered in a strategic manner as the move towards de-carbonisation. Local Authorities can take targeted action through the implementation of cordon or corridor-based low emission zones e.g. Clean Air Zones. These and other more place-specific interventions to resolve poor air quality can be focused on ensuring the environmental benefits are more fairly received. Developing policy that encourages consistent and easily accessible EV charging information presented to users in a way that is useful and actionable. Building upon the electrification narrative above, the wider energy needs of the region will need careful consideration in terms of electrical grid distribution, generation capacity, storage capabilities, resilience and reliability, the needs of major businesses who have logistics components (especially large distributors) and needs of new and expanding developments (housing and commercial). In addition, as hydrogen use cases emerge for heavy duty cycles (such as HGVs) the establishment of a hydrogen fuelling network will need to be considered with associated transmission and storage capabilities. Energy and mobility will become intrinsically linked and whilst energy needs are only related explicitly to one of TfSE's objectives, it will be an imperative nevertheless. Learning and job opportunities will inevitably change and TfSE could influence this agenda with LEP and other partners.
TfSE Role	**Lead:** As above. Additionally TfSE could set policies to encourage zero carbon transport uptake and public transport usage. This is to be considered in the wider context of decarbonisation across the built environment and potential energy supply needs and impacts.

Table 25 – Stakeholder Opportunities Associated with DfT Six Key Future Mobility Changes: New Business Models

Theme	Opportunity Narrative
3. New Business Models	As outlined in the earlier Stages of this report, traditional transport services are being disrupted by digitally enabled platforms for mobility. These new business models are changing the booking, payment and access experience, providing customers with improved choice, flexibility and access to multiple modes. The move towards different forms of shared mobility and access to mobility (through shared assets) could have impacts right across the land use and transportation sectors. New Business Models directly relate to TfSE's Strategic Priorities of; ***- Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and*** ***- Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and*** ***- Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;*** Many New Business Models are centred around shared journeys and shared assets; shared services could lead to a reduction in the need to own multiple cars, thus enabling a shift in the fleet using the region's roads. This could lead in some places to efficiencies (through reductions in vehicles) but could potentially increase trip making in others. Business models in the existing transportation / mobility sector are moving quickly. Not only is electronic ticketing well advanced (including in-app ticketing), app-drive on-account services are now well established (Uber, Arriva Click) in the area. The move towards bundled and / or Mobility as a Service solutions could complicate the landscape further especially if low emission zones, city access zones and energy generation / use were factored into the equation. Business Models and their underlying payment systems provide opportunities to engage customers in different ways and reduce friction in transport networks. The removal of friction in the booking, payment, access and use of transport networks in the TfSE area could lead to improvements in system efficiency as well as gaining a greater understanding of real and predictive demand. Simplified, bundled ticketing and supporting business models could improve access to opportunities for excluded groups and reduce the reliance (perceived or otherwise) on the private car. There is an opportunity through TfSE's existing smart ticketing initiative to not only lead the ticketing element of new business models (and indeed extend it into new realms such as barrier-less and on-account) but to influence the market place in terms of Mobility as a Service and other emerging solutions. TfSE could indeed explore different regulatory approaches that may help accelerate / direct funding towards the other opportunities listed in this matrix.
Lead Influencer	**Fleet Operating Companies / Mobility Service Providers** e.g., ArrivaClick, National Express, local bus operators, Gatwick Airport, HGV Haulage firms, Uber.

Lead Influencer Objective	Deploy new business models to gain ridership and mode share from other traditional modes (private car, public transport and walk / cycle) and work with providers to develop a pricing strategy that is inclusive and appropriate for the region. Influence the marketplace to create a 'new normal' and efficiently provide services to users through a platform
TfSE Role	**Influence:** Actively engage to understand the potential implications of deployment of these services and the potential impacts on local transport services. Engaging with service providers to achieve shared aims and objectives where possible and ensure outcomes align with TfSE priorities.

Table 26 – Stakeholder Opportunities Associated with DfT Six Key Future Mobility Changes: New Modes

Theme	Opportunity Narrative
4. New Modes	New modes will impact upon existing transport infrastructure recently seen with emergence of micro-mobility (electric scooters, e-bikes, solo cycles) and drones and their application to both passenger and freight movements. In urban areas, these could alleviate congestion, reduce noise and emissions and improve traffic flow. Unsurprisingly all vehicles must be safe and secure by design. New infrastructure must recognise future movements and modes. Shared access and shared journeys on these modes will have different impacts. New modes could have unintended consequences particularly surrounding the parking and management of those assets across existing transport infrastructure. New Modes have some relevance to TfSE's Strategic Priorities of; ***- Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.*** ***- Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;*** New modes are being deployed as shared assets (and mostly electric or low emission) which means they are aimed at having a high utilisation across a wide user base. This is supportive of improving accessibility but may not focus on the most deprived communities. Whilst some new modes are aimed at private ownership and could significantly help in improving first and last mile accessibility, again the cost of technology is likely to mean the benefits will not be received by those currently excluded.
Lead Influencer	**Department for Transport**
Lead Influencer Objective	In line with the nine pillars outlined in DfT's Future of Mobility: Urban Strategy, the objective is to ensure new modes are considered safe and don't introduce negative externalities. The options must be available to all parts of society, must be integrated and must not detract from walking, cycling and active travel.
TfSE Role	**Influence:** While TfSE would benefit from having a proactive role in the discussion with industry and government, they are unlikely to be able to lead on this agenda. Being ready to support Local Authority partners in the development of a code of practice would be helpful to provide consistency across the TfSE area, particularly with the advent of Micromobility and Drones. Engaging with influential private landowners who will have commercial interests in trialling new modes across their estates (e.g. airports, logistics, business parks) can help to spread that learning across the TfSE area.

Table 27 – Stakeholder Opportunities Associated with DfT Six Key Future Mobility Changes: Data & Connectivity

Theme	Opportunity Narrative
5. Data & Connectivity	The connectivity agenda comprises many partners – telecommunications companies, infrastructure and service network operators, vehicle manufacturers and customers. Digital connectivity has arguably become a utility in its own right (similar to power and water), underpinning much of our socio-economic functionality. Data and Connectivity is key to underpinning all forms of future mobility. It is the digital infrastructure that supports the real-time functionality of digital mobility platforms, the future operating requirements for connected and autonomous vehicles. Data and Connectivity aligns strongly across many of TfSE's Strategic Principles: ***- Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network;*** ***- Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally;*** ***- Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and*** ***- Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change.*** Digital connectivity could help enable asset performance improvements, help manage supply / demand and provide real time and predictive information to residents and transport users. A hyper-connected TfSE area could not only improve physical connectivity through improved networks but also improve digital access for remote working / learning and healthcare as well as enabling cross geographic collaboration. As 5G becomes available everyone and everything is better connected enabling the development of hundreds of new use cases and bandwith to support excellent service provision. Generally connected / digital improvements to the transport network (road, rail and low-level air) could enable improved access to opportunities but as described above digital access could unlock further opportunities for all.
Lead Influencer	**Communications Network Providers –** broadband, mobile network providers e.g. Vodafone, O2, BT, PlusNet, Sky Broadband, Virgin Media; and **Transport network operators –** Network Rail, Highways England
Lead Influencer Objective	The race to provide next generation networks will require investing in existing 4G sites to ensure they are 5G ready. enable 5G and support All four UK operators plan to launch 5G in 2019, and it is thought that 5G will account for a quarter of all mobile data traffic in Britain by 2022. A report from Deloitte suggests that 15 million Brits would switch to 5G as soon as they could but believes only 50,000 compatible handsets will be sold in the UK in 2019, rising to 2-3 million in 2020. Network Rail's digital railway aspirations include transforming the rail network for passengers, business and freight operators by deploying modern signalling and train control technology to increase capacity, reduce delays, enhance safety and drive down costs. This will be achieved through replacement of traditional lineside train signals with new technology which will increase capacity, improve performance and enhance safety.

TfSE Role	**Influence:** The rapidly changing communications sector is complex and largely driven by commercial concerns and opportunities. Digital connectivity should be a key part of the agenda particularly in terms of enabling future ready networks and places. It is beyond TfSE's current remit to drive this agenda, as it is pan-sectoral, but the needs of future mobility / technology need to be elevated within the sub-national agenda. In order to achieve outcomes that help address TfSE's wide objectives and priorities it is also key that TfSE: - Understands best practice and innovative players in the area – Promotes appropriate academic research, testbeds and skill development in the area – Encourages sharing of data within the TfSE area

Table 28 – Stakeholder Opportunities Associated with DfT Six Key Future Mobility Changes: Changing Attitudes

. Theme	Opportunity Narrative
6. Changing Attitudes	A culmination of changing attitudes across people, businesses, and government are manifesting as an increasing appetite for future mobility technology and business models. People are increasingly comfortable using smartphone for travel planning and purchasing, customer expectations are driving towards affordable, convenient and personalised mobility and consumers expect online purchases to arrive promptly, and are willing to pay extra for same day delivery (despite also increasingly becoming aware of their contribution to climate change). For businesses, they are understanding the direct impact the adoption of new business models can have on their bottom line and performance of their assets. Government also has moved from an experimental phase of supporting pilot studies to fostering an environment for long term investment in mobility services and the decarbonisation agenda. A consultation was launched in July 2019 for example, proposing that all new-build homes are fitted with an electric car charge point (despite the fact that homes with no private drive facilities still need consideration). The process across each group is gradual and includes a period of education (developing awareness and knowledge), moving to conversational (discussion of recent learnings), and then mainstream implementation (visibility of investments). As the landscape changes, this process will iterate. As highlighted within the DfT's Future of Mobility: Urban Strategy; ***Supporting partners to meet the current and future housing needs, employment space, and regeneration;*** ***Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network.*** Attitudes towards sharing and new mobility business models will support the adoption of alternatives to private car ownership. This could ultimately lead to new housing developments and employment sites not built around the car as the primary means of access. An increase in the use of shared assets could reduce the needs for parking / storage provision for vehicles and, if electrified, reduce air quality impacts. Changing attitudes to flexible working arrangements and the provision of excellent digital infrastructure will also support increased productivity, whether on the move, or from working at home.
Lead Influencer	**TfSE and the General Population within the South East**
Lead Influencer Objective	TfSE should champion a shift in thinking to put the customer back at the heart of all forms of mobility / transport. This is a shift away from focusing on infrastructure but would help to create conditions for different discussions with operators and help to meet TfSE priorities which aim to improve business, the lives of citizens and wider outcomes.
TfSE Role	**Lead:** As above.

8.2 ASSESSMENT OF OPTIONS FOR TFSE TO INCREASE PUBLIC AND PRIVATE SECTOR COLLABORATION

8.2.1. Considering the changes expected in terms of the mega trends that influence mobility, the technology changes within the sector itself and the golden threads emerging from the review of SDC interventions. There are many potential options for TfSE to be the catalyst for change across the region.

8.2.2. These options are all focused on setting future mobility and the associated technology changes within a wider context and highlighting that a framework for change requires both public and private sector representation as summarised in Table 29:

Table 29 – Assessment of Options for TfSE to Increase Public and Private Sector Collaboration

Option and Desired Outcome	Assessment
General: Following publication of the findings of DfT's Future of Mobility: Urban Strategy, TfSE to develop its own Future Mobility paper to supplement the Strategic Transport Plan to provide a consistent foundation across the area.	**Benefits:** ▪ Provides consistent interpretation of Future Mobility and its applicability to the area and all of its varied locations ▪ Provides a view of outcome-focused vision with potential priorities and partnerships **Challenges:** ▪ Could possibly replicate DfT work depending upon outcomes ▪ Potential to be at odds with developing narratives in City Regions ▪ If not sufficiently wide-ranging could result in negative perceptions or be urban-focused **Partners:** DfT, partner LAs, Highways England, Network Rail
General: TfSE to establish Future Mobility forum for the TfSE area to share knowledge, identify synergies in programmes and to develop common approaches	**Benefits:** ▪ Potential cross-boundary issues could be prevented through a collective approach ▪ A singular approach across the TfSE area could be the catalyst for larger at-scale deployments and cost efficiencies ▪ Demonstrates commitment and an 'open for business' attitude **Challenges:** ▪ Willingness of parties to engage if agendas vary ▪ States of engagement and readiness vary across the TfSE area **Partners:** City Region Transport Authorities, Shire and Unitary Authorities, LEPs

Option and Desired Outcome	Assessment
Rail: TfSE to develop specific working group to consider the long-term future of rail (heavy, light and mass Transit) for the TfSE area; specifically, to consider the potential impact of future mobility on operations and to ensure consistency of approach and maximisation of benefits.	**Benefits:** ▪ Provides a view of outcome-focused vision with potential priorities and partnerships ▪ Focusses on long term outcomes rather near-term actions e.g. improving the customer reach & experience and improving access beyond traditional rail curtilage **Challenges:** ▪ Willingness of parties to engage if agendas vary ▪ Potential replication of existing forums ▪ Scepticism from industry as to the need **Partners**: DfT, Rail Delivery Group, Network Rail, TOCs, City Region Transport Authorities, Shire and Unitary Authorities, LEPs
Freight: TfSE to develop specific working group to consider the long-term future of freight (road, rail, sea, air, low-level air) for the TfSE area; specifically, to identify pain points in the logistics chain and where future technologies could deliver change in addition to ensuring consistency of approach and maximisation of benefits	**Benefits:** ▪ Provides a view of outcome-focused vision with potential priorities and partnerships ▪ Brings together all partners in freight industry ▪ Focusses on long term outcomes rather near-term actions **Challenges:** ▪ Willingness of parties to engage if agendas vary ▪ Potential replication of existing forums ▪ Scepticism from industry as to the need within the context of ongoing commercial activities **Partners:** DfT, FTA, RHA, ports, airports, low level air representatives, City Region Transport Authorities, Shire and Unitary Authorities, LEPs
Autonomous Vehicles: TfSE to develop specific working group to consider Autonomous Vehicle agenda for the TfSE area to ensure consistency of approach and maximisation of benefits	**Benefits:** ▪ Consistency of interpretation across all networks in the TfSE area to deliver consistency, cost savings and efficiencies ▪ Potential synergies of approach with regards to the use and sharing of AV data which could have wider benefits ▪ Provides consistency of approach for test and commercial deployment in varied geographies **Challenges:** ▪ Singular approach may not be feasible or desirable ▪ Willingness of parties to engage if agendas vary ▪ States of engagement and readiness vary across the Region **Partners:** CCAV, City Region Transport Authorities, Shire and Unitary Authorities, Automotive Sector

Option and Desired Outcome	Assessment
Mobility as a Service (MaaS): TfSE to develop specific working group to consider MaaS agenda for the TfSE area to ensure consistency of approach and maximisation of benefits	**Benefits:** ▪ Consistency of interpretation across all networks in the TfSE area to deliver consistency, cost savings and efficiencies ▪ Provides opportunities for greater cross-boundary implementation **Challenges:** ▪ Singular approach may not be feasible or desirable ▪ Willingness of parties to engage if agendas vary ▪ States of engagement and readiness vary across the TfSE area **Partners:** City Region Transport Authorities, Shire and Unitary Authorities, public transport sector, MaaS sector, car club/car hire sector, bike hire sector, scooter hire sector,
Low Level Air: TfSE to develop specific cross-sectoral working group to consider Low Level Air agenda for the TfSE area to ensure consistency of approach and maximisation of benefits	**Benefits:** ▪ Consistency of interpretation across all networks in the TfSE area to deliver consistency, cost savings and efficiencies ▪ Provides consistency of approach for test and commercial deployment in varied geographies **Challenges:** ▪ Singular approach may not be feasible or desirable ▪ Willingness of parties to engage if agendas vary ▪ States of engagement and readiness vary across the TfSE area ▪ May replicate work at national level ▪ Scepticism from industry as to the need **Partners:** Leads at a national level, DfT, CAA, City Region Transport Authorities, Shire and Unitary Authorities, developers of Low Level Air systems
Energy: TfSE to develop cross sectoral forum to consider the future energy needs and implications for transport / mobility and energy to help ensure future capacity and resilience.	**Benefits:** ▪ Directly links future energy needs and transportation / mobility needs at a strategic level ▪ Provides a potential evidence base in terms of wider investment needs to support TfSE objectives ▪ Provides foresight of potential energy issues **Challenges:** ▪ Scepticism from industry as to the need ▪ Commercial sensitivities **Partners:** Energy providers, distributors and re-sellers, Highways England, City Region Transport Authorities, Shire and Unitary Authorities, Automotive Sector, Network Rail, leads at a national level and within neighbouring regions

Option and Desired Outcome	Assessment
Digital communications: TfSE to develop cross sectoral forum to consider the future communications needs and implications for digital and physical mobility access to help future capacity and resilience.	**Benefits:** ▪ Directly links future communications / digital needs and transportation / mobility needs at a strategic level ▪ Provides a potential evidence base in terms of wider investment needs to support TfSE objectives ▪ Provides foresight of potential digital issues **Challenges:** ▪ Scepticism from industry as to the need ▪ Commercial sensitivities **Partners:** Mobile and broadband providers, Highways England, City Region Transport Authorities, Shire and Unitary Authorities, Automotive Sector, Network Rail, leads at a national level and within neighbouring regions
Research & Development: TfSE to develop stronger ties with DfT, Innovate UK and other research bodies so that research, trials and early stage deployments consider the specific needs of the networks and customers in the TfSE area	**Benefits:** ▪ To encourage early justification, demonstration and deployment of beneficial technologies / solutions ▪ Gain earlier sight of funding opportunities ▪ Demonstrates commitment and an 'open for business' attitude **Challenges:** ▪ None **Partners:** DfT, Innovate UK, Connected Places Catapult, local innovation hubs / enablers and others
Automotive: TfSE to develop links with the automotive sector supply chain and associated bodies to actively engage and understand the emerging priorities and opportunities in the TfSE area	**Benefits:** ▪ Provides early insights into trends and opportunity for knowledge share ▪ Enables collaborative approach to innovation focused on needs of the TfSE area ▪ Demonstrates commitment and an 'open for business' attitude **Challenges:** ▪ Willingness to engage with sub-national partner ▪ Commercial sensitivities **Partners:** Society of Motor Manufacturers and Traders (SMMT), McLaren Automotive, Unipart Group, and others
Stakeholders/Public: TfSE to establish diagonal slice stakeholder and public groups to act as a litmus test for future mobility trends, services and technologies in order to seek initial views as to applicability, acceptability and likely uptake.	**Benefits:** ▪ Provides foresight of needs and expectations ▪ Gathers insights into understanding and engagement with future mobility / technology across the TfSE area ▪ Demonstrates true community collaboration **Challenges:** ▪ Creating consistent messages for diagonal slice of participants **Partners:** Youth Councils / groups, advocacy groups, voluntary sector, public via open call

8.2.3. Many of these options may be outside TfSE's current core activities and resourcing. However, given that the emerging agenda is so wide and it has significant potential impacts on investment decisions, it is suggested that the broad themes are investigated further.

8.3 INSIGHTS INTO HOW TO BUILD THE BENEFITS OF INNOVATIVE TECHNOLOGIES INTO A BUSINESS CASE

8.3.1. This Future Transport Technology report has identified a number of trends and changes as a result of future mobility solutions. These will need to be considered within the development of business cases.

8.3.2. While there is uncertainty over how best to embed impacts of emerging mobility in modelling, which underpins the quantified elements of benefits forecasting in business cases, it is crucial that business case development going forward seeks to capture the trends identified in this report. Anticipating these trends is difficult, but it is nevertheless important to consider them to ensure a robust and realistic approach to the assumptions is being made in the development and justification for interventions. It is suggested that a worst-case scenario could be that interventions are either superseded or do not fulfil their intended function and that care should be taken in considering short, medium and long-term priorities.

8.3.3. Any divergence between the intended benefits and value for money for interventions should be identified within benefit realisation (BR) and monitoring and evaluation (M&E) analysis and reporting. Assumptions related to emerging mobility changes, particularly where they are important for benefit streams reported on in the Economic Case, should be specified as key performance metrics within these BR and M&E plans and these could be tracked, and their impacts on strategic objectives considered using benefits mapping and logic maps, which are typically introduced within the Strategic Case, and discussed more fully within the Management Case of business cases.

FORECASTING IMPACTS

8.3.4. A major consideration in capturing innovative technologies in future business cases relates to the underlying analytics, in particular, producing demand and benefit forecasts of the future to support the appraisal process.

8.3.5. There is significant uncertainty in various areas of technological advancement, and this uncertainty needs to be captured in the business case process (with the most significant effects being on the Strategic and Economic Cases, but also on other elements of the business case).

8.3.6. There are a number of issues that will impact on the demand and benefit forecasts that support the business case, including:

- How quickly new innovative technologies will be adopted (for example what assumptions are made about the timing and level of penetration of CAVs within the vehicle fleet).
- The changes in travel behaviour brought about by innovative technologies (e.g. how different elements of society will engage with a new transport offer).
- The impact innovative technologies will have on the effective capacities, speeds, utilisation and safety within the transport network.
- What the forms of ownership/engagement models will be for different elements of society in relation to CAVs and MaaS.

8.3.7. Considering the above, there is a very strong case for a wide range of different future scenarios (or counterfactuals) to be considered and the benefits of any given intervention assessed against that range. (This would be different to standard low/high growth type analysis currently considered within WebTAG when providing demand forecasts to support business cases.) The analysis would consider how interventions fare against different circumstances. Similar to the earlier point about

capturing emerging mobility changes specifically in BR and M&E plans by identifying key metrics associated with them, it would be beneficial if scheme promoters were requested to include sensitivity tests directly related to different mobility counterfactuals and report on these within the Economic Case. This would show the sensitivity of the Benefit Cost Ratio (BCR) and Value for Money (VfM) category to changes in any mobility assumptions. This would increase confidence in the appraisal process and provide a range of uncertainty.

8.3.8. There is a question of whether available analytical tools can reasonably forecast some of the above interactions, even if a reasonable set of assumptions could be made. There may be a need for more complex and disaggregate models to forecast the future, to enable these future relationships to be forecast to a reasonable level of robustness.

APPRAISAL IMPACTS

8.3.9. Table 30 provides an assessment of the main potential impacts of the six pillars outlined within the Future of Mobility: Urban Strategy on appraisal methods for future business cases.

