Written evidence submitted by techUK (SDV0027)

About techUK

techUK is a membership organisation launched in 2013 to champion the technology sector and prepare and empower the UK for what comes next, delivering a better future for people, society, the economy and the planet. It is the UK's leading technology membership organisation, with more than 900 members spread across the UK. We are a network that enables our members to learn from each other and grow in a way which contributes to the country both socially and economically. By working collaboratively with government and others, we provide expert guidance and insight for our members and stakeholders about how to prepare for the future, anticipate change and realise the positive potential of technology in a fast-moving world.

Executive Summary

The development of automated vehicles (AVs) or "self-driving" vehicles offers truly transformative changes in the way people and goods are transported. The domestic AV market is said to be valued at £41.7bn in 2035, with the potential to save 3,900 lives and prevent 47,000 serious accidents in the UK by 2030[1] [2]. However, the UK is losing pace in its development compared to other jurisdictions including the US and the European Union. To realise AV's benefits and achieve our ambition for the UK to be a world leader in AV technology and regulation, the government needs to introduce a policy framework which supports the deployment of AVs. Prior to submitting this evidence, the Government published how it intends to achieve this by 2025. We welcome the arrival of this framework, however, what happens in the interim is critical, such as supporting new testing of vehicles without a human driver and answering questions over how the regulatory framework will function in practice.

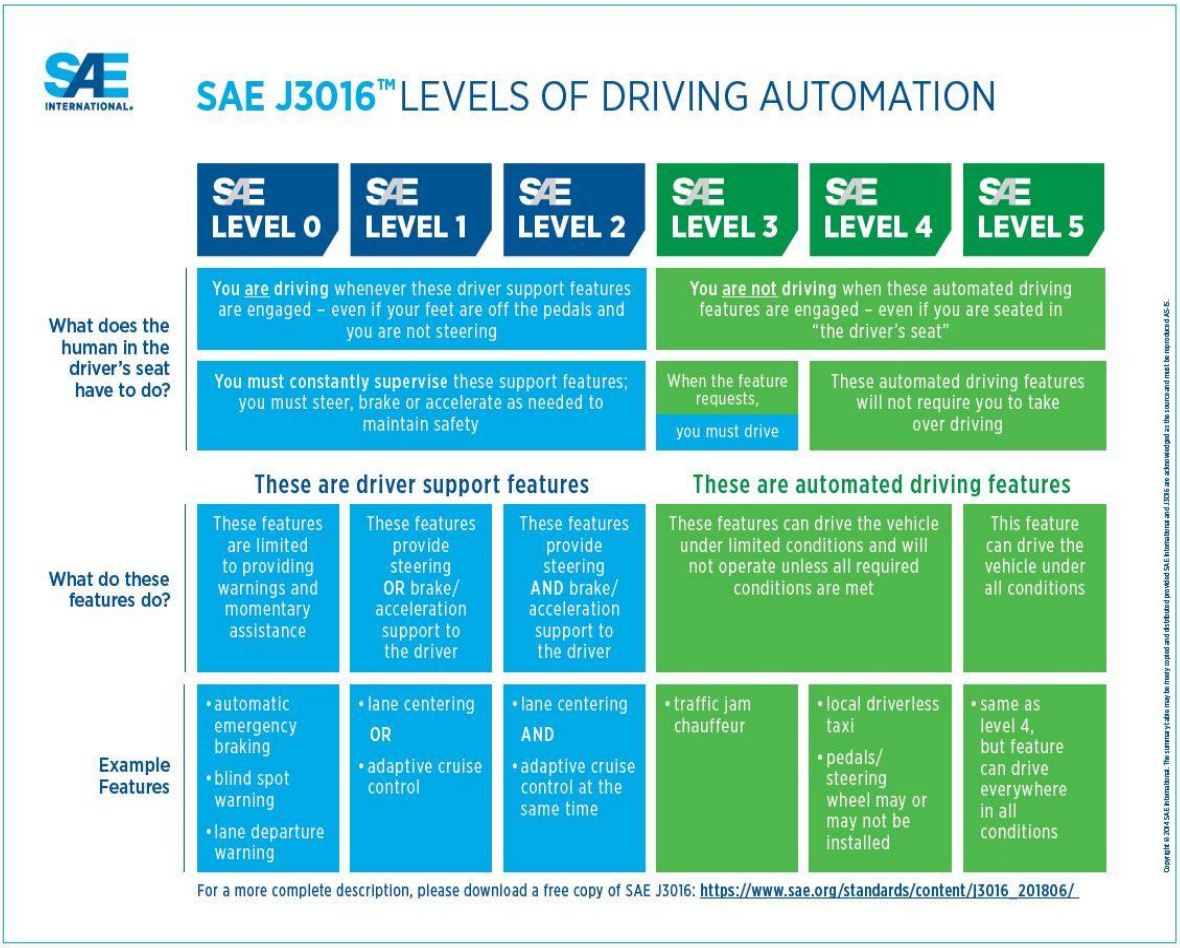
With the right conditions, the UK has an opportunity to become a pioneer in the development of this truly transformative technology, building on our established technological and automotive heritage and offering significant improvements in safety, efficiency, mobility, productivity and user experience.

Defining our terms

Driving automation has developed its own specialist language and taxonomy. It is critical that this is understood to avoid confusion. The Society of Automotive Engineers International (SAE) has pioneered common terms to define driving automation which we adopt within this evidence.

The SAE's taxonomy is best known for establishing six "levels" of driving automation and an understanding of SAE levels is needed to participate in policy debates and make comparisons across jurisdictions.

The SAE's J3016 standard summarises the six levels of automation in the following figure[3]:



In this evidence, we will reference SAE levels as a descriptive feature of driving automation and the opportunities and challenges created. We will also reference a series of other terms which we define in-line with the Law Commission for England and Wales's 2022 report on automated vehicles[4].

These terms are:

- An **automated driving system (ADS)** is defined as the combination of software and hardware capable of performing the entire dynamic driving task. ADS refers to a system within a vehicle, not the vehicle itself. A single ADS may operate in different operation design domains.

  A dynamic driving task defined the core of what "driving" means from a technical perspective.

  An operational design domain sets out the conditions in which any automated driving system or feature is designed to function. It may relate to a physical location, a type of road, a time of day, a speed, or weather.

- An **"automated vehicle" (AV)** is a generic term. It refers to a vehicle equipped with an ADS which is able to