Table 30 – Assessment of Potential Impacts of DfT Six Key Future Mobility Changes on Appraisal Methods

	Data & Connectivity	Automation	Cleaner Transport	Changing Attitudes	New Business Models	New Modes*
Economic						
Business Users and Transport Providers Impacts could be positive or negative	Impact on operating costs	Impact on willingness to pay and operating costs.	Impact on operating costs.	Impact on willingness to pay and operating costs.	Impact on operating costs.	N/A
Reliability Impacts are likely to be positive as network efficiency improves	Impact on reliability of transport offer.	Impact on reliability of transport offer.			Level of available information available will impact on reliability.	N/A
Regeneration Impacts are likely to be positive, increasing the overall level of accessibility		Impact on accessibility and hence regeneration.		Impact on accessibility and hence regeneration.	Impact on accessibility and hence regeneration.	N/A
Wider Impacts Impacts are likely to be positive, increasing the overall level of accessibility (productivity, agglomeration, employment effects)		Impact on accessibility and hence WIs.		Impact on accessibility and hence WIs.	Impact on accessibility and hence WIs.	N/A
Environment						
Noise / Air Quality / Greenhouse Gases Impacts are likely to be positive through network and operational efficiencies in addition to a greater awareness of climate change affecting travel choices. However, improved network efficiency may lead to induced demand.	Potential negative second order impact through demand changes.	Potential negative second order impact through demand changes.	Significant impact likely.	Potential negative second order impact through demand changes.	Potential negative second order impact through demand changes.	N/A

	Data & Connectivity	Automation	Cleaner Transport	Changing Attitudes	New Business Models	New Modes*
Historic Environment / Biodiversity / Landscape / Townscape / Water Environment Impacts could be positive or negative due to changed infrastructure requirements	Potential impacts due to required infrastructure.	Potential impacts due to required infrastructure.	Potential impacts due to required infrastructure.			N/A
Social						
Commute and other users Impacts could be positive or negative	Impact on operating costs.	Impact on willingness to pay and operating costs.	Impact on operating costs.	Impact on willingness to pay and operating costs.	Impact on operating costs.	N/A
Reliability Impacts are likely to be positive as network efficiency improves	Impact on reliability of service.	Impact on reliability of service.			Level of available information available will impact on reliability.	N/A
Physical Activity Impacts are more likely to be negative than positive due to the potential for increased motorised travel		Availability and choice will impact on physical activity.		Availability and choice will impact on physical activity.	Availability and choice will impact on physical activity.	N/A
Journey Quality Positive impact		Likely to be significant impact.		Likely to be significant impact.	Likely to be significant impact.	N/A
Accidents Impacts are more likely to be positive than negative However, any induced demand may lead to an increased number of accidents (second order impacts)	Second order impact through demand changes.	Likely to be an impact on accident rates.		Second order impact through demand changes.	Second order impact through demand changes.	N/A
Security Impacts are more likely to be positive than negative	Potential impact.			Significant impact.	Significant impact.	N/A

	Data & Connectivity	Automation	Cleaner Transport	Changing Attitudes	New Business Models	New Modes*
Access to Services / Option Values Positive impact		Significant impact.		Significant impact.	Significant impact.	N/A
Affordability Impacts are more likely to be positive than negative				Potential impact.	Potential impact.	N/A
Severance Impacts could be positive or negative due to changed infrastructure requirements	Potential impacts due to required infrastructure.	Potential impacts due to required infrastructure.		Second order impact through demand changes.	Second order impact through demand changes.	N/A

*It should be noted that 'New Modes' per-se are not considered to have an impact on appraisal impacts as they themselves are potentially the subject of such appraisal.

BUSINESS CASE SUMMARY & RECOMMENDATIONS

8.3.10. In summary, the impact of emerging mobility changes on modelling and business cases is currently unknown. There are likely to be modifications to data used within benefit forecasting process such as within the DfT Data Book, which may relate to values of time, assumptions regarding the vehicle mix and vehicle emissions, but these changes would be largely picked up when the Data Book is updated (a regular occurrence). However, there are also likely to be impacts (both positive and negative) related to specific methodologies employed within economic appraisal – these have been briefly outlined within Table 30. The results of DfT's recent consultation shown in 'Appraisal and modelling strategy: informing future investment decisions' (April 2019), showed that:

- The DfT recognises the need to improve on current methods with a particular focus on transport user benefits. By undertaking research into how to use the current framework in the case of land use change, and looking into improving the dimensions of values of time to better understand the value people derive through decreased congestion, and in the future what the impacts might be of new technology on the transport network, such as Connected and Autonomous Vehicles and Mobility as a Service ride-sharing models.
- Industry identified support for a renewed focus on the customer experience, journey quality and reliability. Several responses suggested that improved valuation guidance would be beneficial, to facilitate conducting appraisal under conditions where there is widespread mobility as a service (MaaS) and/or roll-out of connected and autonomous vehicles (CAVs). In particular, the appropriate values of time and journey comfort attributes in such a scenario are highly uncertain with no commonly accepted values in circulation.

8.3.11. Our recommendations for TfSE are to:

- Consider the types of impacts which may result from these potential future changes (which has been done at a high level in Table 30 above).
- Try to encourage (or mandate) scheme promoters (business case authors/ those involved within the economic appraisal) to consider these impacts themselves for their specific schemes – not all

schemes would be affected equally. We have suggested two areas where this thinking could be undertaken and built into the appraisal process:

- During the benefits realisation and monitoring and evaluation analysis and reporting, via the use of mobility-specific metrics (such as EV / CAV uptake, mode share reporting which disaggregates any new mobility modes, etc)
- Using the same or similar metrics to undertake additional sensitivity tests within the Economic Case to establish the sensitivity of the BCR and VfM category to changes in some of these mobility assumptions (to give confidence in the results by providing a range of certainty / uncertainty).

- TfSE could separately monitor the changes in EV / CAV uptake within the TfSE area annually and compare these rates of change to those currently predicted. Any differences would help to inform whether the impacts are likely to be larger or smaller than currently anticipated.
- TfSE could mandate these suggestions within their own economic appraisal and business case guidance, through any TfSE assurance framework.
- As part of the supporting documents for business cases, it is suggested that the impacts of changes in technology are also considered within Monitoring and Evaluation and Benefits Realisation Plans for future monitoring and review

8.4 THE RELATIVE NEED FOR FUNDING FROM THE PUBLIC SECTOR TO ENABLE NEW MOBILITY SOLUTIONS

8.4.1. The Future of Mobility: Urban Strategy outlines the national context for the funding mechanisms available to the public sector to enable the development of new mobility solutions.

8.4.2. Funding mechanisms aimed at supporting industry and local leaders includes:

Table 31 – Funding Mechanisms Aimed at Supporting Industry & Local Leaders

Total Funding Available	Name	Funding for:
£90 million	Future Mobility Zones	Foster experimentation and trialling (as part of the Transforming Cities Fund)
£1 billion	Advanced Propulsion Centre	Supporting the automotive industry to adapt
£246 million	Faraday Battery Challenge	Supporting the automotive industry to adapt
£80 million	'Driving the Electric Revolution' Challenge	Supporting the automotive industry to adapt

8.4.3. Funding mechanisms aimed at technology-specific development programmes:

Table 32 – Funding Mechanisms Aimed at Technology Specific Development Programmes

Total Funding Available	Name	Funding for:
£400 million	Charging Infrastructure Investment Fund	Zero emission vehicles
£2 million	E-Cargo Bike Grant Programme	Zero emission vehicles
£125 million	Future Flight programme	Drones and future flight

8.4.4. Thus at present there is nearly £2 billion of funding available to the public sector for a wide range of Future Mobility related projects. In order for TfSE to capitalise on these funding opportunities, it is recommended that TfSE:

- Incorporate Future Mobility elements into the Transforming Cities Fund bids. This could be approached using the DfT's Future Mobility: Urban Strategy's six key changes so to ensure proposals align with the overall national strategy and the ten specific principles outlined within it.
- Scope out potential private sector interest in the TfSE area and seek those looking to invest or provide in-kind contributions. Public-private partnerships are critical for integrating future mobility initiatives into the wider community and to help improve public perceptions surrounding the changing nature of transport.
- Track funding, performance, lessons learnt and the partnerships involved in trials across the rest of the UK so to inform bidding, prevent duplication of similar endeavours and promote efficient allocation of resourcing.
- Measure and mitigate for the deviation of mobility service operator objectives from TfSE Strategic Priorities. Engage with disruptors as soon as possible to understand their business models, targeted customer segments and geographical locations in which they intend to target, so to prevent the exacerbation of present social inequalities.
- Let industry know that the TfSE area is open for innovation in mobility.

8.5 IDENTIFICATION OF FURTHER ACTIONS TFSE CAN DO TO ENSURE A CUSTOMER FOCUS TO ITS ACTIVITIES

8.5.1. As explored previously, in a changing, increasingly diverse society with an evolving economy and jobs market it will be increasingly important to consider the needs of all customers. The following table identifies drivers of customer choice and their experiences of the transport system. Many of the new players in the transport system are focusing on segmenting markets, seeking returns from customers appearing to offer most low-risk, high-yield opportunities and are focusing heavily on a customer-centric approach – arguably missing from the business models up on which traditional modes are based upon. Placing the customer at the centre of the future mobility debate, in the context of the digital agenda and trend to customer immediacy, provides a very different outcome focused starting point.

8.5.2. Table **33** outlines some further actions TfSE could undertake to ensure a focus on the needs of the end users and customers across all activities which contribute to the economy in the TfSE area.

Table 33 – Further Actions TfSE Could Undertake to Ensure a Customer Focus

Driver	Potential actions
Employment opportunities	The needs of a diverse and evolving workforce will need careful consideration with regards to how people access employment in the context of future mobility. TfSE could; ■ Work more closely with LEPs to understand anticipated economic scenarios, sectoral employment changes and diversification to inform future customers' needs ■ Work with major employers (in centralised and de-centralised models) to understand their emerging business needs and employee mobility needs and expectations ■ Consider wider projections of the potential impacts of automation on the jobs market and the types and locations of future employment
Educational attainment	Educational needs and the models that serve them are changing potentially altering patterns of mobility substantially. Remote access to education is increasing (for some or the majority of the time) and with a changing jobs market and the impacts of automation the potential for re-skilling and lifelong learning could increase. In order to put the customer at the centre of future mobility considerations, TfSE could; ■ Work with major centres of education to understand the evolving trends in education and how this impacts physical and digital access ■ Work with LEPs to understand their future skills requirements and how these are proposed to be met to assess mobility needs ■ Work with major employers to understand their on-the-job training needs and how these could evolve with regards to the impacts of automation and artificial intelligence.
Healthcare needs	With the ageing and growing of the population predicted to continue across the UK, the healthcare needs of a geographically and demographically diverse population will potentially increase. The transport and mobility needs associated with a potentially increasing number of healthcare professionals, planned and emergency hospital visits and the distribution of medicines could be significant. In the context of potential future mobility opportunities and challenges TfSE could; ■ Examine the role of digital healthcare provision and how this could be considered as part of the wider mobility agenda ■ Examine the role of drone provision in how this could be embedded within emergency healthcare services ■ Work closely with healthcare commissioning bodies to examine potential opportunities to improve the healthcare and mobility provision ■ With local authorities consider the locations where ageing populations are expected to be greatest and actively plan for future scenarios
Goods and services	Access to goods and services has changed significantly over the last 20 years with the advent of the internet age. Home shopping has transformed how, when and where deliveries are made, reducing 'order to delivery' times and increasing returns. This has led to changes in logistics networks which in turn has led to an increase in van (and cars as vans) use on our highway networks. With the arrival of autonomous solutions (as already being operated in parts of the UK) further disruption could be expected. TfSE could; ■ Engage with major retailers (internet and others) to understand supply chain trends and their impacts on mobility ■ Engage with major hauliers to understand their future needs in the TfSE area ■ Develop specific long haul and last mile policies to encourage desirable outcomes across the region.

Driver	Potential actions
Raw materials, crops, products & waste	The timely movement of raw materials, crops, components, finished products and waste is an essential component of the economy of the TfSE area. Food production and distribution is essential for a growing population. Traditional production techniques are being disrupted by additive (3D printing), on-demand and modular techniques moving production closer to consumers. The movement of commercial and domestic waste to landfill and recycling facilities will also change as the move to less waste and more sustainable packaging potentially gathers pace. This is a developing area impacting freight and logistics in a myriad of ways. In the context of potential future mobility opportunities and challenges TfSE could; ■ Engage with academia and the LEPs to understand trends in the TfSE area and assess mobility implications ■ Consider specific policies with partners to positive encourage the reduction of trips and mileage associated with production, consumption and waste ■ Work with farming organisations and food producers to understand trends and mobility implications
Social interactions	Social interactions remain an essential part of life and arguably digital connectivity and social media have brought people together in hitherto impossible ways. The evolving need and expectations of existing and future users are hard to predict but are an essential driver of leisure based mobility movements. In the context of potential future mobility opportunities and challenges TfSE could; ■ Work with partners such as Transport Focus to understand social mobility needs ■ Regularly seek opinions from a diagonal slice (a diverse socio-economic sample of the population) of the population to understand trends, needs and expectations (including, importantly the young)
Retail and leisure	The retail sector has been the subject of considerable disruption largely due to the advent of online shopping. The sector continues to evolve and diversify with the experience economy blurring the boundaries between traditional shopping, leisure activities and on-line purchasing. This has impacted the retail offer in high streets in towns, cities and retail parks across the TfSE area as well as the leisure sector with changes to pubs, clubs, coffee shops and cinemas. Changes to retail and leisure have obvious knock on effects on our road and rail networks. In the context of potential future mobility opportunities and challenges TfSE could; ■ Engage with retail bodies to understand trends and expectations for / impacts on mobility ■ Through the diagonal slice (identified above) consider retail and leisure expectations and needs
Tourism	The TfSE area has some of the premier tourist locations in the UK. From our vibrant cities to the coastal towns, the Southeast is a draw for day trippers, 'staycationners' as well as international visitors. The future mobility needs of tourists are likely to be as varied as now, if not more so, especially if environmental restrictions were to limit access to sensitive areas. In the context of potential future mobility opportunities and challenges TfSE could; ■ Engage with tourism bodies in the area to track trends and needs in the sector

8.5.3. Clearly there could be significant resource implications with many of these activities, but at the centre of many of these actions is collaboration between TfSE and partners, employers and service providers across the area who are dependent upon transport and mobility for their core activities. A focus on collaborative, cross-sectoral outcomes could unlock new ways of planning and delivery.

8.6 RECOMMENDATIONS AND INSIGHTS

8.6.1. Table **34** highlights the interdependencies of future mobility with adjacent sectors, previously referred to in Tables 6-10, and provides recommendations as to further actions TfSE could take with regards to engaging with other adjacent sectors to enable wider improvements for transportation across the TfSE area.

8.6.2. Arguably transportation has been traditionally siloed, which in the context of future mobility is inhibitory to the pursuit of technology enabled access opportunities. With transportation technologies now being intrinsically linked with energy availability and digital communications, there is therefore a requirement to consider the whole eco-system to deliver vastly improved outcomes.

Table 34 – Adjacent Sector Recommendations to Enable Wider Transportation Improvements

Desired Outcomes	TfSE Role	Action and Partners
Energy Sector		
Sufficient and reliable supply of energy across all sectors	Consider and understand strategic energy needs of transport. Consider and understand the implications of future mobility on energy needs. Setting a vision and strategy for interaction and integration of transport and energy across the South East.	TfSE to develop cross sectoral forum to consider the future energy needs and implications for transport and energy to help ensure future capacity and resilience Develop vision and strategy for transport and energy **Partners:** Energy providers, distributors and re-sellers, Highways England, Shire and Unitary Authorities, Automotive Sector, Network Rail, leads at a national level and within neighbouring regions
Communications		
Consistently fast and reliable digital coverage in all communities / corridors	Consider and understand the economic needs for digital communications and the implications for travel demand to inform South East policy. Consider and understand the strategic transport needs for digital communications	TfSE to develop cross sectoral forum to consider the future communications needs and implications for digital and physical access to help future capacity and resilience **Partners:** Mobile and broadband providers, Highways England, Shire and Unitary Authorities, Automotive Sector, Network Rail, leads at a national level and within neighbouring regions

Desired Outcomes	TfSE Role	Action and Partners
Spatial Planning		
Spatial planning, economic development and transport policy are integrated at a sub-national level. Planning and delivery of transport services and infrastructure, digital communications and energy generation and supply are integrated at a sub-national level. Planning of new development prioritises major trip generators in the most accessible locations.	Consider and understand the implications of spatial planning and economic development policy on transport at a sub-national level. Consider and understand the impact of future mobility South East spatial planning and economic policy	TfSE to develop a land use / mobility forum to consider the wider implications of anticipated social / mobility trends to provide forward facing insights for decision making **Partners:** Representatives from LA planners / place experts
Health		
Improved health and social care outcomes through comprehensive and consistent access to services	Consider and understand the implications of health policy on transport at a strategic level Consider and understand the implications / opportunities of future mobility on the delivery of health and social care policy	TfSE to facilitate regional discussion focusing upon healthcare and ageing population and future mobility needs **Partners:** Leads at national and regional level including NHS commissioning bodies and local partners
Education		
Increased educational attainment through consistent access to provision	Consider the implications of future mobility trends upon the skills and education sector in particular those associated with automotive, AI and robotics.	TfSE to facilitate a wider South East discussion around the transport / mobility skills agenda to equip the region with the future skills it will need. **Partners:** Relevant university leads, LEP leads, local education and skills leads.
Environment		
Achievement of targets for reductions in climate change emissions Reduction in emissions related to poor air quality Reduction in existing wider environmental impacts from transport Understanding and limiting of wider environmental impacts of future mobility	Consider the implications of future mobility propulsion change (across all modes) with regards to air quality impacts.	TfSE to develop a cross sectoral forum on transport / mobility which could consider uptake trends, successful and unsuccessful initiatives and the emerging changes from public sector interventions and ongoing market change. **Partners:** Existing TfSE transportation partners including environmental groups.

9 CONCLUSIONS

9.1.1. As outlined throughout this report the Future Mobility landscape is complex, fast moving and interdependent upon existing networks, infrastructure and to some degree existing services and markets.

9.1.2. Given the pace of technological change and the rapid deployment of new service models agility will be key to navigating an uncertain landscape, especially considering the overarching role that TfSE will have in shaping transportation across the region.

9.1.3. There is an obvious imperative to simultaneously capitalise upon the potential of future mobility to help TfSE meet its objectives and aspirations (and those of its partners) whilst avoiding investment in potentially obsolete or redundant solutions/ assets.

9.1.4. The recommendations described in Section 8 above will help TfSE and its partners through what will be a period of significant change. This approach, coupled with and integrated approach to strategy and policy across all forms of mobility (existing and future) considered alongside socio-economic, land use, energy and communications needs will help develop a mobility eco-system that meets the region's future opportunities and challenges.

Appendix A

TFSE MOBILITY MODEL DASHBOARDS

Ride-sharing

Modes Impacted In UK:	Journey Range:	Unlimited	UK Model Maturity:	4

Definition	*Ride-sharing schemes match private vehicle drivers with potential passengers (often co-workers) making similar regular or one-off long-distance trips.*
Sub-models	*Employee-led ride-sharing, P2P (Peer to Peer) ride-sharing*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice	**Liftshare** offers a ride-sharing platform to facilitate P2P and employee led ride-sharing across the UK. The platform has over 600,000 members and works with 900 employer clients to provide them with individual car share platforms. Thames Valley Park (TVP), located in Reading, Berkshire, is one such client, who chose to partner with Liftshare to provide a fully integrated platform and marketing support in order to manage demand for car parking spaces. Other clients such as Jaguar Land Rover (who have been partnered since 2015), have seen 10,000 staff members registered on the platform and 5,000 are confirmed to share daily. Designated car sharing parking bays have incentivised ride sharing and promoting monetary savings.
	Faxi gives employers the opportunity to create their own commuter ride-sharing community. The Faxi platform is capable of verifying employee ride sharing in real times which allows companies to offer incentives, such as priority parking to ride sharers. In 2018, Faxi partnered with Gatwick Airport to launch the first airport staff ride-sharing service in the world, offering preferential parking (up to 1 mile closer to the airport than other staff car parks) to incentivise drivers. Other Faxi partnerships, such as with Northampton County Council, have resulted in the proportion of staff ride-sharing increasing from 2% to 20% in the first 6 months after launch.
Major Market Failures	**Didi Chuxing** suspended their ride-sharing (P2P) service in China, DiDi Hitch, following a number of sexual misconduct, and murder cases in which drivers were not appropriately vetted and drivers subsequently committed crimes. The service matched private car owners with people who were headed in the same direction so they could split the cost. Regular ride-hailing services offered by Didi were not affected by changes.
Opportunities	Operators such as Faxi at Gatwick Airport are already operational // other large private car trip generator employment sites could benefit from similar solutions
Barriers	Customer willingness to share vehicles (particularly in the UK) ***//*** employer backed incentives // flexibility issues // critical mass requirements // safety concerns
Wider Implications	Supports private car use over public transport // requires digital platform with functionality to track users usage and behaviour // potential of high-occupancy vehicle lanes to support dense uptake of initiatives along a certain corridor could be considered // combining ride-sharing with car sharing (i.e. using the asset throughout the day)

Potential Future Mobility Model Impacts Analysis

	Short term to 2020	*Medium term to 2025*	*Long term to 2030*
Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	↓	↓	↔
Wider Impacts across all Modes:	• Direct substitute for single-car occupancy journeys thereby reducing VKT • Insignificant mode shift from long-distance bus, rail (slight increases in VKT)		• Users revert to public transport & ridehailing enabled by MaaS • Automation and electrification are adopted quicker by fleet operators and provide attractive mobility options

Contribution of Mobility Model to achieving TfSE Principles	*1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:*		*2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:*		*3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:*	
	Supporting partners to meet the current and future housing needs, employment space, and regeneration;	Med.	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	N/A	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	Min.
	Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and	Med.	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	N/A		
	Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally;	Min.				

Ride-sourcing

Modes Impacted In UK:	Journey Range:	UK Model Maturity:
	<30km	3

Definition	*Ride-sourcing schemes match customers with available rides using a smartphone app. Users can register their desired trips and pay on account via pre-approved payment methods with prices set according to supply and demand.*
Sub-models	*Single origin & destination point-trip, single origin & multiple destination trip, multiple origins & multiple destination trips (pooled), multiple origins & multiple destination trips (walk + pooled), multiple origins & single destination trips (pooled)*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice

Uber, which was launched in 2009 in the USA and in the UK in 2012, offers a variety of different ride-hailing services premised around the use of an app based platform that matches private vehicle drivers to riders. Services available in regions of the UK including Brighton & Sussex, the Home Counties and on the South Coast include:

- UberX - Provides a private ride in a standard car for up to four people
- UberXL – Provides a private ride in a larger vehicle that can seat up to six people
- UberAssist – Provides additional assistance from trained drivers for elderly or disabled passengers
- UberExec – Provides premium rides in high-end cars
- UberPool – Provides a ride that is possibly shared with others riders going in the same general direction

There are now approximately 15 million Uber trips completed each day in over 65 countries/600 cities worldwide.

Arriva Click, which is an on-demand flexible minibus service that takes multiple passengers heading in the same direction, launched in 2017 in Sittingbourne Kent. A survey of Arriva Click customers in 2018 reported that 43% adopted service for their daily commute and 52% of customers switched from private motor transport (inclusive of own car, taxi and passenger in car). Following success of the service in Kent, 6 minibuses were launched in South Liverpool in summer 2018 and planned to increase to 25 by summer 2019.

Major Market Failures

Ford Chariot launched in the USA in 2014 and in London in 2018. In London the service ran a fleet of 14-seater buses across six routes that were accessed via an app. The service ceased global operations in early 2019, with the firm citing low ridership (average of 5 riders per vehicle per day reported in New York, USA) and lack of regulatory frameworks in operating cities as reasons for the shutdown.

RATP Slide, which launched in July 2016 in Bristol as the first micro-transit service in the UK, operated an app-based weekday service allowing commuters on a similar route to share a ride to and from work. Despite the scheme making more than 40,000 passenger trips and being popular with customers (receiving an average rating of 4.9/5 in customer ratings), the service closed in November 2018. Challenging conditions posed by roadworks which impacted journey time reliability and increased competition from two new Metrobus Rapid Transit routes no longer made the service viable.

Opportunities	New operating models **//** area wide approach rather than route approach to planning // planning through partnerships can potentially support and enhance the reach of public transport, particularly for off-peak journeys
Barriers	Customer willingness to share vehicles **//** dependency upon technology & e-payments // regulatory changes that limit availability & use e.g. protection of established private hire // privacy concerns // equitable access
Wider Implications	Disruption to established bus networks & taxi operators // risk of failure leads to lack of services // parking & congestion impacts // potential mode shift from public mass transit services to private hire vehicles

Potential Future Mobility Model Impacts Analysis

Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	*Short term to 2020*	*Medium term to 2025*	*Long term to 2030*
	↑	↑	↑

Wider Impacts across all Modes:

- Some use as direct subsitute for private car/hire services
- Mode shift from mass transit services thereby increasing VKT
- Geographical extent of service expanded, offering point-to-point transport to more people, producing more trips (increasing VKT)
- Growth in single occupancy ride sourcing only, not pooled
- Preliminary fleet introduction of L4/5 CAVs by operators leads to increased utilisation (increase VKT)
- Mainstream MaaS introduction adds VKT as easier access to ride sourcing. Little regulation prevents nudging trips towards public transport/active modes (increase VKT)
- Ride sourcing services incur empty miles searching for/attending reservations (increase VKT)
- Pooling will grow in dense urban areas but single occupancy prevails

Contribution of Mobility Model to achieving TfSE Principles

1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:		*2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:*		*3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:*	
Supporting partners to meet the current and future housing needs, employment space, and regeneration;	Min.	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	N/A	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	N/A
Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and	N/A				
Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally;	Min.	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	N/A		

Mobility Asset Sharing

Modes Impacted In UK:	Journey Range:	<50km	UK Model Maturity:	3

Definition	*Mobility asset sharing allows customers to access and share use of different mobility modes without having to own them (e.g. car/ bicycle). Assets are generally available at permanent or semi-permanent locations and booked, paid for and located via an app.*
Sub-models	*Round-trip based services, one-way fixed-point services, one-way free-floating services, peer to peer, corporate fleets, dockless bikes, docked bikes, flexi-docked bikes, cargo-bike hire, dockless scooters, flexi-docked scooters*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice	**Co-Wheels,** is a social enterprise operating the only independently owned national car club across 60 locations in the UK including the Isle of Wight, Eastleigh, Chichester, Horsham, Lewes, Tunbridge Wells, Maidstone, Hastings, Bracknell and Reading in the South East. The service offers members pay-as-you-go access to low-emission cars available by to hour or da. Each vehicle has its own designated bay which customers pick them up from and drop them back to the same bay at the end of the reservation. Report for Co-Wheels indicates that members are less likely to buy a car in the future and that after joining the club, 40% of members drive less.
	BTN Bikeshare Brighton & Hove, is a bike sharing scheme offering residents and visitors the opportunity to hire a bicycle from as little as 3p per minute or £72 annually for 60 minutes per day and return to any official docking station when their ride is complete. The scheme has 450 bikes available across 54 hubs with 120 new bikes in the pipeline, providing turn-up-and-go cycle hire. In the schemes first year 53,591 cyclists made 347,234 trips across the city.
	Turo, launched in the UK in September 2018, offering a peer-to-peer car sharing platform that allows private car owners to rent out their vehicles via an online and mobile interface. As of January 2019, the firm had added more than 1,000 privately owned cars and 75,000 users to the UK platform. The firm has also recently taken over EasyCar Club's 80,000 strong customer base.
Major Market Failures	**GoDrive,** a pay-by-minute car sharing scheme in London ran for 18months (2015-2016) with 50 vehicles in operation and primarily operated from private parking spaces on a hub system that allowed driver to return cars to a different, pre-determined location.
	Ofo is a Chinese dockless bike-sharing firm that allows users to hire bikes and leave them in their desired location using a phone application. However, after launching in the UK, Ofo pulled out of multiple cities including Norwich, Sheffield, Oxford and London due to bankruptcy issues. This was reportedly due to the lack of take-up and vandalism that occurred to the bikes**.**
Opportunities	Potential for integration at key transport hubs// models meet specific trip needs (off-peak, leisure, ad-hoc journeys) and therefore target the need for ownership of the second/third car // opportunity to define a vision for place and to determine how shared assets should be accessed & used within those spaces
Barriers	Customer willingness to share assets **//** irresponsible use and customer trust // high operational costs // safety implications // asset maintenance and condition // time-distance pricing can be deemed unattractive // economies of scale // unfamiliarity with concept // redistribution of assets // dependency upon technology & e-payments
Wider Implications	Vehicular services support private car usage // requires digital platform with functionality to track usage and behaviour // disruption to pedestrian networks // parking & congestion impacts vary dependent on mode // cost of managing assets & misuse not currently measured and typically left to operators to self-regulate

Potential Future Mobility Model Impacts Analysis

	Short term to 2020	*Medium term to 2025*	*Long term to 2030*
Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	⟺	⟺	⟺
Wider Impacts across all Modes:	• Car sharing only significant impact in urban/suburban areas where parking is at a premium & there is a critical mass • Not all car club users previously using private vehicles (small increase in VKT) • Underlying lack of will from the public to share assets undermines uptake of model • Any reduction in VKT from micro-mobility asset sharing negated by redistribution services	• With preliminary introduction of L4/5 CAVs by operators in ride-sourcing fleets, car-sharing and ride-sourcing models converge as they essentially offer the same service (accounted for in ride-sourcing VKT). • Underlying lack of will from the public to share assets undermines sharing of other assets • Any reduction in VKT from micro-mobility asset sharing negated by redistribution services • Micro-mobility asset sharing increasingly integrated in wider planning of mobility hubs	
Contribution of Mobility Model to achieving TfSE Principles	***1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:***	***2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:***	***3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:***
	Supporting partners to meet the current and future housing needs, employment space, and regeneration; — Med.	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and — Maj.	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change; — Min.
	Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and — Maj.		
	Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally; — Min.	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies. — Min.	

MaaS Platforms

Modes Impacted In UK:	Journey Range:	UK Model Maturity:
	N/A (enabler only)	2

Definition	*MaaS is the integration of multi-modal public and private sector mobility services, delivered through one or more digital platforms. It incorporates travel information, payments, reservation of demand responsive modes and authentication. MaaS is designed to enable customers to seamlessly access and consume mobility services to undertake end-to-end journeys meeting the individual's quality, cost and time preferences.*
Sub-models	*Monthly subscription models, pay-per ride, journey planning platforms*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice	**Whim,** which launched in the West Midlands region in April 2018, is a Mobility as a Service operator offering a single access point, via smartphone application, to multiple transport options in Birmingham. This launch followed the service debut in Helsinki in 2016, which as of October 2018 had 60,000 active users per month, with users booking 1.8 million trips. Whim offers three tiers of service: • 'Whim to Go' is the free, pay-as-you-go option, offering pay-per-ride access to public transport, taxi and car hire • 'Whim Everyday' at £99 per month offers unlimited rides on public transport, up to £49 spend per day on car hire and pay per ride on best-price taxis services • 'Whim Unlimited' at £349 per month offers unlimited ride on public transport, car hire and taxi (within 3 mile radius) Whim in the West Midlands is partnered with National Express West Midlands, West Midlands Combined Authority, Gett, Enterprise car rental and Sixt. NextBike will soon be adding bike sharing options to the service offering. **As of early 2019 Whim Everyday & Whim Unlimited services have been temporarily suspended for new subscribers while they 'revise the product offering'.**
	NaviGoGo, is Scotland's first MaaS pilot which ran with 98 young people in Dundee and North East Fife from October 2017 to March 2018. Pilot participants were given access to streamlined and personalised information and payment (where available) for trains, taxis, bike schemes, buses, car clubs and walking via a WebApp. During the trial the NaviGoGo service was used to plan over 2,000 journeys with more than £3,500 spent through the platform.
Major Market Failures	**No significant market failures to report**
Opportunities	New operating models **//** multi-modal approach to journey planning // integrates public and private transport services // discourages private car use // reduced parking & congestion impacts // biggest commercial market is the 'flexi traveller' not those who are daily dependent on their car or well suited by the current public transport offering (shown in numerous trials)
Barriers	Dependency upon technology & e-payments // requires public/private transport provider buy in and coordination // requires large scale sharing of data // requires the resolution of technical, regulatory and business-model issues across a full range of transport modes and services // accessing multiple private/public operators' data onto a common platform // platform ownership & accountability
Wider Implications	Disruption to established bus and rail networks // risk of failure leads to lack of services // parking & congestion impacts // impacts for ongoing ticketing programmes such as SmartCards which could potentially be leapfrogged by MaaS type solutions rendering investments obsolete // potential to influence travel behaviour through information and pricing to help deliver strategic objectives

Potential Future Mobility Model Impacts Analysis

	Short term to 2020	*Medium term to 2025*	*Long term to 2030*
Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	N/A	↑	↑
Wider Impacts across all Modes:	• Not yet established in the mainstream and therefore negligible impact on baseline VKT	• MaaS enables easier access to ride-sourcing and asset sharing options in locations it is operational (VKT increases) • MaaS unlocks PT services in certain area, some customers assumed to use ride-sourcing services to reach PT (VKT increases) • Ride sourcing services incur many empty miles searching for/attending reservations • However, origin-destination data allows for enhanced planning and deployment of transport services in line with demand to combat surge in single occupancy ride-sourcing	

Contribution of Mobility Model to achieving TfSE Principles	*1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:*		*2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:*		*3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:*	
	Supporting partners to meet the current and future housing needs, employment space, and regeneration;	Med.	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	Med.	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	N/A
	Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and	Med.				
	Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally;	Min.	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	Min.		

Parking Platforms

Modes Impacted In UK:	Journey Range:	UK Model Maturity:
	*N/A*	3

Definition	*Parking platforms provide consumers with information and app-based payment functions to reduce the traditional problems associated with finding and paying for parking.*
Sub-models	*Platform-based parking services*

Geographical Applicability: 

Existent Mobility Model Analysis

UK Best Practice	**AppyParking** was founded in London in 2013 and provides parking apps and services for drivers. Its products involve software that shows on-street and off-street parking (including disabled, electric and motorcycle bays) as well as yellow line and loading rules in major cities in the UK. Additionally, products include digital kerbside maps, cashless parking applications and real-time analytics to monitor on-street and car park occupancy.
	JustPark was founded in 2006 and enables drivers to find, reserve and pay for available parking spaces. The app boasts over 20,000 reservable parking locations and 2.5 million registered drivers. Additionally, the service (primarily WebApp) enables space owners to rent out their parking spaces (e.g. driveways) to make profits. The service also offers parking management solutions to help companies with under-utilised car parks. This involves real time reporting on car park performance, online payment platforms and targeted promotion.
Major Market Failures	**No significant market failures to report**
Opportunities	Subject to legislation can enable dynamic usage of kerbside and dynamic pricing // potential to adapt for future technologies (AVs) // potential to significantly reduce parking enforcement costs // customer satisfaction improvement as only pay for the time they require parking // potential for improved user experience and congestion benefits through reductions in vehicles circulating the find parking spaces
Barriers	Dependency upon technology & e-payments // requires potentially private data to be made available // requires large scale sharing of data // will need constant monitoring to keep up to date
Wider Implications	Services support private car usage // requires large sensor network to track bay usage and behaviour // requires digital platform for ticketing and bay location

Potential Future Mobility Model Impacts Analysis

	Short term to 2020	*Medium term to 2025*	*Long term to 2030*
Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	⟺	⟺	⟺
Wider Impacts:	• Platforms gradually integrated into journey planning, preventing excess circulating in search of parking space (rather than simply being used a payment platform) and slight reduction in VKT • Platforms enable parking spaces to be used more efficiently and therefore faciliate more trips (negating any reductions in VKT)		

Contribution of Mobility Model to achieving TfSE Principles

1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:		*2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:*		*3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:*	
Supporting partners to meet the current and future housing needs, employment space, and regeneration;	N/A	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	Med.	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	N/A
Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and	N/A	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	N/A		
Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally	N/A				

Digital as a Mode

Modes Impacted In UK:	All modes	Journey Range:	*Unlimited*	UK Model Maturity:	4

Definition	*The use of digital connectivity to reduce / remove the need to travel can be referred to as 'digital as a mode'. Digital access to work, education and healthcare provides for similar opportunities without physical movement.*
Sub-models	*Work, Education and Health based services*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice	The Open University was established in April 1969 and enables flexible, distance teaching in the UK and in 157 countries worldwide. The university has seen over 2 million students receive an education which they may have otherwise been denied at campus-based universities. The Open Universities distance learning works using online study materials such as online tutorial rooms, online forums and recorded lectures and broadcasts. Additionally, the University has an online library and provides each student with a tutor who can provide advice and guidance.
	Babylon Health is the UK's leading digital health provider. It aims to make healthcare more accessible and affordable by using digital and online platforms to connect healthcare professionals to their patients. This can be through video and audio chats and can involve sharing photos and materials to aid consultations. Additionally, doctors can send prescriptions to their customers desired pharmacy so that they can be easily collected. Babylon also offers an online "Healthcheck" service which includes answering lifestyle and family history questions to create personalised health reports and to get practical insights to stay healthy. The service also enables users to build a "Digital Twin" so that they can get a better insight to their body and its functions.
Major Market Failures	**No significant market failures to report**
Opportunities	New operating models **//** area wide approach rather than route approach to planning // planning through partnerships can potentially support and enhance the reach of public transport, particularly for off-peak journeys
Barriers	Dependency upon technology implementation and responsible use // regulatory changes that limit availability & use // privacy concerns // equitable access
Wider Implications	Disruption to established bus networks & taxi operators // increasingly flexible work patterns potentially reduce likelihood of dependable shared services // parking & congestion impacts // increasing focus on digitised services potentially reduced non-digital service provision

Potential Future Mobility Model Impacts Analysis

Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	***Short term to 2020***	***Medium term to 2025***	***Long term to 2030***
	⟷	↓	↓

Wider Impacts:

- Work place, education and healthcare culture changes only adopted by certain proportions of the population and geographies.
- Infrastructure a limiting factor
- Just because someone isn't commuting, doesn't mean they aren't undertaking other trips that they previously would have not been able to make in the time saved e.g. gym, shops

- Increasing proportion of population digitally literate and can maximise opportunities
- Cost of digital communications tech falls
- Just because someone isn't commuting, doesn't mean they aren't undertaking other trips that they previously would have not been able to make in the time saved e.g. gym, shops

Contribution of Mobility Model to achieving TfSE Principles

1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:		***2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:***		***3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:***	
Supporting partners to meet the current and future housing needs, employment space, and regeneration;	Min.	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	N/A	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	Med.
Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and	Med.	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	N/A		
Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally;	N/A				

Digital Based Freight Models

Modes Impacted In UK:	Journey Range:	N/A	UK Model Maturity:	2

Definition	*Digitally enabled freight models (i.e. accessed online, in-vehicle or through mobile devices) offer customers easier access to real-time and price transparent freight services. In turn, data-driven models improve supply chain visibility and asset utilisation for operators through the likes of integrated fleet management systems.*
Sub-models	*Fleet management systems, transport management systems, tender platforms, digital marketplaces (shipper to carrier & carrier to carrier)*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice	**Uship** is an open marketplace running in the UK than connects customers with customer-reviewed service providers who have extra trunk space, specialising in transporting large/bulky items e.g. vehicles, pianos, and animals. The platform does not offer automated matching of supply and demand but allows customers to choose from a variety of different offers and book accordingly. Transportation service providers in turn place competing bids for the right to haul a customer's shipment on uShip. For some categories, customers can select an upfront quote for transport services or enter an acceptable price to be matched with a transporter. Customers can book a shipment immediately from these quotes or opt to wait for auction bids.
	Quiqup is a crowd shipping platform that was founded in 2014 and provides on-demand delivery services through a network of self-employed drivers in London & Dubai through an online platform. The Quiqup browser dashboard allows users to easily book and manage their deliveries, with access to a courier in minutes and enabling them to track the progress of live orders and schedule deliveries in advance. The platform is free to use with no obligatory subscriptions.
	Transporeon is a global (with European operations) cloud-based transport management system that provides software-as-a-service solutions for multiple freight and logistics players, creating a digital connection between shippers and carriers to achieve smart, transparent and more cost-effective movement of goods around the world. Services include time slot management, transport assignment, real time visibility and mobile order management. The platform has over 100,000 users.
Major Market Failures	**No significant market failures to report**
Opportunities	Enhanced supply chain visibility // efficiency and utilisation improvements // less administrative burden // optimised choice of transport services // improved sustainability // updates customer interfaces
Barriers	Non-interoperable standards // lack of interconnected systems // process digitalisation and re-engineering // data ownership // trust issues // data confidentiality and protection // requirement for change in organisation and behaviour // economies of scale
Wider Implications	Congestion impacts through better utilisation of vehicles // incumbents must respond to digital challengers or risk being left behind // potential industry consolidation around major players & platforms

Potential Future Mobility Model Impacts Analysis

	Short term to 2020	*Medium term to 2025*	*Long term to 2030*
Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	⟺	⟺	↓
Wider Impacts:	• Business models still in their infancy • Open market means innovation is rife but no regulation prevents widescale adoption and transparency • Unwillingness to share data prevents widescale adoption	• Business models still in their infancy • Accelerated by low emission initiatives in urban areas (scheme specific) impacting freight resulting in small reductions in VKT • Unwillingness to share data prevents widescale adoption	• Business models increasingly established • Accelerated by low emission initiatives in urban areas (scheme specific) impacting freight resulting in small reductions in VKT
Contribution of Mobility Model to achieving TfSE Principles	***1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:***	***2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:***	***3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:***
	Supporting partners to meet the current and future housing needs, employment space, and regeneration; — N/A	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and — Min.	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change; — Min.
	Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and — Min.	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies. — N/A	
	Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally; — Min.		

Service Based Freight Models

Modes Impacted In UK:	Journey Range:	<10km	UK Model Maturity:	2

Definition	*Digitally enabled services using increasing amounts of data and automated technologies to provide customers with a wider selection of flexible last-mile delivery and collection options.*
Sub-models	*Digitally enabled last mile delivery*

Geographical Applicability:

Existent Mobility Model Analysis

UK Best Practice	**Starship Technologies** operate a robot delivery service that is available to users through an app. Users are able to control where and when their packages arrive, with deliveries which are then delivered straight to the customers front door. The robots journey can also be tracked using real-time technology through the app. The delivery service launched in Milton Keynes in October 2018 and offers customers a £7.99 subscription for an unlimited number of deliveries.
	InPost provides a UK network of nearly 1,200 fully automated parcel lockers that are accessible 24/7 which can temporarily store goods for customers to pick up at a later time. All lockers are located in safe and secure locations e.g. Transport for London sites, Esso petrol stations and Morrisons supermarkets and enable Customers can collect, send and return parcels to the lockers.
	Waitrose 'While You're Away' us a trial occurring in South London, where front doors of 100 people have been fitted with 'smart door locks' to give drivers access to customers' homes to unpack groceries while they are out. Waitrose says it anticipates making the service available to 1000 customers in spring 2019.
Major Market Failures	**No significant market failures to report**
Opportunities	Opportunity to reduce last mile delivery costs // increased flexibility for customer
Barriers	Trust issues // requirement for change in organisation and behaviour // physical obstacles regulation (e.g. preventing delivery droids from operating on some pavements)// public acceptance // regulations // vandalism
Wider Implications	Congestion impacts // land use planning

Potential Future Mobility Model Impacts Analysis

	Short term to 2020	*Medium term to 2025*	*Long term to 2030*
Impact on Baseline Total VKT (Vehicle Kilometres Travelled)	⟺	⟺	⟺
Wider Impacts:	• Business models still in their infancy • Technology costs are high and not widely implemented • Consumer attitudes and trust in technology and enabling remote access (e.g. in-boot and in-house deliveries enabled by smart locks) prevents model growth	• Business models still in their infancy • Technology costs are high and not widely implemented • Pavement devices and drones only applicable in urban/peri-urban places and have a negligible impact on VKT as only capture a small margin of deliveries. • Last-mile delivery solutions increasingly integrated in wider planning of mobility hubs (e.g. parcel lockers) • Lockers, in-boot and in-house deliveries prevent multiple delivery attempts and consolidate deliveries into one (although negligible impact on VKT)	• Business models become more established • Pavement devices and drones only applicable in urban/peri-urban places and have a negligible impact on VKT as only capture a small margin of deliveries. • Lockers, in-boot and in-house deliveries prevent multiple delivery attempts and consolidate deliveries into one (although negligible impact on VKT) • Last-mile delivery solutions increasingly integrated in wider planning of mobility hubs (e.g. parcel lockers)

Contribution of Mobility Model to achieving TfSE Principles	***1. Ensuring the delivery of a high quality, sustainable and integrated transport system that supports increased productivity to grow the South East and UK economy and compete in the global marketplace by:***		***2. Facilitating the development of a high quality, sustainable and integrated transport system that works to improve safety, quality of life and access to opportunities for all by:***		***3. Facilitate the delivery of a high quality, sustainable and integrated transport system that protects and enhances the South East's unique natural and historic environment by:***	
	Supporting partners to meet the current and future housing needs, employment space, and regeneration;	N/A	Ensuring the delivery of an accessible, affordable, safe and sustainable transport network across all modes, with seamless planning, payment and interchange for journeys within the South East, to the rest of the UK, and internationally; and	N/A	Supporting the implementation of new technologies and other approaches to help minimise emissions and reduce the South East's contribution to global climate change;	Min.
	Determining how digital technologies could reduce the need to travel, promote shared transport, and improve network efficiency through the creation of a digitally connected transport network; and	Min.				
	Ensuring improved connectivity and journey time reliability for people and goods between major economic hubs within the South East, to and from London, and beyond to the rest of the UK and internationally;	N/A	Improve accessibility to, from and within deprived communities, particularly coastal communities, to support sustainable economic growth and the rebalancing of these local economies.	N/A		

Appendix B

MOBILITY MODEL WIDER IMPACTS

MODEL		SHORT TERM TO 2020		MEDIUM TERM TO 2025		LONG TERM TO 2030
Ride sharing	↓	▪ Direct substitute for single-car occupancy journeys thereby reducing VKT ▪ Insignificant mode shift from long-distance bus, rail (slight increases in VKT)	↓	▪ Direct substitute for single-car occupancy journeys thereby reducing VKT ▪ Insignificant mode shift from long-distance bus, rail (slight increases in VKT)	↔	▪ Users revert to public transport & ridehailing enabled by MaaS ▪ Unwillingness to share ultimately stifling sector growth but countered by high cost of technology (rice sensitive consumers potentially need to ride-share to overcome high cost of private CAV and ULEV vehicles) ▪ Automation and electrification are adopted quicker by fleet operators and provide attractive mobility options
Ride sourcing	↑	▪ Continued private sector disruption. ▪ Some use as direct subsitute for private car/hire services ▪ Mode shift from mass transit services thereby increasing VKT ▪ Geographical extent of service offering increased, offering point-to-point transport to more people, producing more trips (increasing VKT) ▪ Growth in single occupancy ride sourcing only, not pooled	↑	▪ Preliminary fleet introduction of L4/5 CAVs by operators leads to increased utilisation (increase VKT) ▪ Mainstream MaaS introduction adds VKT as easier access to ride sourcing. Little regulation prevents nudging trips towards PT/active modes (increase VKT) ▪ Ride sourcing services incur empty miles searching for/attending reservations (increase VKT) ▪ Pooling will grow in dense urban areas but single occupancy prevails ▪ Convergence of ride sourcing and car sharing models with the preliminary penetration of L4/5 CAVs in private hire/car sharing fleets.	↑	▪ Preliminary fleet introduction of L4/5 CAVs by operators leads to increased utilisation (increase VKT) ▪ Mainstream MaaS introduction adds VKT as easier access to ride sourcing. Little regulation prevents nudging trips towards PT/active modes (increase VKT) ▪ Ride sourcing services incur empty miles searching for/attending reservations (increase VKT) ▪ Pooling will grow in dense urban areas but single occupancy prevails ▪ Convergence of ride sourcing and car sharing models with the preliminary penetration of L4/5 CAVs in private hire/car sharing fleets.
Mobility asset sharing	↔	▪ Impacts are very dependent on specific mobility sub-models ▪ Car sharing only significant impact in urban/suburban areas where parking is at a premium & there is a critical mass ▪ Not all car club users previously used private vehicles (small increase in VKT) ▪ Underlying lack of will from the public to share assets undermines uptake of model ▪ Any reduction in VKT from micro-mobility asset sharing negated by redistribution services	↔	▪ With preliminary introduction of L4/5 CAVs by operators in ride-sourcing fleets, car-sharing and ride-sourcing models converge as they essentially offer the same service (accounted for in ride-sourcing VKT). ▪ Underlying lack of will from the public to share assets undermines sharing of other assets ▪ Any reduction in VKT from micro-mobility asset sharing negated by redistribution services ▪ Asset sharing increasingly integrated in wider planning of mobility hubs	↔	▪ With preliminary introduction of L4/5 CAVs by operators in ride-sourcing fleets, car-sharing and ride-sourcing models converge as they essentially offer the same service (accounted for in ride-sourcing VKT). ▪ Underlying lack of will from the public to share assets undermines sharing of other assets ▪ Any reduction in VKT from micro-mobility asset sharing negated by redistribution services ▪ Asset sharing increasingly integrated in wider planning of mobility hubs
MaaS Platforms	N/A	▪ Not yet established in the mainstream and therefore negligible impact on baseline VKT	↑	▪ MaaS enables easier access to ride-sourcing and asset sharing options in locations it is operational (VKT increases) ▪ MaaS unlocks public transport services in certain areas, some customers assumed to use ride-sourcing services to reach public transport (VKT increases) ▪ Ride sourcing services incur many empty miles searching for/attending reservations ▪ However, origin-destination data allows for enhanced planning and deployment of transport services in line with demand to combat surge in single occupancy ride-sourcing	↑	▪ MaaS enables easier access to ride-sourcing and asset sharing options in locations it is operational (VKT increases) ▪ MaaS unlocks public transport services in certain areas, some customers assumed to use ride-sourcing services to reach public transport (VKT increases) ▪ Ride sourcing services incur many empty miles searching for/attending reservations ▪ However, origin-destination data allows for enhanced planning and deployment of transport services in line with demand to combat surge in single occupancy ride-sourcing
Parking Platforms	↔	▪ Platforms gradually integrated into journey planning, preventing excess vehicle ciculation from searching for a parking space (rather than simply being used a payment platform). Thus causing slight reduction in VKT. ▪ Platforms enable parking spaces to be used more efficiently and therefore faciliate more trips (negating any reductions in VKT)	↔	▪ Platforms gradually integrated into journey planning, preventing excess vehicle ciculation from searching for a parking space (rather than simply being used a payment platform). Thus causing slight reduction in VKT. ▪ Platforms enable parking spaces to be used more efficiently and therefore faciliate more trips (negating any reductions in VKT)	↔	▪ Platforms gradually integrated into journey planning, preventing excess vehicle ciculation from searching for a parking space (rather than simply being used a payment platform). Thus causing slight reduction in VKT. ▪ Platforms enable parking spaces to be used more efficiently and therefore faciliate more trips (negating any reductions in VKT)

Digital as a Mode	⟷	▪ Work place, education and healthcare culture changes only adopted by certain proportions of the population and geographies. ▪ Infrastructure a limiting factor ▪ Just because someone isn't commuting, doesn't mean they aren't undertaking other trips that they previously would have not been able to make in the time saved? E.g. gym, shops	↓	▪ Increasing proportion of population digitally literate and can maximise opportunities ▪ Cost of digital communications technology falls ▪ Just because someone isn't commuting, doesn't mean they aren't undertaking other trips that they previously would have not been able to make in the time saved e.g. gym, shops	↓	▪ Increasing proportion of population digitally literate and can maximise opportunities ▪ Cost of digital communications technology falls ▪ Just because someone isn't commuting, doesn't mean they aren't undertaking other trips that they previously would have not been able to make in the time saved e.g. gym, shops
Digital Based Freight Models	⟷	▪ Business models still in their infancy ▪ Open market means innovation is rife but no regulation prevents widescale adoption and transparency ▪ Unwillingness to share data prevents widescale adoption	⟷	▪ Business models still in their infancy ▪ Accelerated by low emission initiatives in urban areas (scheme specific) impacting freight resulting in small reductions in VKT ▪ Unwillingness to share data prevents widescale adoption	↓	▪ Business models increasingly established ▪ Accelerated by low emission initiatives in urban areas (scheme specific) impacting freight resulting in small reductions in VKT
Service Based Models	⟷	▪ Business models still in their infancy ▪ Technology costs are high and not widely implemented ▪ Consumer attitudes and trust in technology and enabling remote access (e.g. in-boot and in-house deliveries enabled by smart locks) prevents model growth	⟷	▪ Business models still in their infancy ▪ Technology costs are high and not widely implemented ▪ Pavement devices and drones only applicable in urban/semi-urban places and have a negligible impact on VKT as only capture a small margin of deliveries. ▪ Last-mile delivery solutions increasingly integrated in wider planning of mobility hubs (e.g. parcel lockers) ▪ Lockers, in-boot and in-house deliveries prevent multiple delivery attempts and consolidate deliveries into one (although negligible impact on VKT)	⟷	▪ Business models become more established ▪ Pavement devices and drones only applicable in urban/semi-urban places and have a negligible impact on VKT as only capture a small margin of deliveries. ▪ Lockers, in-boot and in-house deliveries prevent multiple delivery attempts and consolidate deliveries into one (although negligible impact on VKT) ▪ Last-mile delivery solutions increasingly integrated in wider planning of mobility hubs (e.g. parcel lockers)

Appendix C

INNOVATE UK FUNDED CAV PROJECTS IN TFSE REGION

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles Test Bed (Phase 2)	Connected and Autonomous Vehicles Test Bed 2	Smart Mobility Living Lab:	Our vision is to create a world leading test environment for the development of future mobility solutions in London. The Smart Mobility Living Lab based in the Royal Borough of Greenwich (RBG) and the Queen Elizabeth Olympic Park (QEOP). Businesses will be able to test their ideas, technology and services, examples include: • Testing autonomous and connected vehicles on real roads safely • Exploring the relationship and interaction between autonomous vehicles and people in complex and busy real world environments • Testing the use of driverless pods to carry people short distances (1-2 miles) from transport nodes, i.e. railway and underground stations to major venues or destinations • Exploring the use of large data sets to improve the flow of traffic and people • Exploring how much more can be achieved through a more integrated transport system that requires little interaction from the passenger • Exploring the benefits of new technology for logistics companies This is an exciting project and part of the UK Governments commitment for the UK to be at the forefront of this new and rapidly evolving market. Investment will give UK industry the opportunity to take the lead and reinforce its position as a leader in this field.	2017/18	Collaborative R&D	Cubic Transportation Systems Ltd	No	43191	43921	1213978	2427956	108269.43	Active	Live	Large	RH1 5LA	South East	Coast to Capital
Connected and Autonomous Vehicles 2 - Stream 1	Connected and Autonomous Vehicles 2 - Stream 1 CRD	HumanDrive	The project will build an autonomous vehicle with human like, natural control / path planning, by 2019, that 1) is able to be fully autonomous on country roads, when overtaking, on roundabouts and/ or motorways 2) mimics the driving behaviour of human beings, to provide an enhanced experiences for the occupants. Nissan and Hitachi will use their global automotive, artificial intelligence/ machine learning and communication technology expertise to build vehicles and AI models that are fit for purpose, and use the expertise of Horiba MIRA, Cranfield University and the University of Leeds to ensure the system is validated and end-user acceptance is evaluated. Atkins and SBD will address protective security, making the vehicle digitally and physically secure. The Transport Systems Catapult will be responsible for project management and development of safety aspects of the project. The impact of L4 vehicles on the Strategic Road Network will be explored through work by Highways England and TSS. Highways England and Milton Keynes Council will provide support to the demonstration route of the vehicle.	2016/17	Collaborative R&D	Atkins Limited	No	42917	43830	43752	87504	31792.36	Active	Live	Large	KT18 5BW	South East	Coast to Capital
Connected and Autonomous Vehicles 2 -Stream 2	CAV 2, Stream 2	5*StarS: Automotive Cyber Security through Assurance	The rapidly proliferating wireless connectivity & automation of road vehicles offers many benefits to society, and significant commercial opportunity, but also brings a potential explosion of Cyber Security threats. 5*StarS partners HORIBA MIRA, Ricardo, Roke, Thatcham Research with Axillium support will deliver an innovative assurance methodology to assure that CAV components, systems & vehicles have been designed & tested to the relevant cyber security standards throughout their whole development lifecycle, and a Euro NCAP 5 star type consumer rating framework for assessing the Cyber Security of new vehicles, clarifying risk for the insurance industry	2016/17	Collaborative R&D	RICARDO UK LIMITED	No	42917	43646	181478	362955	154256.3	Active	Live	Large	BN43 5FG	South East	Coast to Capital

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles 2 -Stream 3	CAV 2, Stream 3	Cambridge Autonomous Bus System Feasibility Study	The Cambridge Autonomous Bus System Feasibility Study will examine the opportunity to use new, electric, autonomous mini-buses to provide much needed transport links between Cambridge's science campuses, park & ride locations and rail stations. These vehicles and special paths could provide a significant improvement in traffic congestion, improve air quality, and solve serious work commute difficulties for residents in the Cambridge region. The vehicles could use the Cambridge Guided Busway after hours when the buses are not running to provide transport to the thousands of people working night shifts at the Addenbrooke's and Cambridge Biomedical Campuses. Another possible multiuse pathway would allow pedestrians, bicycles and the automated mini-buses to safely share a new connection between the Wellcome Genome Campus and the Whittlesford Parkway rail station. The partners in the study are the RDM Group, Cubic Corporation, The Welcome Genome Campus and Cambridgeshire County Council. The study also has the support of the Addenbrooke's Hospital, Cambridge Biomedical Campus, Astra Zeneca and Stagecoach.	2016/17	Feasibility Studies	Cubic Transportation Systems Ltd	No	42917	43281	19999	39997	19900.59	Active	Closed	Large	RH1 5LA	South East	Coast to Capital
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	FLOURISH	Connected and autonomous vehicles will play a significant role in a future transport system and unlock enormous social benefits at the same time. FLOURISH looks to enable the delivery of many of these benefits by helping to ensure that connected and autonomous vehicle are developed with the user in mind and are technically secure, trustworthy and private. Using older people and others with assisted living needs as an exemplar to develop an understanding of the diverse needs of a particular user group, FLOURISH will develop innovative products, processes and services that are directly transferrable to the wider community. FLOURISH will expand existing physical and virtual vehicle test capability and help deliver up to 10,000 jobs through the establishment of the Bristol City-Region as a world class independent test facility for connected and autonomous vehicles.	2015/16	Collaborative R&D	Atkins Limited	Yes	42522	43616	444628	889256	377933.8	Active	Live	Large	KT18 5BW	South East	Coast to Capital
Connected and Autonomous Vehicles 2 - Stream 1 (Challenge Led Funding)	Connected and Autonomous Vehicles 2 - Stream 1 CRD	StreetWise	StreetWise aims to develop and demonstrate the technology, safety validation methods, insurance and service models for delivering an autonomous personal mobility solution targeted at replacing the urban commuter car. The project will show that the technology is now sufficiently mature to be safe in urban environments, sufficiently intelligent to co-exist with human drivers, road users and pedestrians and will demonstrate how we can use this technology to build compelling service offers to recover commuting time, reduce commuting costs, cut accident rates, reduce congestion and cut emissions. The StreetWise project will be delivered by a consortium led by FiveAI - a company specialising in perception and artificial intelligence in-vehicle technologies - working in collaboration with component technology providers (McLaren Applied Technologies, University of Oxford), transport sector related innovators (Arriva, TRL Limited & Transport for London) and the UK's largest automotive personal insurance provider (Direct Line Group).	2017/18	Collaborative R&D	McLaren Applied Technologies Ltd	No	42979	43890	149403	298806	0	Active	Live	Large	GU21 4YH	South East	Enterprise M3

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles 2 - Stream 1 (Challenge Led Funding)	Connected and Autonomous Vehicles 2 - Stream 1 CRD	ROBOPILOT	Arrival find trucks today totally unacceptable. At Arrival we are making trucks the way they should be – affordable, elegant, quiet, clean and safe. We are removing all the barriers to entry for electric vehicles by pricing them in line with conventional trucks, giving every fleet manager, tradesman or company, no matter how big or small, the opportunity to change the way they transport goods and make our towns and cities better places to live in. Arrival is well funded by private venture capital but its plans are extremely ambitious and require considerable investment. The public funding provided by the Robopilot project will greatly accelerate the 'safety' component of our vision in line with key objectives of both central Government and City authorities such as Transport for London. It will develop & demonstrate autonomous driving functionality for our recently announced electric delivery van, which can then be adapted for our planned future rollout of larger trucks and buses. It brings advanced autonomous racing technology to the light commercial vehicles market. Demonstration of SAE level 4 autonomy over a 10-mile route on mixed public roads in all weathers, and of driverless self-parking, will be planned and conducted with potential customers.	2017/18	Collaborative R&D	Thales UK Limited	No	43101	44012	277144	554287	0	Active	Live	Large	KT15 2NX	South East	Enterprise M3
Connected and autonomous vehicles Round 3 (CRD)	Connected and Autonomous Vehicles 3: R&D	A radical mode SHIFT away from cars to Integrated Mobility-as-a-Service enabled by autonomous pods	"_Shift -_ a collaboration between aiPod, Oxbotica, Transport for London, Gordon Murray Design, Innogy, Bosch and Imperial College, and seeks to catalyse a radical mode _shift_ from cars to integrated mobility as a service (MaaS) using autonomous pods. aiPod proposes a city-friendly urban mobility service based on fleets of small self-driving pods, that are safe, predictive, convenient, comfortable, inexpensive, road efficient, zero emission, 100% renewable energy, public transport integrated and city friendly. _Shift_ will trial a commercial city-friendly, subscription-based, MaaS offering, based on SAE Level 4 small self-driving pods, in a London Borough, delivering a safe, zero emissions solution, focused on improving transport options and utility, reducing vehicle ownership and congestion, encouraging city-friendly transport outcomes. The project will involve 10 Connected Autonomous Vehicles and 10 Families who will have access to a low cost MaaS subscription - similar to an autonomous car club that is integrated with London public transport. The trial will explicitly share data with the city and use simulation to model the impact of predictive autonomous pods on city transport, congestion and mode-shift away from car ownership. The users experience and feedback will then inform the design of the optimal citizen and city centric pod by iconic British vehicle designer - Gordon Murray Design."	2017/18	Collaborative R&D	Gordon Murray Design Limited	No	43221	43951	62818	104696	5153.82	Active	Live	Medium	GU4 8EP	South East	Enterprise M3

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and autonomous vehicles Round 3 (CRD)	Connected and Autonomous Vehicles 3: R&D	AutopleX	Currently the automotive industry is launching semi-autonomous driver assist features where the driver has to be aware of their surroundings to regain control where the car can't cope. Moving towards full autonomy, the vehicle will have to operate without a driver as a backup. Vehicles will have to handle complex situations and any road junction. The vehicle relies on its sensors to operate safely and efficiently. These sensors have limitations when there are obstructions in the way or there are rapid lane change and fast moving traffic where a clear view is not possible for example some lane merges or roundabouts. The AutopleX project includes the technical domains of cybersecurity, cooperative autonomous driving, vehicle-to-anything (V2X) communications, Advanced Driver Assistance Systems (ADAS), and Internet of Things (IoT) to demonstrate enhanced autonomy for complex vehicle manoeuvres at junctions, supporting SAE Level 4+ autonomy.	2017/18	Collaborative R&D	Siemens Public Limited Company	No	43556	44469	370626	741252	0	Active	Live	Large	GU16 8QD	South East	Enterprise M3
Connected and autonomous vehicles Round 3 (CRD)	Connected and Autonomous Vehicles 3: R&D	Autonomous Valet Parking	"As autonomous vehicles start to become a reality, one of the unanswered questions remains - where and how will those cars park? Parkopedia today provides the ability for drivers to find and pay for parking in 75 countries around the world. As part of this proposal, Parkopedia is looking to deliver a proof of concept involving an autonomous vehicle that will fulfil the valet function by navigating the vehicle to an open parking space, executing the parking maneuver automatically with no human involvement and responding to a summon request by navigating the vehicle back to the driver. To enable this autonomous valet parking demonstration, Parkopedia is partnering with Transport Systems Catapult to understand the impact of autonomous valet parking on the parking industry and the University of Surrey to research the mapping and localisation requirements for the maps and navigation software that will power these autonomous vehicles."	2017/18	Collaborative R&D	University of Surrey	No	43221	44135	229808	229809	49960.64	Active	Live	Academic	GU2 7XH	South East	Enterprise M3
Connected and autonomous vehicles Rnd 3 (FS)	Connected and Autonomous Vehicles 3: Feasibility Studies	5G Above the Cloud (AtC)	"The overriding demand on all levels of Connected and Autonomous Vehicles (CAVs) will be safety. Any vehicle that moves must have the necessary Situation Awareness (SA) to achieve safe and secure control of the vehicle. It is vital to ensure that the resolution of SA is appropriate to the environment as the demographics of a moving vehicle change. CAVs are being designed with the expectation of ubiquitous communication to the cloud and so will be severely affected by inadequate network coverage due to the cell tower densification issue. The lack of base stations will have the greatest impact on vehicles that operate outside of city centres which is likely to be the norm in the majority of cases. The aim of this project is to test the technical feasibility of a proposed system that will have the ability to maintain 5G Quality of Experience (QoE) access to SA data specifically tailored to CAVs, particularly when outside of closed environments."	2017/18	Feasibility Studies	University of Surrey	No	43313	43677	73192	73192	10953.4	Active	Live	Academic	GU2 7XH	South East	Enterprise M3

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Connected and Autonomous Vehicles 2 -Stream 2	CAV 2, Stream 2	CAPRI	The CAPRI project will design & deliver a complete, market ready, mobility service deployable in urban scenarios using trusted secure PODs and systems supported with a 'complete package' of viable business cases, legal, regulatory, insurance recommendations to enable quick and easy deployments. A series of trial deployments demonstrate increasingly complex POD-based mobility services. Whilst addresing all CCAVs priority areas, including cyber security of vehicle and data validated real-time controld systems, our focus is on innovative business models based around POD mobility services.	2016/17	Collaborative R&D	Dynniq UK Limited	No	43009	43921	185443	370886	13193.8	Active	Live	Large	RG24 8WZ	South East	Enterprise M3
Connected and Autonomous Vehicles 2 -Stream 4	CAV 2, Stream 4	Autonomous and Connected vehicles for CleaneR Air (ACCRA)	UK Government AQ strategy states that there are over 50,000 premature deaths yearly due to AQ pollution. Emissions from transport are a key contributor to poor AQ. Vehicles which have an internal combustion engine and an electric only range can offer zero emission (ZE) operation but cities lack the ability to monitor and control the vehicles. Project ACCRA - a collaboration between Dynniq, Tevva, EarthSense, Transport Systems Catapult, Cenex and Leeds City Council - will address this problem by developing a system capable of allowing remote control of a vehicles energy management system to ensure ZE operation where it has maximum benefit to AQ. The operation will be demonstrated in a proposed Clean Air Zone in Leeds. Under the overall management of the Transport Systems Catapult, the consortium will develop a hybrid vehicle interface (Tevva), a decision-making engine (Dinniq) capable of taking inputs from a range of city data, such as live air quality information (EarthSense) potentially triggering on-demand ZE running instructions (known as active geofencing). The application, markets, business models and scalability of the system will be evaluated by Cenex and the Transport Systems Catapult to inform Leeds and other CAZ cities of the its potential use.	2016/17	Collaborative R&D	Dynniq UK Limited	Yes	42917	43281	154674	309348	81620.89	Active	Final Claim	Large	RG24 8WZ	South East	Enterprise M3
Connected and Autonomous Vehicles 2 -Stream 3	CAV 2, Stream 3	Project Alloyed	Seamless. Intelligent. Fast. Safe. Independent. Exciting. Project Alloyed will study and build technologies for vehicles of the future that will enable uninterrupted access to networks regardless of where you are, provide valuable data from within your car and its immediate surroundings and allow you to enjoy your favourite Apps and new services. This project is a collaborative effort between the Public Sector, Private Sector and Academic bodies within the UK. The project is co-funded by the UK Government and will last for 12 months.	2016/17	Feasibility Studies	EPITOMICAL LIMITED	Yes	42948	43404	51836	74053	51835.15	Active	Closed	Micro	GU2 7YB	South East	Enterprise M3
Connected and Autonomous Vehicles 2 -Stream 3	CAV 2, Stream 3	Project Alloyed	Seamless. Intelligent. Fast. Safe. Independent. Exciting. Project Alloyed will study and build technologies for vehicles of the future that will enable uninterrupted access to networks regardless of where you are, provide valuable data from within your car and its immediate surroundings and allow you to enjoy your favourite Apps and new services. This project is a collaborative effort between the Public Sector, Private Sector and Academic bodies within the UK. The project is co-funded by the UK Government and will last for 12 months.	2016/17	Feasibility Studies	University of Surrey	No	42948	43404	46980	46980	40572.8	Active	Closed	Academic	GU2 7XH	South East	Enterprise M3

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Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	UK Connected Intelligent Transport Environment (UK CITE)	The UK Connected and Intelligent Transport Environment (UK CITE) creates a real-world-lab for companies to test how connected and autonomous vehicles (CAV) can interact with communications infrastructure (so called V2X). The project will install the relevant infrastructure along sections of the M42, M40, A45, A46 and Coventry city centre. This test environment will be available to other vehicle manufacturers or fleet users who wish to test V2X technologies. It will act as a world class research asset to attract R&D to the UK. CAV test vehicles will examine the impact of V2X on road safety, traffic flow and the ability to provide other services like WiFi. Cyber-security will also be included from the outset. V2X will improve a vehicles journey through the road network. E.g. in case of an accident instead of an expensive gantry on the motorway a connected car could provide warnings and guidance to the driver, or an autonomous vehicle could respond automatically. The impact on the UK road network will be simulated based on these trials - enabling the UK to get the most benefits from CAV for the least infrastructure cost.	2015/16	Collaborative R&D	Siemens PLC	No	42522	43465	301599	603198	279688.4	Active	Live	Large	GU16 8QD	South East	Enterprise M3
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	FLOURISH	Connected and autonomous vehicles will play a significant role in a future transport system and unlock enormous social benefits at the same time. FLOURISH looks to enable the delivery of many of these benefits by helping to ensure that connected and autonomous vehicle are developed with the user in mind and are technically secure, trustworthy and private. Using older people and others with assisted living needs as an exemplar to develop an understanding of the diverse needs of a particular user group, FLOURISH will develop innovative products, processes and services that are directly transferrable to the wider community. FLOURISH will expand existing physical and virtual vehicle test capability and help deliver up to 10,000 jobs through the establishment of the Bristol City-Region as a world class independent test facility for connected and autonomous vehicles.	2015/16	Collaborative R&D	Dynniq UK Limited	No	42522	43616	459763	919527	208229.68	Active	Live	Large	RG24 8WZ	South East	Enterprise M3
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	FLOURISH	Connected and autonomous vehicles will play a significant role in a future transport system and unlock enormous social benefits at the same time. FLOURISH looks to enable the delivery of many of these benefits by helping to ensure that connected and autonomous vehicle are developed with the user in mind and are technically secure, trustworthy and private. Using older people and others with assisted living needs as an exemplar to develop an understanding of the diverse needs of a particular user group, FLOURISH will develop innovative products, processes and services that are directly transferrable to the wider community. FLOURISH will expand existing physical and virtual vehicle test capability and help deliver up to 10,000 jobs through the establishment of the Bristol City-Region as a world class independent test facility for connected and autonomous vehicles.	2015/16	Collaborative R&D	React AI Ltd	No	42522	43616	170717	243882	145109.45	Active	Live	Micro	KT13 8DU	South East	Enterprise M3

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Connected and Autonomous Vehicles - Technical FS	Connected & Autonomous Vehicles FS	Optimised Vehicle Autonomy for Ride and Emissions	This project aims to demonstrate the concept of optimising the driving style of autonomous vehicles (AVs) for passenger ride comfort, vehicle emissions and fuel consumption, and journey time. The results of this project will evaluate the impacts of customers interacting with AVs to specify a driving style to suit their requirements (e.g. minimise travel time, or maximise comfort) on AV fuel consumption and emissions and on traffic at the network level using simulation methods. The collaboration between Emissions Analytics and the Centre for Transport Studies, Imperial College London, combines access to a range of vehicles for testing, expertise in vehicle emissions measurement, innovation in sensor development and expertise in the simulation of AVs. New measurements of ride comfort and emissions will be used to develop models that can be used in further simulations of passenger-AV interactions. As part of this project, a ride comfort sensor will be developed to independently measure vibrations so that standard ride comfort metrics can be calculated. The ride quality sensor developed in this project will also be used to detect road degradation for highways maintenance.	2015/16	Feasibility Studies	Emissions Analytics Limited	Yes	42491	42947	86866	124093	86810.83	Active	Closed	Small	SO23 7QA	South East	Enterprise M3
Connected and Autonomous Vehicles - Technical FS	Connected & Autonomous Vehicles FS	PAVE: People in Autonomous Vehicles in Urban Environments: Culham City	"I want to live in a vibrant community with easy access to work, leisure, family and entertainment and to my local towns and the countryside. I want to be independent and mobile in my old age. I want to live well and Iwant my great grandchildren to be able to live well too." Technology will play a key role in delivering these aspirations. Connected autonomous vehicles will be part ofthe solution. Culham City is a new test site that will be used explore how smart technologies can improve how we live by enabling the safe and controlled testing of the next generation of transport solutions. In the process we will generate the evidence, to convince users, regulators, insurers and investors alike, that autonomous vehicles are a benefit to society.Culham City puts real people at the heart of CAV research and will create a world leading facility that will anchor CAV research in the UK for decades to come.	2015/16	Feasibility Studies	Siemens Public Limited Company	No	42461	42735	4775	9550	2542.6	Active	Closed	Large	GU16 8QD	South East	Enterprise M3

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Connected and Autonomous Vehicles: Simulation CR&D	Connected and Autonomous Vehicles Simulation: Collaborative R&D	OmniCAV	"OmniCAV will lay the foundations for the development of a comprehensive, robust and secure simulator, aimed at providing a certification tool for Connected Autonomous Vehicles (CAVs) that can be used by regulatory and accreditation bodies, insurers and manufacturers to accelerate the safe development of CAVs. It brings together a team of eleven internationally renowned organisations, with decades of accumulated knowledge in the area, in order to produce a single-point-of-call simulator to establish when a CAV can safely progress from a testbed to road trial. To achieve this, OmniCAV will use highly detailed road maps, together with a powerful combination of traffic management, accident and CCTV data, to create a high-fidelity dual (traffic and driving) simulation environment, including AI-trained road users to interact with the AV under test. Scenarios for testing will be developed and randomised in a holistic way to avoid CAVs training to specific conditions, whilst maximising coverage, and the integrity of the testing environment will be taken into consideration through creation of a root-of-trust design to secure the test inputs, simulator configuration and resulting test outputs. Critically, the simulator will offer market-leading coverage of a representative element of the UK road network, through encompassing rural roads, peri-urban and urban roads, to help enable autonomy for all. Representatives of the key end-users, including a local authority, an OEM and an insurance provider, will be engaged throughout to understand their needs. The validity of the synthetic test environment compared to the real-world is of particular importance, and OmniCAV will be tested and refined through an iterative approach involving real-world comparisons and working in conjunction with a CAV test-bed.	2018/19	Collaborative R&D	Ordnance Survey Limited	No	43435	44165	175180	350359	0	Active	Live	Large	SO16 0AS	South East	Solent

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Connected and autonomous vehicles Rnd 3 (FS)	Connected and Autonomous Vehicles 3: Feasibility Studies	Feasibility study on polar codes for 5G URLLC	"Fifth generation (5G) mobile communication will support a greater range of applications than 4G. One of the new use cases is Ultra-Reliable Low-Latency Communication (URLLC), which will be a key connectivity enabler for Connected and Autonomous Vehicles (CAVs). These vehicles will benefit from ultra-high performance communications, both with each other and with the Internet via 5G basestations. They will be able to communicate with 10x better reliability and 10x better delay than any previous mobile communication systems. For the first time, CAVs will be able to rely on mobile communications to exchange life-saving messages, which can avert collisions. The ultra-high reliability of URLLC will be achieved using Forward Error Correction (FEC). This will mitigate the communication errors that are inherent to mobile communication, caused by noise, interference and poor signal strength. However, FEC is the most computationally intensive process in mobile communications. Owing to this, vehicles will need to use dedicated hardware acceleration, so that FEC can be completed quickly enough to support ultra-low communication delays. The 3rd Generation Partnership Project (3GPP) will soon begin specifying the international standard for FEC in 5G URLLC. The proposed project will conduct a feasibility study on the application of a particular FEC code for URLLC, namely the polar code. Polar codes enable particularly high reliability, but are challenging to implement in hardware acceleration. Despite this, AccelerComm has developed patent-pending, first-to-market Intellectual Property (IP) on the hardware acceleration of polar codes. This IP solution has much greater hardware efficiency than all previous hardware acceleration implementations of polar codes. This project will significantly enhance the AccelerComm polar coding IP, extending its capability from eMBB applications to meet the much stricter and conflicting URLLC requirements of 10x improvements to reliability and latency. More specifically, innovative solutions will be developed to merge successive	2017/18	Feasibility Studies	AccelerComm Ltd	Yes	43252	43799	165655	236650	78946.88	Active	Live	Micro/Small	SO17 1BJ	South East	Solent

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Connected and autonomous vehicles Rnd 3 (FS)	Connected and Autonomous Vehicles 3: Feasibility Studies	Feasibility study on polar codes for 5G URLLC	"Fifth generation (5G) mobile communication will support a greater range of applications than 4G. One of the new use cases is Ultra-Reliable Low-Latency Communication (URLLC), which will be a key connectivity enabler for Connected and Autonomous Vehicles (CAVs). These vehicles will benefit from ultra-high performance communications, both with each other and with the Internet via 5G basestations. They will be able to communicate with 10x better reliability and 10x better delay than any previous mobile communication systems. For the first time, CAVs will be able to rely on mobile communications to exchange life-saving messages, which can avert collisions. The ultra-high reliability of URLLC will be achieved using Forward Error Correction (FEC). This will mitigate the communication errors that are inherent to mobile communication, caused by noise, interference and poor signal strength. However, FEC is the most computationally intensive process in mobile communications. Owing to this, vehicles will need to use dedicated hardware acceleration, so that FEC can be completed quickly enough to support ultra-low communication delays. The 3rd Generation Partnership Project (3GPP) will soon begin specifying the international standard for FEC in 5G URLLC. The proposed project will conduct a feasibility study on the application of a particular FEC code for URLLC, namely the polar code. Polar codes enable particularly high reliability, but are challenging to implement in hardware acceleration. Despite this, AccelerComm has developed patent-pending, first-to-market Intellectual Property (IP) on the hardware acceleration of polar codes. This IP solution has much greater hardware efficiency than all previous hardware acceleration implementations of polar codes. This project will significantly enhance the AccelerComm polar coding IP, extending its capability from eMBB applications to meet the much stricter and conflicting URLLC requirements of 10x improvements to reliability and latency. More specifically, innovative solutions will be developed to merge successive	2017/18	Feasibility Studies	UNIVERSITY OF SOUTHAMPTON	No	43252	43799	12470	12470	6234.93	Active	Live	Academic	SO17 1BJ	South East	Solent
Connected and Autonomous Vehicles 2 -Stream 2	CAV 2, Stream 2	5*StarS: Automotive Cyber Security through Assurance	The rapidly proliferating wireless connectivity & automation of road vehicles offers many benefits to society, and significant commercial opportunity, but also brings a potential explosion of Cyber Security threats. 5*StarS partners HORIBA MIRA, Ricardo, Roke, Thatcham Research with Axillium support will deliver an innovative assurance methodology to assure that CAV components, systems & vehicles have been designed & tested to the relevant cyber security standards throughout their whole development lifecycle, and a Euro NCAP 5 star type consumer rating framework for assessing the Cyber Security of new vehicles, clarifying risk for the insurance industry	2016/17	Collaborative R&D	ROKE MANOR RESEARCH LIMITED	No	42917	43646	114272	228545	97131.2	Active	Live	Large	SO51 0ZN	South East	Solent
Connected and Autonomous Vehicles 2 -Stream 3	CAV 2, Stream 3	Secure CAN with Q-PUF	Spoof-proof, hardware-implemented secure CAN Protocol	2016/17	Feasibility Studies	CYNATION LIMITED	Yes	42979	43496	104612	149446	85221.39	Active	Live	Micro	SO17 1XS	South East	Solent

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Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	Pathway to Autonomous Commercial Vehicles	This project will develop a cloud based software model for its tyre data monitoring system on commercial vehicles, trailers and PSV's that will offer accurate predictions of tyre and mechanical issues by using real time data from the installed hardware. Tyre data from each vehicle will be linked with satellite communications and intelligent decision making to provide drivers, fleet managers, and tyre service providers with a real time system to prevent unnecessary downtime, such as roadside breakdowns and improve efficiencies in vehicle andtyre management. Tyres have a significant impact on vehicle safety, fuel consumption and CO2 emissions. Damaged tyres can cost fleet operators tens of thousands of pounds in repair costs, wasted fuel and fines from late deliveries. In response to this, Tructyre, a Hampshire based SME, has gathered together a strong consortium of companies and academic partners to develop predictive software with an automated data exchange capability between vehicle, fleet operator and tyre service provider.	2015/16	Collaborative R&D	Tructyre Fleet Management Ltd	Yes	42491	43220	356342	593902	344556	Active	Final Claim	Medium	SO50 4NT	South East	Solent
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	Pathway to Autonomous Commercial Vehicles	This project will develop a cloud based software model for its tyre data monitoring system on commercial vehicles, trailers and PSV's that will offer accurate predictions of tyre and mechanical issues by using real time data from the installed hardware. Tyre data from each vehicle will be linked with satellite communications and intelligent decision making to provide drivers, fleet managers, and tyre service providers with a real time system to prevent unnecessary downtime, such as roadside breakdowns and improve efficiencies in vehicle andtyre management. Tyres have a significant impact on vehicle safety, fuel consumption and CO2 emissions. Damaged tyres can cost fleet operators tens of thousands of pounds in repair costs, wasted fuel and fines from late deliveries. In response to this, Tructyre, a Hampshire based SME, has gathered together a strong consortium of companies and academic partners to develop predictive software with an automated data exchange capability between vehicle, fleet operator and tyre service provider.	2015/16	Collaborative R&D	University of Portsmouth	No	42491	43220	263733	263733	247822.53	Active	Final Claim	Academic	PO1 2UP	South East	Solent
Connected and Autonomous Vehicles - Technical FS	Connected & Autonomous Vehicles FS	Atlas	The Atlas Project will study the feasibility of and requirements of the technologies and services required todeliver autonomous navigation 'anywhere' in a safe, reliable and resilient manner. Specifically, the project will study the navigation, mapping, data, communications and processing requirements; ,identifying the on-vehicle and infrastructure elements required to support autonomous navigation. The project also considers how data can be reused for the planning of urban environments more suited to autonomy. The consortium partners collaborating on this project are: Ordnance Survey (lead), Gobotix Ltd, Oxford Technical Solutions Ltd, Transport Research Laboratory, Sony Europe Ltd, Royal Borough of Greenwich and Satellite Applications Catapult.	2015/16	Feasibility Studies	Ordnance Survey Limited	Yes	42491	42947	41494	82987	38805.94	Active	Final Claim	Large	SO16 0AS	South East	Solent
Connected and Autonomous Vehicles - Technical FS	Connected & Autonomous Vehicles FS	Road Accident 3D Reconstruction	Who is responsible for a road accident involving driverless cars? The answer to this question, and many like it, is the motivation for this proposal: To study the feasibility of producing a highly precise 3D reconstruction of a vehicle's trajectory, in the build-up to a road accident and the accident itself, by advancing event data recorders such as dashcams.	2015/16	Feasibility Studies	Roke Manor Research Limited	Yes	42461	42582	17273	34546	16546.48	Active	Closed	Large	PO15 7AF	South East	Solent

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Connected and Autonomous Vehicles: Simulation CR&D	Connected and Autonomous Vehicles Simulation: Collaborative R&D	OmniCAV	"OmniCAV will lay the foundations for the development of a comprehensive, robust and secure simulator, aimed at providing a certification tool for Connected Autonomous Vehicles (CAVs) that can be used by regulatory and accreditation bodies, insurers and manufacturers to accelerate the safe development of CAVs. It brings together a team of eleven internationally renowned organisations, with decades of accumulated knowledge in the area, in order to produce a single-point-of-call simulator to establish when a CAV can safely progress from a testbed to road trial. To achieve this, OmniCAV will use highly detailed road maps, together with a powerful combination of traffic management, accident and CCTV data, to create a high-fidelity dual (traffic and driving) simulation environment, including AI-trained road users to interact with the AV under test. Scenarios for testing will be developed and randomised in a holistic way to avoid CAVs training to specific conditions, whilst maximising coverage, and the integrity of the testing environment will be taken into consideration through creation of a root-of-trust design to secure the test inputs, simulator configuration and resulting test outputs. Critically, the simulator will offer market-leading coverage of a representative element of the UK road network, through encompassing rural roads, peri-urban and urban roads, to help enable autonomy for all. Representatives of the key end-users, including a local authority, an OEM and an insurance provider, will be engaged throughout to understand their needs. The validity of the synthetic test environment compared to the real-world is of particular importance, and OmniCAV will be tested and refined through an iterative approach involving real-world comparisons and working in conjunction with a CAV test-bed.	2018/19	Collaborative R&D	THATCHAM RESEARCH	No	43435	44165	0	25000	0	Active	Live	Medium	RG19 4NR	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles 2 - Stream 1 (Challenge Led Funding)	Connected and Autonomous Vehicles 2 - Stream 1 CRD	StreetWise	StreetWise aims to develop and demonstrate the technology, safety validation methods, insurance and service models for delivering an autonomous personal mobility solution targeted at replacing the urban commuter car. The project will show that the technology is now sufficiently mature to be safe in urban environments, sufficiently intelligent to co-exist with human drivers, road users and pedestrians and will demonstrate how we can use this technology to build compelling service offers to recover commuting time, reduce commuting costs, cut accident rates, reduce congestion and cut emissions. The StreetWise project will be delivered by a consortium led by FiveAI - a company specialising in perception and artificial intelligence in-vehicle technologies - working in collaboration with component technology providers (McLaren Applied Technologies, University of Oxford), transport sector related innovators (Arriva, TRL Limited & Transport for London) and the UK's largest automotive personal insurance provider (Direct Line Group).	2017/18	Collaborative R&D	TRL LIMITED	No	42979	43890	1081455	1081455	355615.86	Active	Live	RTO	RG40 3GA	South East	Thames Valley Berkshire

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Connected and Autonomous Vehicles 2 - Stream 1 (Challenge Led Funding)	Connected and Autonomous Vehicles 2 - Stream 1 CRD	DRIVEN: Insuring, Ensuring and Exporting Fleet Wide Level 4 Connected Autonomy	DRIVEN aims to remove fundamental barriers to real-world commercial deployment of autonomous vehicles, by addressing the need for real-time risk assessment frameworks to authorise engagement of Level 4 autonomous driving sessions and provide pro-active connected insurance. This integration of risk and dynamic authorisation into a L4 autonomous vehicle control system is transformative, underpinned by distributed data sharing, learning and connected real-time risk management to optimise overall autonomous fleet safety and operation. To realise these developments, Oxbotica, a market leader in the deployment of real-world autonomy solutions in the UK, will lead a consortium including Oxford Robotics Institute, XL Catlin, Nominet, Telefonica, Transport Research Laboratory, RACE, Oxfordshire County Council and Westbourne Communications. The ambitious trials programme culminates in 6 co-operative L4 CAVs performing mixed urban and motorway driving routes in a live-traffic environment between Oxford and London. DRIVEN demonstrates autonomy as a viable service, unlocking new service models that enable widespread autonomy for UK plc and accelerate market implementation in UK and globally.	2017/18	Collaborative R&D	TELEFONICA UK LIMITED T/A O2	No	42917	43830	181821	363641	74752.92	Active	Live	Large	SL1 4DX	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles 2 - Stream 1 (Challenge Led Funding)	Connected and Autonomous Vehicles 2 - Stream 1 CRD	DRIVEN: Insuring, Ensuring and Exporting Fleet Wide Level 4 Connected Autonomy	DRIVEN aims to remove fundamental barriers to real-world commercial deployment of autonomous vehicles, by addressing the need for real-time risk assessment frameworks to authorise engagement of Level 4 autonomous driving sessions and provide pro-active connected insurance. This integration of risk and dynamic authorisation into a L4 autonomous vehicle control system is transformative, underpinned by distributed data sharing, learning and connected real-time risk management to optimise overall autonomous fleet safety and operation. To realise these developments, Oxbotica, a market leader in the deployment of real-world autonomy solutions in the UK, will lead a consortium including Oxford Robotics Institute, XL Catlin, Nominet, Telefonica, Transport Research Laboratory, RACE, Oxfordshire County Council and Westbourne Communications. The ambitious trials programme culminates in 6 co-operative L4 CAVs performing mixed urban and motorway driving routes in a live-traffic environment between Oxford and London. DRIVEN demonstrates autonomy as a viable service, unlocking new service models that enable widespread autonomy for UK plc and accelerate market implementation in UK and globally.	2017/18	Collaborative R&D	TRL Ltd	No	42917	43830	426120	426120	309898.73	Active	Live	RTO	RG40 3GA	South East	Thames Valley Berkshire

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles Test Bed (Phase 2)	Connected and Autonomous Vehicles Test Bed 2	Smart Mobility Living Lab:	Our vision is to create a world leading test environment for the development of future mobility solutions in London. The Smart Mobility Living Lab based in the Royal Borough of Greenwich (RBG) and the Queen Elizabeth Olympic Park (QEOP). Businesses will be able to test their ideas, technology and services, examples include: • Testing autonomous and connected vehicles on real roads safely • Exploring the relationship and interaction between autonomous vehicles and people in complex and busy real world environments • Testing the use of driverless pods to carry people short distances (1-2 miles) from transport nodes, i.e. railway and underground stations to major venues or destinations • Exploring the use of large data sets to improve the flow of traffic and people • Exploring how much more can be achieved through a more integrated transport system that requires little interaction from the passenger • Exploring the benefits of new technology for logistics companies This is an exciting project and part of the UK Governments commitment for the UK to be at the forefront of this new and rapidly evolving market. Investment will give UK industry the opportunity to take the lead and reinforce its position as a leader in this field.	2017/18	Collaborative R&D	TRL LIMITED	Yes	43191	43921	4931234	7388176	516215.59	Active	Live	RTO	RG40 3GA	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles Test Bed (Phase 2)	Connected and Autonomous Vehicles Test Bed 2	UK Central CAV Testbed (Midlands Future Mobility)	Driven by the need to reduce traffic congestion and accidents on our roads, the development and deployment of CAVs (connected and autonomous vehicles) will provide significant societal benefits, as well as business opportunities for the the automotive, comunications, infrastructure and transport sectors in the UK. Demonstrating CAVs on road, in real-world driving situations, not only helps to establish confidence in the technology, but also provides invaluable learning that can be incorporated to achieve the ultimate aim of making them, and the additional services that they could provide, a commercially viable and desirable means of road-transport. A consortium comprising of Amey, AVL, Costain, Coventry University, HORIBA MIRA, TfWM (Transport for West Midlands), WIG (Wireless Infrastructure Group) and the University of Warwick will therefore deliver a full suite of urban environments, in Coventry and Birmingham, to test CAVs and their related technologies and services, in order to accelerate their deployment in the real-world, benefitting the region and UK companies. Furthermore the testing will be supported by extensive public engagement and a database of participants who will help support the more human elements of technology and service evaluation. To attract continued R&D investment into the region and the UK, the test infrastructure will be operational after the project conclusion and will be fully self-sustaining.	2017/18	Collaborative R&D	Costain Limited	No	43160	44165	1569166	3138332	601255.31	Active	Live	Large	SL6 4UB	South East	Thames Valley Berkshire
Connected & Autonomous Vehicles - London BIM	Connected & Autonomous Vehicles - London BIM	London BIM	A proof of concept focusing on System Centric Safety and potential benefits of BIM to support the adoption of CAV technologies in future mobility services. BIM models are currently used in major road infrastructure projects, but not for the urban road systems where future CAV based mobility services will operate. By merging the traditional BIM approach with data relevant to the CAV community such as road surface, line markings, street furniture, utilities to create the basis for a cost effective validation tool.	2017/18	Collaborative R&D	TRL LIMITED	Yes	43132	43404	500000	500000	487962.19	Active	Closed	Large	RG40 3GA	South East	Thames Valley Berkshire

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles 2 - Stream 1	Connected and Autonomous Vehicles 2 - Stream 1 CRD	HumanDrive	The project will build an autonomous vehicle with human like, natural control / path planning, by 2019, that 1) is able to be fully autonomous on country roads, when overtaking, on roundabouts and/ or motorways 2) mimics the driving behaviour of human beings, to provide an enhanced experiences for the occupants. Nissan and Hitachi will use their global automotive, artificial intelligence/ machine learning and communication technology expertise to build vehicles and AI models that are fit for purpose, and use the expertise of Horiba MIRA, Cranfield University and the University of Leeds to ensure the system is validated and end-user acceptance is evaluated. Atkins and SBD will address protective security, making the vehicle digitally and physically secure. The Transport Systems Catapult will be responsible for project management and development of safety aspects of the project. The impact of L4 vehicles on the Strategic Road Network will be explored through work by Highways England and TSS. Highways England and Milton Keynes Council will provide support to the demonstration route of the vehicle.	2016/17	Collaborative R&D	HITACHI EUROPE LIMITED	No	42917	43830	835207	1670414	157296.67	Active	Live	Large	SL6 8YA	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles 2 -Stream 2	CAV 2, Stream 2	5*StarS: Automotive Cyber Security through Assurance	The rapidly proliferating wireless connectivity & automation of road vehicles offers many benefits to society, and significant commercial opportunity, but also brings a potential explosion of Cyber Security threats. 5*StarS partners HORIBA MIRA, Ricardo, Roke, Thatcham Research with Axillium support will deliver an innovative assurance methodology to assure that CAV components, systems & vehicles have been designed & tested to the relevant cyber security standards throughout their whole development lifecycle, and a Euro NCAP 5 star type consumer rating framework for assessing the Cyber Security of new vehicles, clarifying risk for the insurance industry	2016/17	Collaborative R&D	THATCHAM RESEARCH	No	42917	43646	236659	394433	127961.73	Active	Live	Medium	RG19 4NR	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles 2 -Stream 4	CAV 2, Stream 4	MERGE Greenwich	The CC-CARS project will evaluate the operational and commercial realities of using SAE level 4 automated vehicles to deliver integrated ridesharing services in an urban environment. It builds upon ongoing work in the Innovate UK-funded GATEway project that is bringing connected and automated vehicle (CAV) technology to the streets of Greenwich. CC-CARS will explore how to enhance urban mobility, as well as reduce total vehicle journeys and thereby reduce emissions and pollution. The role of the consortium partners will be as follows: Addison Lee will explore using its booking, allocation and dispatch technology to pair ridesharing journeys and coordinate with the broader transport network. The project will also consider the user perspective, factoring safety, comfort, privacy, security and accessibility into the service. General Motors will provide guidance on suitable vehicle design and performance characteristics enabling Immense Simulations to simulate CC-CARS operations. Transport Systems Catapult will use passenger movement data to determine likely vehicle missions. The consortium will start by looking at vehicle movements in Greenwich, determining what journeys could be provided by automated vehicles to inform the deveopment of a CAV service business model.	2016/17	Collaborative R&D	TRL LIMITED	No	42917	43281	137923	137923	137923	Active	Closed	RTO	RG40 3GA	South East	Thames Valley Berkshire

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	UK Connected Intelligent Transport Environment (UK CITE)	The UK Connected and Intelligent Transport Environment (UK CITE) creates a real-world-lab for companies to test how connected and autonomous vehicles (CAV) can interact with communications infrastructure (so called V2X). The project will install the relevant infrastructure along sections of the M42, M40, A45, A46 and Coventry city centre. This test environment will be available to other vehicle manufacturers or fleet users who wish to test V2X technologies. It will act as a world class research asset to attract R&D to the UK. CAV test vehicles will examine the impact of V2X on road safety, traffic flow and the ability to provide other services like WiFi. Cyber-security will also be included from the outset. V2X will improve a vehicles journey through the road network. E.g. in case of an accident instead of an expensive gantry on the motorway a connected car could provide warnings and guidance to the driver, or an autonomous vehicle could respond automatically. The impact on the UK road network will be simulated based on these trials - enabling the UK to get the most benefits from CAV for the least infrastructure cost.	2015/16	Collaborative R&D	Huawei Technologies (UK) Co Ltd	No	42522	43465	38683	77366	32883.1	Active	Live	Large	RG2 6UF	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	UK Connected Intelligent Transport Environment (UK CITE)	The UK Connected and Intelligent Transport Environment (UK CITE) creates a real-world-lab for companies to test how connected and autonomous vehicles (CAV) can interact with communications infrastructure (so called V2X). The project will install the relevant infrastructure along sections of the M42, M40, A45, A46 and Coventry city centre. This test environment will be available to other vehicle manufacturers or fleet users who wish to test V2X technologies. It will act as a world class research asset to attract R&D to the UK. CAV test vehicles will examine the impact of V2X on road safety, traffic flow and the ability to provide other services like WiFi. Cyber-security will also be included from the outset. V2X will improve a vehicles journey through the road network. E.g. in case of an accident instead of an expensive gantry on the motorway a connected car could provide warnings and guidance to the driver, or an autonomous vehicle could respond automatically. The impact on the UK road network will be simulated based on these trials - enabling the UK to get the most benefits from CAV for the least infrastructure cost.	2015/16	Collaborative R&D	Vodafone Group Services Limited	No	42522	43465	125072	250144	81052.71	Active	Live	Large	RG14 2FN	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	MOVE-UK: accelerating automated driving by connected validation & big data analysis	The MOVE-UK project will help the UK to become a world leader in the development of automated and driverless cars. The project partners (Bosch, Jaguar Land Rover, TRL, Direct Line Group, The Floow and the Royal Borough of Greenwich) will speed up the entry of automated, driverless car technologies to the motor market. The project will allow these technologies to be developed and tested more rapidly and at lower cost to manufacturers. Driverless systems will be tested in the real world, providing large amounts of data that will be used to develop and improve the technology. These technologies will not control the test vehicles but will generated information which will be fed into a unique data store. This data store will allow us to develop new,faster ways of improving and demonstrating the safety of the automated driving systems. We will also use this information to provide “smart cities” with new ways to improve services for residents and the environment; to help us understand how detailed data from cars can be used in the future to benefit drivers; and, to help the project partners to understand the how driverless technologies will change their businesses in the future.	2015/16	Collaborative R&D	TRL ACADEMY	No	42583	43677	229523	229523	229522.89	Active	Live	RTO	RG40 3GA	South East	Thames Valley Berkshire

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	MOVE-UK: accelerating automated driving by connected validation & big data analysis	The MOVE-UK project will help the UK to become a world leader in the development of automated and driverless cars. The project partners (Bosch, Jaguar Land Rover, TRL, Direct Line Group, The Floow and theRoyal Borough of Greenwich) will speed up the entry of automated, driverless car technologies to the motor market. The project will allow these technologies to be developed and tested more rapidly and at lower cost tomanufacturers. Driverless systems will be tested in the real world, providing large amounts of data that will be used to develop and improve the technology. These technologies will not control the test vehicles but will generated information which will be fed into a unique data store. This data store will allow us to develop new,faster ways of improving and demonstrating the safety of the automated driving systems. We will also use this information to provide "smart cities" with new ways to improve services for residents and the environment; to help us understand how detailed data from cars can be used in the future to benefit drivers; and, to help the project partners to understand the how driverless technologies will change their businesses in the future.	2015/16	Collaborative R&D	TRL Ltd	No	42583	43677	0	0	209899.92	Withdrawn	Live	Large	RG40 3GA	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles - CRD	Connected & Autonomous Vehicles CR&D	MOVE-UK: accelerating automated driving by connected validation & big data analysis	The MOVE-UK project will help the UK to become a world leader in the development of automated and driverless cars. The project partners (Bosch, Jaguar Land Rover, TRL, Direct Line Group, The Floow and theRoyal Borough of Greenwich) will speed up the entry of automated, driverless car technologies to the motor market. The project will allow these technologies to be developed and tested more rapidly and at lower cost tomanufacturers. Driverless systems will be tested in the real world, providing large amounts of data that will be used to develop and improve the technology. These technologies will not control the test vehicles but will generated information which will be fed into a unique data store. This data store will allow us to develop new,faster ways of improving and demonstrating the safety of the automated driving systems. We will also use this information to provide "smart cities" with new ways to improve services for residents and the environment; to help us understand how detailed data from cars can be used in the future to benefit drivers; and, to help the project partners to understand the how driverless technologies will change their businesses in the future.	2015/16	Collaborative R&D	TRL Ltd	No	42583	43677	841634	841634	365593.11	Active	Live	RTO	RG40 3GA	South East	Thames Valley Berkshire
Connected and Autonomous Vehicles - Technical FS	Connected & Autonomous Vehicles FS	Atlas	The Atlas Project will study the feasibility of and requirements of the technologies and services required todeliver autonomous navigation 'anywhere' in a safe, reliable and resilient manner. Specifically, the project will study the navigation, mapping, data, communications and processing requirements; ,identifying the on-vehicle and infrastructure elements required to support autonomous navigation. The project also considers how data can be reused for the planning of urban environments more suited to autonomy. The consortium partners collaborating on this project are: Ordnance Survey (lead), Gobotix Ltd, Oxford Technical Solutions Ltd, Transport Research Laboratory, Sony Europe Ltd, Royal Borough of Greenwich and Satellite Applications Catapult.	2015/16	Feasibility Studies	TRL Ltd	No	42491	42947	43981	43981	37744.3	Active	Final Claim	RTO	RG40 3GA	South East	Thames Valley Berkshire

Not in TfSE region

Appendix D

INNOVATE UK FUNDED CLEANER TRANSPORT PROJECTS IN TFSE REGION

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Electric vehicle charging for public spaces: feasibility studies	Electric Vehicle Charging for Public Spaces: Feasibility Studies	Electric Vehicle Network Extender (EV-NetX)	"The EV-NETX project is seeking to address key barriers to the adoption of electric vehicles (EVs); the cost of infrastructure, the ease of use of that infrastructure, and the challenging business case for investing in that infrastructure. Our current business model for EV charging is based around a margin on the energy sold through the network. This requires a well utilised asset and a high turnover of vehicles. This is in direct conflict with the user experience, as users will often require the parking space for longer than the charging event duration. This tension prevents the investor from maximising the utilisation of their asset and other drivers from accessing the charger, both inhibiting take-up of EVs. A key advantage of EVs, is that through leveraging the established electricity grid, we can offer drivers the option to plug in every time they park their vehicles. This however, requires an oversupply of chargers, or a vehicle rotation policy. Some technology solutions have arisen around the deployment of mobile chargers linked to a battery. These however, come with the additional overheads required to move and operate the mobile charger. Our solution builds on the existing charger network to increase the number of access points, without requiring the installation of additional chargers and the associated cost, until energy demand warrants it. By providing end users multiple sockets from one charging post, linked to a smart network, we are able to both offer a significant reduction in the cost of the infrastructure, improve the user experience by removing the need to move a charged vehicle and improve the utilisation of existing assets."	2018/19	Feasibility Studies	Hodos Media LImited	No	43466	43555	13302	19003	0	Active	Live	Micro/Small	BN18 9DF	South East	Coast to Capital
Innovation in Vehicle-To-Grid (V2G) Systems: Real World Demonstrator	Innovation in Vehicle-To-Grid (V2G) Systems: Stream 3 Real-World Demonstrators	EV-elocity	This project and our consortium of partners will focus on the business models which will enable the sharing of the value V2G can bring to the grid, local and regional businesses and of course the consumer. Ultimately we are looking to define and test scaleable business models which will link our technology (existing and new) to a range of new service models. Our partners are ATKearney, Cenex, e-Carclub, Warick University,University of Nottingham, Honda, Slamjam, Nottingham City Council, Leeds City Council, Forward Utility. and a mix of local SME's. We will take an airport such as (Liverpool John Lennon Airport or Gatwick)as our primary demonstrator for 100 EV's connected and parked at the Airport and enable them through our technology to be used as an aggregated battery storage. The consumers of the vehicles will be able to monetise through the trading to the grid and our App will allow them full control of these parameters of trading. The output of the project is to help the current and future EV consumers monetise their investment while accelerating the take up of EV's in UK through this trading monetisation. Our V2G solution will be EV car maker agnostic and will inform the necessary scale from the 100 demonstrator to large scale deployment across the country and Internationally.	2017/18	Collaborative R&D	FORWARD UTILITY HOLDING COMPANY LIMITED	No	43221	44316	335696	559494	230530.9	Active	Live	Unknown	BN1 6NG	South East	Coast to Capital

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
IDP14: Accelerating the Transition to Zero Emission Vehicles (R&D)	IDP14: Accelerating the Transition to Zero Emission Vehicles (R&D)	Aluminium for Ultra Low Emission Vehicles (Al-ULEV)	Constellium has developed innovative and ground breaking high strength aluminium extrusion alloys for use in light weight crash resistant vehicle structures for integration of battery enclosures into ultra low emissions vehicles (ULEVs). The extrusions can form both the protective structures and can provide novel thermal management systems which can control battery operating temperatures to precise levels reducing the risk of thermal runaway and optimising battery pack operating temperatures during the urban cycle to reduce energy losses. This provides significant advantages in manufacturing costs/set up time whilst meeting current legislative requirements, providing the opportunity to define new standards of safety, crash management and energy efficiency. Both energy and power density of battery systems are increased by reducing battery enclosure weight by using an aluminium extrusion intensive architecture, combining innovative extrusion shape design and advanced manufacturing processes with the high strength aluminium extrusion alloys. The project aims to take another major step with disruptive high strength aluminium extrusion alloys and process technology, coupled with bespoke section design for the manufacture of vehicle integration structures and battery enclosures for a new generation of lightweight hybrid and electric vehicles for the UK market that will have a major impact on the UK government's carbon reduction targets for the UK vehicle fleet. The project will design, develop extruded components for prototype vehicle integration systems and for battery enclosures for Gordon Murray Design for an electric vehicle based on the aluminium intensive version of their i-Stream vehicle under development in the IUK CAAHS project. The second development in the project will be for vehicle integration and battery box enclosures, for the JLR I-Pace. The longer term intention is to establish a UK based manufacturing facility for world leading cost efficient aluminium extruded sections based on the intensive use of fully recyclable aluminium alloys in order to provide an on-shore resource for both extrusion and ULEV component manufacture.	2018/19	Collaborative R&D	Gordon Murray Design Limited	No	43344	44074	449181	748637	77230.26	Active	Live	Medium	GU4 8EP	South East	Enterprise M3
IDP14: Accelerating the Transition to Zero Emission Vehicles (R&D)	IDP14: Accelerating the Transition to Zero Emission Vehicles (R&D)	Paradigm_Shift - breakthrough Small Lightweight EV Platform	"Paradigm_SHIFT, a collaborative project between Gordon Murray Design (GMD), Delta and aiPod, will accelerate the transition to zero-emissions transport by developing a next-generation Zero-emission Vehicle Platform (ZVP). The project will combine GMD's iStream superlight(TM) technology (developed under IDP11) and Delta's advanced battery technology (""AMPLiFII"" through OLEV funding) and electric vehicle drivetrain (IDP10) to develop this ZVP. The platform will deliver dramatically lower mass (450kg), high levels of safety, lower energy, and drive-by-wire capabilities in a small footprint, making zero-emission transport options available more rapidly to the entire population. iStream superlight(TM) is stronger, lighter and dramatically lower cost than conventional vehicle manufacturing technologies, involving stamped steel. Less weight means less energy to power each transport mile. Delta's advanced EV drivetrain will then deliver this transport with zero-emissions. aiPod will take this platform to market with fleets of thousands of vehicles, manufactured in small, low capital cost, globally distributed plants, delivering cost-effective, integrated mobility-as-a-service (MaaS) to cities throughout the world."	2018/19	Collaborative R&D	Gordon Murray Design Limited	Yes	43282	43769	1524394	2540656	347759.3	Active	Live	Medium	GU4 8EP	South East	Enterprise M3
IDP14: Accelerating the Transition to Zero Emission Vehicles (FS)	IDP14: Accelerating the Transition to Zero Emission Vehicles (FS)	Automotive exhaust muffler incorprating heat recovery	This project aims to establish the feasibility of combining the silencing properties of an automotive muffler with a heat exchanger in order to the reduce weight, space and complexity that would arise from separate systems. The heat exchanger can be used to recover waste heat energy from the exhaust gases, which can be converted to electrical energy, and which would significantly improve the efficiency of hybrid vehicles.	2018/19	Feasibility Studies	AERO ACOUSTICS LTD	Yes	43252	43616	71000	101429	55344.01	Active	Live	Micro/Small	GU8 6BZ	South East	Enterprise M3

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Wireless electric vehicle charging for commercial users: feasibility studies	Wireless Electric Vehicle Charging for Commercial Users: Feasibility Studies	Cost-effective electric vehicle charging for public spaces by novel coreless wireless charger technology	"Shortage of public charging places is slowing down EV adoption. All owners of electric vehicles have to charge their EVs and current wired charging methods greatly limits the potential users of electric vehicles only to those who are living in private homes and have opportunity to install home charging equipment. Many people living in multi-story apartment buildings are discouraged to use EVs for the lack of available charging places close to their homes. Wireless charger providing automatic operation as soon as the car is parked, would greatly simplify EV use. There are a few wireless charging technologies attempting to address these issues, however majority of them are based on inductive power transfer principles developed more than a hundred years ago. Existing products have several shortcomings, two most obvious being _charger price and the necessity for extremely precise parking (coil alignment)_ . Current wireless charging systems run into thousands of pounds, thus making wireless charging a nice feature for the few luxury car owners, but seriously impeding the use of these systems for ordinary people. The innovation is the new coreless WPT technology developed by Lesla is up to 10 times cheaper compared to current wireless charging products. This has been achieved by using novel coil frequency and phase synchronization approach, which does not require use of very expensive high frequency rectifiers for each coil. Hence, this technology also ensures that the installation of the coils is much simpler, not involving replacing whole or part of road surface. The wireless charging coils can be inlaid in small 1"" trenches, which are covered straight away, thus minimizing traffic disruptions. By using Lesla technology whole parking areas can be electrified for the price of a single charger, which brings following benefits: the reduced charger costs per vehicle, thus making the technology more economically feasible; increased ease of operation: the vehicles do not have to be parked with extreme accuracy, also increased use of the space: the parking spots do not have to be reserved for electric cars only, as all spots in a car park can serve as charging spots. The project is aimed to evaluate the benefits of widespread wireless charging infrastructure and to develop business model for public wireless charging operators based on example of a	2018/19	Feasibility Studies	LESLA LIMITED	Yes	43466	43555	45650	65215	18443.28	Active	Live	Micro/Small	KT13 8RN	South East	Enterprise M3
Seeding Tomorrow's Vehicle Technologies Today - IDP12 (Challenge Led Funding)	Seeding tomorrow's vehicle technologies today - IDP12 CRD - ISCF	Additive Manufacturing of Automotive parts which are Lightweight and offer performanace Advantages over conventional Manufacturing (AMALGAM	The aim of the AMALGAM project is to develop and demonstrate a revolutionary approach to the design and manufacture of compound boosting systems, leading to improved engine efficiency and lower CO2 emissions.The new approach combines the latest hybrid laser cladding and 5-axis machining AM approach with parts produced by powder bed fusion AM and conventional manufacturing in a single “join as you make” operation. This will provide a cost effective, efficient and flexible method of producing high performance automotive parts, using the optimum combination of processes. The AMALGAM approach enables novel part design and material combinations to be used which will have a dramatic impact on performance. The new approach is not restricted to boosting systems but can be used in a wide range applications in motorsport, low volume and mainstream vehicles, as well as the wider high volume manufacturing sector.	2017/18	Collaborative R&D	MCLAREN AUTOMOTIVE LIMITED	No	43009	43555	0	41234	0	Active	Live	Large	GU21 4YH	South East	Enterprise M3

Competition Title	Programme Title	Project Title	Public Description	Competition Year	Innovate UK Product Type	Participant Name	Is Lead Participant	Project Start Date	Project End Date	Grant Offered (£)	Total Costs (£)	Actual Spend to Date (£)	Participant Withdrawn From Project	Project Status	Enterprise Size	Postcode	Address Region	Address LEP
Innovation in Vehicle-To-Grid (V2G) Systems: Real World Demonstrator	Innovation in Vehicle-To-Grid (V2G) Systems: Stream 3 Real-World Demonstrators	V2GO	V2GO (Vehicle-To-Grid Oxford) will develop, trial and evaluate potential business models, on- and off-vehicle hardware and products and services by engaging with UK fleet operators. Fleet vehicles account for 56% of new registrations and are quickly (i.e., ?3 years) turned over into the private market. A better understanding of fleet operators' attitudes and valuations of different V2G technologies, products and services could create additional pathways for increasing the uptake of Ultra Low Emission Vehicles (ULEVs). The energy storage capacity of electric vehicles (EVs), present new opportunities and value propositions for V2G power system services (e.g., potentially alleviate the need for generation and transmission investments; increasing network efficiency and energy security. Given the size and use patterns of fleets, they could generate economies of scale that will help realise V2G opportunities and maximise their values. V2GO brings together an interdisciplinary consortium of 8 partners from industry and research with expertise in energy and power markets and systems, fleet operation value chains and electric mobility. The project will address three objectives: 1\. To build confidence in and demonstrate the value of V2G to fleet operators; 2\. To engage with and understand ULEV owner's attitudes to V2G services and technologies; 3\. To demonstrate the technical and commercial potential for ULEVs through the power grid and vehicle-to-building to directly and indirectly support the electricity system. These objectives will be met through a real-world demonstrator trial (WP3), a portfolio of research (WP4; WP5), development of V2G business models, products and services (WP2, WP4) and exploitation and dissemination (WP6, WP7). The trial will run for 20 months and involve at least 100 EVs from different sized fleets including Royal Mail, UPS, DPD, DL, EDF Energy, Oxford County Council, University of Oxford and Addisson Lee. Two novel tools will be developed to facilitate the provision of V2G products and services and maximise their value: 1) a flexibility assessment toolkit, allowing fleet managers and V2G aggregators to work together to quantify the potential benefits of fleet electrification, and the added value of providing V2G products and services; and 2) a real-time coordination platform which will assess: a) based on the size and operation of an EV fleet the combination of V2G services that could maximize overall value (e.g., short term operating reserve, firm frequency response, enhanced reactive power services); and b) how fleet operation could potentially be modified to improve value, considering power system and mobility value chains.	2017/18	Collaborative R&D	THE VIRTUAL FORGE LIMITED	No	43252	44347	178637	255196	0	Active	Live	Small	GU24 8AF	South East	Enterprise M3
Low Emission Vehicles Systems (IDP13) Stream 1 (FS)	Low Emission Freight Demonstration	Dedicated To Gas	This project will trial 81 dedicated gas HGVs ranging from 7.5 tonne to 44 tonne which are new to the UK market. Four vehicle manufacturers will be trialled across ten different vehicle configurations, creating a wealth of valuable data on vehicle performance, fuel efficiency, reliability and cost. When using CNG/LNG, CO2e savings of up to 8% can be achieved, and biogas produced from waste will be introduced during the project, resulting in Well-To-Wheel CO2e savings of at least 70% compared to diesel. In addition five refrigeration units will use a prototype liquid nitrogen system, further reducing CO2e and air quality emissions. The vehicles will be trialled by five high profile transport operators across a range of different duty cycles, from urban to long haul. They will be supported by technical experts who will collate comprehensive data via telematics and portable emissions monitoring equipment, which will be fully analysed in order to quantify the potential benefits of dedicated gas technology compared to diesel. Two new state-of-the-art gas stations will be delivered as part of the project, in London and Birmingham, for which no funding is being sought, thus developing infra-structure that is needed to help reduce pollution from heavy transport, whilst keeping a	2016/17	Collaborative R&D	Emissions Analytics Limited	No	42826	43738	145021	207173	79178.69	Active	Live	Small	SO23 7QA	South East	Enterprise M3

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Low Emission Vehicles Systems (IDP13) Stream 1 (FS)	Low Emission Freight Demonstration	Reduced Emissions Logistics (Red-E-Log)	Reducing air pollutant (NOx and PM) and CO2 emissions on UK roads is increasing priority for UK government, retailers, HGV hauliers and the general public. HGVs account for 17% of all UK road transport emissions; but the opportunities to significantly reduce their emissions in the near future are limited. The Reduced Emissions Logistics (Red-E-Log) project offers an immediate solution in the use of liquid biomethane (LBM) burning engines for HGVs. By making use of biomethane (methane produced by bacteria feeding off waste streams) significant amounts of fossil fuel can be eliminated from UK roads. This means the total CO2 equivalent for LBM trucks is as much as 85% less when compared to a present day HGV running on diesel, making this a solution to reducing global CO2 emissions that we can implement today. Red-E-Log is a collaboration between Kuehne & Nagel (K&N), Microlise, Cenex and Emissions Analytics (EA) to deploy 29 of the latest generation (2017 and 2018) OEM warranted 44t duel fuel and Liquid Natural Gas articulated trucks. The project will deploy three state-of-art truck technologies that are not currently (October 2016) in use in the UK with a high-profile fleet, and promote the reintroduction of LBM into the UK market.	2016/17	Collaborative R&D	Emissions Analytics Limited	No	42826	43738	101439	144913	53377.84	Active	Live	Small	SO23 7QA	South East	Enterprise M3
Low Emission Vehicles Systems (IDP13) Stream 1 (FS)	Low Emission Freight Demonstration	TRIUMPH (Temperature-controlled Range-extenders & Integrated Urban Mapping of Pollution) Hotspots	TRIUMPH is a demonstration and study of zero emission capable trucks and refrigeration units in urban environments. Refrigerated urban delivery is a key component of the modern food distribution network and temperature controlled transport is highly polluting in urban environments. Zero emission technologies provide a solution to urban air quality and can also reduce CO2 emissions. A limited evidence base exists to support the uptake of new innovative technologies in a commercial vehicle environment. This project will investigate three solutions to zero emission delivery in urban environments. 1) Fully electric vehicles (supplied by Magtec); 2) Range extended electric vehicles (supplied by Tevva). 3) Liquid nitrogen engine refrigeration units (supplied by Dearman). A detailed study of all three options will be undertaken. The project will also: develop real time environmental sensing, provided by EarthSense, which will inform the control strategy of range extended electric vehicles to provide zero emissions operation in areas of the poorest air quality; develop fleet telemetry systems for the trial vehicles; develop fleet advice software to inform roll out in the wider fleet community; and compare the emission, cost and technical performance to Euro VI diesel vehicles.	2016/17	Collaborative R&D	Emissions Analytics Limited	No	42826	43646	94842	135488	45075.13	Active	Live	Small	SO23 7QA	South East	Enterprise M3

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Seeding tomorrow's vehicle technologies today -IDP12	IDP12 - CRD	Advanced Lithium Ion Capacitors and Electrodes (ALICE)	The Advanced Lithium Ion Capacitors and Electrodes (ALICE) project will develop lithium ion capacitors (LICs) and validate these in a 48V module for use in three market sectors - automotive, e-bus and materials handling equipment. LICs combine the benefits of lithium ior and supercapacitor electrode materials and structures, providing enhancing energy density vs supercapacitors and better power density than batteries. Advanced materials will be developed and scaled (Johnson Matthey) and novel coating techniques (Oxford) used to provide electrode structures optimsed for high rate capability. Roll to roll coating and A5 pouch cell manufacture (Warwick Manufacturing Group) will be followed by 48V module build and testing (Johnson Matthey Battery Systems (JMBS)) based on end user defined requirements (Nacco Materials Handling, BAE systems, JMBS and Delta Motorsport) and accelerated test protocols. Development of a physics based cell model (Imperial) will interlink with sophisticated layer structure characterisation (tomography, TEM) & cell performance results, evolving a rational design approach for specific end use scenarios.	2015/16	Collaborative R&D	Hyster-Yale-Ltd	No	42614	43708	1491	2981	1490.34	Withdrawn	Live	Large	GU16 7SG	South East	Enterprise M3
Low Emission Vehicles Systems (IDP13) Stream 1 (FS)	Low Emission Freight Demonstration	Kinetic energy recovery for urban logistics applications (KERS-URBAN)	This collaborative project aims to evaluate the energy and emissions benefits of a kinetic energy recovery system (KERS) supplied by Alternatech for urban delivery vehicles, including both articulated and rigid vehicles. The partners include Howdens, Sainsbury's, Alternatech and Imperial College London. During the trial period, Howdens and Sainsbury's will introduce 10 vehicles modified by Alternatech into their fleet alongside conventional vehicles. Vehicle telematics data will be collected by Imperial College to quantify the reduction in fuel consumption, CO2 emissions. Emissions testing and advanced vehicle emissions modelling will enable the team to evaluate the benefit of this technology to urban air quality. Furthermore, as the KERS technology reduces the load on the diesel engine, noise measurements will be used to evaluate the potential benefits to residents. This project will also evaluate the opportunity to optimise delivery routes and schedules to best-match the performance characteristics of the KERS system to give the greatest emissions and fuel consumption reductions.	2016/17	Collaborative R&D	ALTERNATECH LIMITED	No	42826	43646	900350	1286214	810315	Active	Live	Micro	SO18 1AQ	South East	Solent
Seeding Tomorrow's Vehicle Technologies Today - IDP12 (Challenge Led Funding)	Seeding tomorrow's vehicle technologies today - IDP12 CRD - ISCF	Flywheels for Fast Charging Multiple Electric Vehicles	The aim of this project is to demonstrate a Flywheel Energy Storage System (FESS) to support Electric Vehicle EV charging stations. The objectives are to design and build an innovative multiple vehicle FESS based fast charging station at an appropriate power and energy rating together with a innovative power electronic converter for efficient interface to the vehicles over a wide power range. Two applications will be demonstrated by initially increasing the capacity of a vehicle charging system, and the offer multiple vehicle fast charging capabilities at motorway service stations and also to demonstrate a "£/kWh" approach in offering Energy Storage services.	2017/18	Collaborative R&D	SDnC Limited	Yes						Active	Withdrawn	Micro	GU2 7YG	South East	Enterprise M3

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IDP14: Accelerating the Transition to Zero Emission Vehicles (FS)	IDP14: Accelerating the Transition to Zero Emission Vehicles (FS)	Up-Featured Trailers for Future Logistics	"Heavy Goods Vehicles (HGVs) account for around 17% of UK GHG emission from road transport and 21% of NOx emissions, while making up just 5% of vehicle miles and 2% of vehicles. Tackling HGV emissions is challenging because they consume large quantities of energy, are used for business-critical logistics functions by a risk averse customer base and are typically sold in much smaller volumes than passenger cars making it harder to recover expensive R&D investments in alternative powertrains. To decarbonise an integrated approach is required incorporating new energy vectors, light-weighting and mileage reduction via increased connectivity, load consolidation between operators and incentives for customer behavioural change. Trailer technologies must evolve to accommodate this and increase the value that they add to logistics systems. Currently, trailers have limited features focused around load carrying, loading/unloading operations and sometimes temperature maintenance. Advanced features are usually reserved for tractor units because of different product pricing and vendor capabilities between truck and trailer sectors. Emerging technologies around energy storage, connectivity and light-weighting could allow trailers to contribute to cost and emission reduction goals in a variety of ways. E.g. by enabling range extension through an energy store capable of exporting power to the tractor units or by exploiting connectivity and interoperability for real time route optimisation and consolidation operations. The project's overall aim is to develop a concept that optimally utilises these technologies to maximise their impact. First we will capture the voice of the customer then deliver and assess the feasibility of an advanced trailer design with a leading body builder using an optimum mix of energy storage, light-weighting and connectivity technologies. The design will have benefitted from testing in a virtual test environment developed to mimic end user duty cycles. Finally, an exploitation and financing plan will be developed detailing how the design can be demonstrated in a representative environment and then industrialised through most appropriate business models. Flexible Power Systems (FPS) are an SME energy company who work with customers to optimise their energy usage across transport and stationary systems via technology deployment and asset management. Lawrence David (LD) are one of the UK's largest trailer builders with decades of commitment to innovation. Heriot Watt University (HWU) are one of the UK's leading research institutions with academics who specialise in logistics and co-lead the Centre for Sustainable Road Freight (SRF). [][0]	2018/19	Feasibility Studies	FLEXIBLE POWER SYSTEMS LTD	Yes	43282	43830	92068	131526	34857.11	Active	Live	Micro/Small	TN8 7DP	South East	South East

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IDP14: Accelerating the Transition to Zero Emission Vehicles (FS)	IDP14: Accelerating the Transition to Zero Emission Vehicles (FS)	Gas Flow/Market Analysis	"Litus Industrial Ltd is developing uncooled ICE-electric powertrains for HGVs. Uncooled engines would cut the energy use/operating costs/CO2 emissions of ICEs by ~30%, more as prime movers for generators in HGVs. They would be many times lighter and smaller, nearly silent, more reliable as there are no cooling/oil systems to fail and cost about the same to manufacture as current cooled engines. They overcome the barriers to widespread uptake of E-HGVs/fuel cell trucks (range anxiety/unit costs/reduced payloads/lack of refuelling/recharging infrastructure) and represent the most effective way of accelerating the transition to zero-emissions HGVs. Once sustainable hydrogen production/infrastructure is available, zero-emission uncooled hydrogen-electric powertrains will enter the market with a fifth the cost of fuel cells, greater durability, similar efficiency and significantly reduced weight. Pistons/cylinders of structural ceramic with service temperatures \>1500°C eliminate the 30% of fuel energy typically wasted to cooling/radiation and are inside thermally- and acoustically-insulating casings. Engines will run at much greater temperatures/pressures than todays', at constant load/speed (the most efficient mode). With no plumbing for a piston-cylinder oil system/liquid cooling, engines can be snap-in cartridges, swapped in minutes. Vehicles and equipment would no longer need to be towed to a repair facility, a real game-changer. Oil would immediately boil away so the only practical way to separate piston and cylinder is by a gas bearing, an established technology in other applications. This is possible due to elimination of piston side thrusts through Litus' innovative twin-contra-rotating crankshaft configuration. Uncooled engines cannot work without gas bearings. Litus' inlet/exhaust port configuration eliminates the valvetrain allowing speeds of 12,000rpm. They are key to cost-effective solutions for the HGV which account for over 20% of UK road transport GHG emissions The technology is also scalable to rail/ships/cars; construction/agricultural/mining machinery; compressors/pumps/gen-sets. Piston/cylinder gas bearings can be used in cooled engines, provided some adjustment of engine layout is made. Uncooled engines will enable fleet operators/OEMs to meet increasingly strict ULEZ/statutory emissions requirements. New supply chains for volume production of ceramic parts and other engine components will be created. So far, ten companies have stated an interest in forming partnerships. Highly efficient uncooled engines are ideal for micro-grid electricity supply and augmenting renewables when there is no sun/wind making them an ideal solution for developing countries as they do not require new power distribution infrastructure. This proposal is to carry out a gas flow analysis and market assessment to demonstrate technical/market viability."	2018/19	Feasibility Studies	OFTTECH LIMITED	No	43344	43677	8750	12500	0	Active	Live	Micro/Small	BN26 6EA	South East	South East
Wireless electric vehicle charging for commercial users: feasibility studies	Wireless Electric Vehicle Charging for Commercial Users: Feasibility Studies	Wireless EV "Charge on the Go"	"**The UK government has banned the sale of internal combustion engine (ICE) vehicles from 2040, and is targeting up to 40% of new van sales to be zero emission by 2030, yet with 4M vans on UK roads, and total van mileage increasing due to internet shopping, currently only 0.3% of new van sales are electric.** With cities and towns also looking to address air quality through the introduction of low, zero emission and clean air zones and stricter emission standards (WLTP), **commercial fleets are under pressure to introduce low emission vehicles, such as electric vehicles (EVs), to minimise the impact on their business**. **However many commercial fleet operators remain wedded to diesel or are hesitant to adopt EVs at scale**, as a result of conflicting government, industry and media reports, waiting for price reductions, and range, residual value and public charging infrastructure improvements. **The purpose of this feasibility study and subsequent phase 2 demonstrator is to showcase an innovative and viable, wireless EV charging solution, the UEtwo, with real word benefits for commercial fleets**. By minimising the business disruption EVs can pose, we aim to give commercial fleet managers the confidence to accelerate the move to EVs than would	2018/19	Feasibility Studies	HEVO POWER EUROPE LTD	No	43466	43555	18103	25862	0	Active	Live	Micro	TN25 6SX	South East	South East

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Wireless electric vehicle charging for commercial users: feasibility studies	Wireless Electric Vehicle Charging for Commercial Users: Feasibility Studies	Wireless Charging in Micro-Fulfilment Centres for Last Mile Delivery	"Light Goods Vehicles (LGVs) account for 15% of UK GHG emissions from road transport and 33% of NOx emissions, while making up just 10% of vehicles. In commercial fleets LGVs are heavily utilised to meet businesses' and household consumers' demands for increasing service quality and extended delivery windows, and LGVs often operate at high load factors for maximum productivity. Several electric vehicle (EV) options have been brought to market by OEMs in this segment but uptake remains low because of limited range and overall higher total costs of ownership. Focusing on home delivery operations within the retail and parcel delivery sectors, the project will explore i) the benefits of wireless charging for van fleets; ii) a novel micro-fulfilment logistics model that is more compatible with EVs and evolving market needs and iii) the benefits of combining micro-fulfilment and wireless charging infrastructure to create revenue opportunities from infrastructure sharing. The wireless charging benefits to be quantified during the project include: i) increased compatibility between vehicles and chargers (no need for multiple connector types on the vehicle or charger side, simple handling for future autonomous vehicles); ii) vehicle charging while handling payload and manoeuvring to maximise utilisation and increase flexibility; iii) reduced space and vehicle parking constraints and maintenance costs; iv) increased flexibility and convenience to click and collect customers who own EVs. The feasibility study will analyse vehicle movement data from up to 4 users to assess the share of activity that could already be met with available EVs and quantify the productivity and range benefits of replacing plug-in chargers with wireless chargers. We will then evaluate charger placement -- both in existing user facilities such as depots and stores as well as in newly developed micro-fulfilment centres (MFCs) -- to simultaneously maximise EV penetration, financial and environmental benefits. MFCs are small-footprint consolidation centres located close to consumers to maximise freight efficiency and collaboration and reduce LGV distance travelled. Revenue and business models for infrastructure installation, utilisation and ownership will be proposed and tested with customers, and a follow-on real-world demonstration plan will be developed. Flexible Power Systems (FPS) are an SME energy company who work with customers to optimise their energy usage across transport and stationary systems via technology deployment and asset management. Heriot-Watt University (HWU) are one of the UK's leading research institutions with academics who specialise in	2018/19	Feasibility Studies	FLEXIBLE POWER SYSTEMS LTD	Yes	43466	43555	38926	55609	0	Active	Live	Micro/Small	TN8 7DP	South East	South East

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Innovation in Vehicle-To-Grid (V2G) Systems: Feasibility Studies	Innovation in Vehicle-to-Grid (V2G) Systems: Stream 1 Feasibility Studies	Integrated Energy Systems for Commercial Vehicles	"The commercial vehicle (CV) sector including HGVs, Light Vans, Buses and Coaches accounts for 34% of UK transport related CO2 emissions, globally HGVs contribute 7% emissions. They also impact air quality with about 39% of NOx and about 19% of PM2.5 emissions from transport coming from the sector, despite commercial vehicles accounting for less than 13% of the vehicles on the road. Electrification is one route to reduce the impact of this sector on the environment alongside route and roadmile optimisation, efficient driving programmes and retrofitting. CVs are a target for V2G because they: (i) congregate in large numbers at depots, (ii) schedule duty cycles in advance, (iii) have battery packs larger than those required for passenger vehicles and (iv) are owned by businesses who would be able to price battery life/energy revenue trade-offs if packaged appropriately. Whilst some projects have explored the feasibility of V2G for passenger vehicles, work in the CV space has been more limited because operators are risk averse and fleets are currently relatively small. Electrifying CVs is challenging; the distances they cover and vehicle mass are larger than those seen in the passenger car segment. Also because they congregate in large numbers, electrification can be curtailed by access to network infrastructure and their impacts on energy systems are complex. This project combines insights into CVs, logistics, technology development and energy markets with customer engagement to explore the role that electrification and V2G technology can play in tackling emissions from this sector. By pursuing a full stack of energy storage services, integrated with the site and network energy system and leveraging other CV operational efficiencies, we aim to deliver a business model for electrification to operators by matching vehicles and services to their needs. The key output of the project will be a deep understanding of customer perspectives and technology challenges alongside a set of viable business models (tested with all stakeholders) that can be replicated in the UK and abroad. A next step would be to demonstrate these models on some reference customer sites before wider roll out. There is also an opportunity to combine this exploration of the benefits of V2G in this sector with a more holistic piece of work seeking to reduce emissions from the sector being undertaken separately by Heriot Watt as part of its work with the Centre for Sustainable Road Freight (SRF) to develop CV sector specific business models."	2017/18	Feasibility Studies	FLEXIBLE POWER SYSTEMS LTD	Yes	43191	43555	73687	105266	73687	Active	Live	Micro/Small	TN8 7DP	South East	South East
Wireless electric vehicle charging for commercial users: feasibility studies	Wireless Electric Vehicle Charging for Commercial Users: Feasibility Studies	Wireless Charging for Electric Taxis - WiCET	"The purpose of the WiCET project is to investigate the commercial and technical viability of wireless charging for full electric and plug-in hybrid vehicles, with particular focus on taxis (Hackney Carriages) and private hire fleets. Given the typical duty cycles of taxis and the required recharging times during a shift, or for vehicles that are double-shifted, wireless charging for opportunity charging is considered to be an enabling technology in moving towards electrified taxi operations. Indeed, installation of wireless chargers at taxi ranks for frequent charging boosts, known as Choko-Choko charging in Japan, offers the opportunity for minimising recharging times and limiting the capacity of on-board batteries. This reduces 'range-anxiety' and helps control vehicle price. These are current barriers to increasing use of EVs. This study will explore the potential to install wireless chargers in taxi ranks and examine the technical, commercial and operational implications. Secondary use-cases will also be explored including the use of wireless charging for emergency vehicles when they are on duty waiting for a call out. This feasibility study brings together all aspects of the wireless charging value chain and will clarify the route to market for both a retrofit and ""factory option"" product. It will prepare the ground for a world leading large-scale commercial demonstrator of EV wireless charging technology in London and Nottingham delivering significant inward investment from IHI (Japan) and ParkingEnergy (Finland) in the UK. The final report will be published and Cenex will also organise a workshop using the successful OLEV Go Ultra Low Nottingham supported LEVEL (Low Emission Vehicle Enterprise and	2018/19	Feasibility Studies	PARKING ENERGY LTD	No	43466	43555	17473	24962	0	Active	Live	Micro	RG1 1NU	South East	Thames Valley Berkshire

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Electric vehicle charging for public spaces: feasibility studies	Electric Vehicle Charging for Public Spaces: Feasibility Studies	Charging Hub Buffer Battery Feasibility Study - CHUBBY	"This study, 'Charging Hub Buffer Battery Feasibility Study' (CHuBBy), will identify opportunities for medium to large scale public charging hubs, focusing on currently available and upcoming technologies for both Direct DC and conventional DC charging in combination with scalable on-site buffer battery solution. The study will explore and deliver a technical framework design for public charge hubs based DC charging combined with local energy storage. it will compare and evaluate suitable technologies and their impact on EV drivers, other road users and impact on communities and transport. Key outcomes are a technical solution for neighbourhood EV charge hubs and a commercial deployment model for councils and charge point operators.. The project aims to identify technical specifications, planning and infrastructure requirements and viable business cases for large scale public charging hub solutions based on direct DC-DC conversion technology, modular local energy storage and close integration with supply-side energy market operations. We will also determine social, operational and economic benefits of advanced charging hubs in neighbourhood and commercial centre deployments. The work will advance the high-tech sector in the UK, create employment opportunities and attract inward investment into the UK. The outcomes of this study will pave way to a demonstration for using massively scalable DC charging in a practical charging hub settings. Such a study will also endorse the UK as an international leader in demonstrating the potential of new and emerging technologies in the field of clean mobility, meeting the aspiration set out in the Government's Road to Zero Strategy. - The final report will be published and Cenex will also organise a workshop using the successful OLEV supported LEVEL (Low Emission Vehicle Enterprise and Learning) programme to	2018/19	Feasibility Studies	PARKING ENERGY LTD	Yes	43466	43555	39780	56828	0	Active	Live	Micro/Small	RG1 1NU	South East	Thames Valley Berkshire
Low Emission Vehicles Systems (IDP13) Freight Demo Stream 2	Low Emission Freight Demonstration - Pipeline	Aerodynamic Configurator for Transport (ACT): reducing haulage sector drags, costs and emissions	The ACT project will develop a web based application for performing virtual aerodynamic simulations of HGVs. We usually conduct these studies on Formula One racing cars to help designers make them go faster; instead of making lorries faster, we are interested in reducing the amount of fuel they use and reducing their emissions so they do less harm to the environment. Using technology known as Computational Fluid Dynamics (CFD), the app will calculate how well a lorry cuts through air as it is driven along. Usually, to use CFD you need expensive computers and software. You also need skilled engineers with specialist knowledge to use them. Our app will be jargon free and work in a web browser so the maximum number of people possible can use it. To find how aerodynamic a lorry is, users simply pick from the range of different cabs, trailers, and modifications then click 'Simulate', sit back and wait for the computer to work out how efficient that combination is. Giving haulage companies the ability to try out different configurations of HVG quickly and easily will help them to pick the most efficient cabs and trailers to use, dramatically reducing the cost of shipping and reducing greenhouse emissions, making the environment healthier for everyone.	2016/17	Collaborative R&D	DYNAMON LTD	No	42826	43190	60049	85784	59988.2	Active	Closed	Micro	SO16 7NP	South East	Solent

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Low Emission Vehicles Systems (IDP13) Freight Demo Stream 2	Low Emission Freight Demonstration - Pipeline	Greenwave: Transforming Driving Behaviour for a more Efficient and Environmentally Friendly Fleet	Greenwave is a ground breaking smartphone application which uses traffic signal data derived from Birmingham City Council's Intelligent Transport System (ITS) to transform fleet driver behaviour through encouraging them through gamification to drive in a more efficient manner, approaching traffic signals at an optimum speed to 'ride the Greenwave'. Drivers will be awarded with a green score each time they drive, based on both their driving style and how they approach traffic signals. Points will accumulate over the month with a monthly league board rewarding the driver with the highest score, thus gamifying driving behaviour and encouraging more efficient driving styles. The solution, developed by Checkedsafe and CloudAmber, will be deployed as a trial on 12 Masternaut equipped vehicles in Amey's Birmingham Highways utility contract over a 6 month period to monitor the impact on MPG and vehicle emissions with the aim being to deliver a 10% reduction in monthly fuel costs and CO2 emissions. There is no known solution of this type in existence which uses data feeds from existing infrastructure to provide drivers with live updates enabling them to change their driving style.	2016/17	Collaborative R&D	IDOX SOFTWARE LTD	Yes	42826	43281	205881	411761	205881	Active	Closed	Large	RG7 4SA	South East	Thames Valley Berkshire

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Innovation in Vehicle-To-Grid (V2G) Systems: Real World Demonstrator	Innovation in Vehicle-To-Grid (V2G) Systems: Stream 3 Real-World Demonstrators	Bus2Grid	Delivered by a compact partnership of UK energy industry leaders and a global leader in e-bus manufacturing combined with academic strength in business modelling, Bus2Grid will deliver the UK's first e-bus to grid multi-megawatt demonstration at commercial scale. Delivered in London, where TfL (project advisor) is leading the way for clean urban transport with a programme of electrification of 300 buses by 2020, Bus2Grid aims to provide the innovation required to accommodate this demand within the distribution network providing a clear route to market and launch pad for V2G services in the e-bus space. Partners: * BYD: Global leader in e-bus manufacturing: * UKPN: UK's leading innovative DNO; * SSE: UK's second largest electricity generator; * Leeds University: One of the UKs largest research intensive universities with expertise across energy systems, cities and transport systems. Key objectives to deliver: * 11 retrofit and 22 new build V2G enabled e-buses and 2.64 MW of bi-directional charging infrastructure in an identified London bus depot (Northumberland Park), with over 1-2 MW of V2G response; * An aggregation platform integrated with the depot's Charging Management System with interfaces to offer services to National Grid and UKPN (DNO); * A test site with three V2G enabled e-buses and charging points to validate the technical solution (based in BYD Service Centre West London); * A clear V2G mass roll-out strategy within the e-bus market; * Demonstrate the value of V2G services to National Grid, DNOs and bus operators; * Create new business models and market frameworks that allow capture of the identified value streams; * Understand bus operators attitudes to V2G technologies at different project stages and to new business models, and create a tailored V2G services proposition; * Disseminate key findings and recommendations for stakeholders critical to the development of V2G markets. Key Innovations:	2017/18	Collaborative R&D	SSE SERVICES PLC	Yes	43282	44377	508543	1695142	0	Active	Live	Large	RG1 3JH	South East	Thames Valley Berkshire
Innovation in Vehicle-To-Grid (V2G) Systems: Real World Demonstrator	Innovation in Vehicle-To-Grid (V2G) Systems: Stream 3 Real-World Demonstrators	EV-elocity	This project and our consortium of partners will focus on the business models which will enable the sharing of the value V2G can bring to the grid, local and regional businesses and of course the consumer. Ultimately we are looking to define and test scaleable business models which will link our technology (existing and new) to a range of new service models. Our partners are ATKearney, Cenex, e-Carclub, Warick University,University of Nottingham, Honda, Slamjam, Nottingham City Council, Leeds City Council, Forward Utility. and a mix of local SME's. We will take an airport such as (Liverpool John Lennon Airport or Gatwick)as our primary demonstrator for 100 EV's connected and parked at the Airport and enable them through our technology to be used as an aggregated battery storage. The consumers of the vehicles will be able to monetise through the trading to the grid and our App will allow them full control of these parameters of trading. The output of the project is to help the current and future EV consumers monetise their investment while accelerating the take up of EV's in UK through this trading monetisation. Our V2G solution will be EV car maker agnostic and will inform the necessary scale from the 100 demonstrator to large scale deployment across the country and Internationally.	2017/18	Collaborative R&D	HONDA MOTOR EUROPE LIMITED	No	43221	44316	397422	794844	11449.5	Active	Live	Large	RG12 1HL	South East	Thames Valley Berkshire

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IDP 13 Low Emission Vehicles Systems Stream 2 (CR&D)	Integrated Delivery Programme 13 (CR&D) - 36 Months	Combining brake & propulsion systems into "Integrated Torque Actuators Modules" (ITAMs)	Energy capture through re-gen braking reduces the duty on a conventional friction brake system. However the ultimate energy storage capacity, weight & residual drag of the friction brake systems have remained unchanged. This is because emergency duty cycles (e.g. ABS) require independent control of the tyre contact patch. A single electric machine (EM) per axle mechanically couples both wheels and cannot offer the level of control required. Consequently significant friction brake downsizing or integration has not been realised to date. That said, multiple independent EMs (1 per corner) do offer the opportunity for integration with the friction brake. This consortium aims to integrate the brake and propulsion systems together into "Integrated Torque Actuator Modules" (ITAMs). It is anticipated these modules would be smaller, lighter and lower cost, yet realise significant vehicle attribute enhancements. The consortium will design, develop and prototype the ITAMs and establish whether they are capable of; 1. All duty cycles including ABS and dynamic stability control (DSC), 2. Zero residual drag torque, 3. Brake emissions capture and storage. 4. zero servicing.	2016/17	Collaborative R&D	Xtrac Limited	No						Active	Withdrawn	Large	RG19 4ZA	South East	Thames Valley Berkshire
Innovation in Vehicle-To-Grid (V2G) Systems: Feasibility Studies	Innovation in Vehicle-to-Grid (V2G) Systems: Stream 1 Feasibility Studies	HAVEN - Home as a Virtual Energy Network	"EV batteries can provide significant flexibility to the grid and hence value to the consumer, but this must be considered in the context of consumers' wider lifestyle and systems. HAVEN will examine the value that V2G and V2H (vehicle-to-home) enabled EVs can provide to consumers within the context of other energy storage systems (e.g. LI-Ion batteries attached to solar PV arrays; thermal storage via hot water tanks) in the home. HAVEN will address questions such as: * The value that V2G-enabled EVs can create by providing flexibility services to the system operator, distribution networks and energy suppliers. * How this value varies when EV batteries are combined with other home energy storage systems. * How value varies across different energy consumption and generation patterns, different driving and commute patterns, etc. * How value varies with different use cases for sharing energy between home energy systems. It will do this by creating robust models of a variety of home energy storage configurations, and using these to determine the value each configuration can create when providing services to the energy system. HAVEN will then test the models against the unique facility of the Salford Energy House (a Victorian terraced house in a climate-controlled chamber), ensuring that they robustly capture the dynamics of different use cases across a range of weather and other factors. This will ensure that the models and resulting consumer propositions accurately reflect the value that can be captured by consumers and the energy system in real world conditions. This will create a unique set of models demonstrating the value V2G-enabled EVs can create for consumers within the wider context of their homes and lifestyles. It will provide unique insight into potential customer propositions and business models for V2G, and also into the algorithms that must be developed to capture and exploit this value within Upside Energy's cloud service that orchestrates distributed energy storage resources and delivers their flexibility to the grid."	2017/18	Feasibility Studies	HONDA MOTOR EUROPE LIMITED	No	43282	43646	8910	17820	5502	Active	Live	Large	RG12 1HL	South East	Thames Valley Berkshire

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Seeding tomorrow's vehicle technologies today -IDP12	IDP12 - CRD	High power density SOFC stack module for light commercial electric vehicle range extender	This collaborative industrial R&D project with Nissan UK, Ceres Power and M-Solv aims to demostrate a compact, high power density, low emission SOFC battery charger for range extension of light commercial electrical vehicles (LCEV) such as the Nissan eNV200. This will involve the design, build, test and demonstration of a compact, robust, fast-response SOFC power module. This project aims to advance the key enabling technologies for a low emission SOFC/EV range extender system suitable for operation with a variety of high efficiency fuel types (including biofuels) applicable to the automotive sector. Success could lead to an APC bid, which would look to raise the market attractiveness of EV by enabling LCEVs to operate for long periods without the restrictions of electrical recharge from the grid. This highly disruptive approach supports the UK's move towards greater use of electric vehicles, supports Nissan UKs leading position in commercial EV development, opens up the 1.4 million annual EU sales of light commercial vehicles and makes significant progress towards the UKs 2030-50 low carbon energy targets.	2015/16	Collaborative R&D	Ceres Power Limited	Yes	42552	43373	573224	955373	487240.4	Active	Final Claim	Medium	RH13 5PX	South East	Coast to Capital
Low Emission Vehicles Systems (IDP13) Stream 1 (FS)	Low Emission Freight Demonstration	HYLIGHT – HYbrid LIquefied petroleum Gas tanker witH magspliT	Magnomatics' innovative and proprietary magnetic CVT MAGSPLIT integrates a magnetic planetary gear and a highly efficient control motor/generator to enable the realisation of more efficient and compact Plug-in Hybrid Electric Vehicle powertrains. A Commercial Vehicle Intent MAGSPLIT component has previously demonstrated high efficiency and robustness in a compact package, showing the potential to reduce CO2 emissions by 1m tonnes p.a. by 2025. For this project, two 18t DAF LF PHEV demonstrator trucks will be delivered by the UK based consortium and operated in a 1 year trial by Calor, with oversight by DAF LF manufacturer Leyland Trucks. Magnomatics will design, build and test the MAGSPLIT device and electrical traction subsystem; Hewland Engineering, a UK transmission manufacturer, will design and manufacture the MAGSPLIT transmissions and AVID Technology will convert, commission and deliver the vehicles, including proprietary electrified ancillaries to enable zero emission capability. The trial will verify the technology, business case and emissions benefits to the consortium, who represent UK based end user, OEM and Tier 1 suppliers, capable of delivering this high value, innovative powertrain to market from a UK manufacturing base.	2016/17	Collaborative R&D	HEWLAND ENGINEERING LIMITED	No	42826	43465	189673	316121	127983.7	Active	Live	Medium	SL6 3LR	South East	Thames Valley Berkshire
Seeding tomorrow's vehicle technologies today -IDP12	IDP12 - CRD	Plasma Removal of Methane from Natural Gas Dual-Fuel Engines (PROMENADE)	The PROMENADE (Plasma Removal of Methane from Natural Gas Dual-Fuel Engines) project will demonstrate the use of non-thermal plasma, advanced combustion and control techniques and Additive Manufacturing to allow dual-fuel (Diesel-Natural Gas) to meet Euro Stage VI emissions standard while delivering considerable fuel economy benefits over conventional diesel engines. Johnson Matthey, G-volution Ltd and HiETA Technolgies along with the University of Manchester and Queen's University Belfast, working with MAN Truck and Bus AGwill provide a full scale engine bench demonstration of these combined technologies.	2015/16	Collaborative R&D	HiETA Technologies Limited	No	42614	43708	249190	355986	211548.7	Active	Live	Small	RG40 1BJ	South East	Thames Valley Berkshire
Seeding tomorrow's vehicle technologies today - IDP12	IDP12 - CRD	Thermoplastic Overmoulding for Structural Composite Automotiv	The TOSCAA project brings together a number of collaborating organisations to integrate a range of innovative, lightweight material and process technologies, enabling the development of a unique TP overmoulded structural automotive component for Automotive vehicle application. The project aims to demonstrate how TOSCAA technology offers the opportunity for this technology deployment in other applications on the vehicle and of interest in other sectors with lightweighting demands such as rail and aero.	2015/16	Collaborative R&D	ENGENUITY LIMITED	No	42614	43190	462415	7E+05	461617	Active	Final Claim	Small	RH15 8RG	South East	Coast to Capital

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Seeding tomorrow's vehicle technologies today -IDP12	IDP12 - CRD	Functional Lattices for Automotive Components (FLAC)	Vehicle efficiency, regardless of the powertrain type, can be increased through several strategies, including reducing weight, aerodynamic drag, reduction in rolling resistance and powertrain efficiency. Out of all, weight reduction is considered to have the greatest potential to increase vehicle efficiency and thus to reduce the CO2 emissions. The objective of the FLAC project is to progressively develop and demonstrate a portfolio lightweight automotive components with increased efficiency and functionality utilising an integrated SLM design methodology, a novel class of lattices, new aluminium alloys for SLM and demonstrate the viability of selective laser melting as a manufacturing route.	2015/16	Collaborative R&D	HiETA Technologies Limited	Yes	42552	43646	525000	750000	406400	Active	Live	Small	RG40 1BJ	South East	Thames Valley Berkshire
Seeding tomorrow's vehicle technologies today - IDP12	IDP12 - CRD	FEVER (Forty Eight Volt Electrified Rear Axle)	The FEVER project will apply 48V electrification to the rear drive-line of a B-segment city car to enable advanced hybrid electric drive functionality at a reduced cost to that of a high voltage PHEV or EV. The objective is to realize a 10%-15% on-cycle benefit based on a Tata Bolt demonstrator with significant real world improvement over a typical city drive cycle. This will require a high level of innovation in the following areas: •Development of a next generation oil cooled, 4 quadrant, Switched Reluctance hybrid motor •Light-weight, low cost electric rear axle module with integrated 48V electric motor and hybrid battery •Package efficient scalable suspension concept with focus on enabling late configurations of vehicle and body structure to optimise for cost and volume implications •IP generation around the development of low voltage advanced motor control and electric driving control strategies The project will culiminate with the delivery of 2 through-the-road hybrid demonstration vehicles	2015/16	Collaborative R&D	Controlled Power Technologies Limited	Yes						Active	Withdrawn	Small	SS15 6TP	East of England	South East
Seeding tomorrow's vehicle technologies today - IDP12	IDP12 - CRD	FEVER (Forty Eight Volt Electrified Rear Axle)	The FEVER project will apply 48V electrification to the rear drive-line of a B-segment city car to enable advanced hybrid electric drive functionality at a reduced cost to that of a high voltage PHEV or EV. The objective is to realize a 10%-15% on-cycle benefit based on a Tata Bolt demonstrator with significant real world improvement over a typical city drive cycle. This will require a high level of innovation in the following areas: •Development of a next generation oil cooled, 4 quadrant, Switched Reluctance hybrid motor •Light-weight, low cost electric rear axle module with integrated 48V electric motor and hybrid battery •Package efficient scalable suspension concept with focus on enabling late configurations of vehicle and body structure to optimise for cost and volume implications •IP generation around the development of low voltage advanced motor control and electric driving control strategies The project will culiminate with the delivery of 2 through-the-road hybrid demonstration vehicles	2015/16	Collaborative R&D	Ricardo UK Limited	No						Active	Withdrawn	Large	BN43 5FG	South East	Coast to Capital

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IDP15: The Road to Zero Emission Vehicles, Feasibility Studies	IDP15: The Road to Zero Emission Vehicles, Feasibility Studies	INEOS Grenadier	This project will assess the feasibility and production of a hydrogen fuel cell powered 4x4, including the vehicle requirements, system design and component supply. The key focus will be on meeting the performance, ruggedness and durability requirements for off-road use, while making use of zero emission technologies with a long range. The fuel cell is well suited to this application since it has better energy storage, and therefore weight to volume ratio, than battery electric vehicles (BEVs), but works with electric motors to meet off-road driveability requirements, therefore opening up a large potential market, since traditional OEMs have vacated the space for heavy duty utility 4x4s (e.g. new concept Mercedes G-Wagen, discontinued Land Rover Defender etc), in addition to creating significant opportunity for carry-over to other off-road applications. The defined aims of the project are: *Simulate the powertrain under real world situations (specified temperatures, etc.) to define system specifications for suppliers. *Derive the respective requirements for the electrical drive unit and DC-DC convertor sub-systems within the powertrain. *Conduct evaluations of suppliers for off-the-shelf components and subsystems, to see whether they can meet performance and quality requirements, and financial/delivery-time constraints. *Carry out an integration and packaging study, to explore the vehicle modifications required to include the hydrogen powertrain. The project will be undertaken by INEOS Automotive, in partnership with AVL Powertrain, to develop an off-road vehicle platform from which many variants can be produced, with further applicability to large vehicles including vans and construction plant. INEOS is uniquely positioned to work with its chemical division to develop much-needed hydrogen filling infrastructure in the UK, and AVL will build on their work on vehicle engineering and design to become experts in the hydrogen fuel cell field. Major challenges in the project involve the design and integration of high-performance subsystems with high durability; and development of optimal solutions to contradictory requirements, such as the need to seal the fuel cell for ingress protection, while also providing sufficient cooling to components. If the Grenadier vehicle range captures just 10% of the UK market for SUVs, it will achieve annual sales of 30,000 units. 1% of the global SUV market would equate to 279,000 units per year. Overall, the project will bring a new vehicle manufacturer into the UK, and help to establish the UK as a hub for the hydrogen economy.	2018/19	Feasibility Studies	INEOS AUTOMOTIVE LIMITED	Yes						Active	Offer Letter Sent	Large	SO43 7FG	South East	Enterprise M3
IDP15: The Road to Zero Emission Vehicles, Large R&D	IDP15: The Road to Zero Emission Vehicles, Large R&D	Optimised Components, Test and simulatiOn toolkits for Powertrains which integrate	"OCTOPUS builds on the success of previous Innovate UK project APEX. **Advanced Electric Motors Research** and **The Thinking Pod innovations** will focus optimising the integrated motor and power electronics 'drive' technology and further integrating with a new transmission and thermal management system to deliver the ultimate single unit e-axle solution designed specifically to meet **Bentley Motors** performance specifications. OCTOPUS will use the world class synchrotron and high performance computing systems available from the **Science & Technology Facilities Council** to build new multi-physics modelling solutions and expertise of the **University of Nottingham** to build power electronics modelling solutions and validate them with test data generated by 'looking	2018/19	Collaborative R&D	HIETA TECHNOLOGIES LTD	No						Active	Offer Letter Sent	Micro/Small	RG40 1BJ	South East	Thames Valley Berkshire

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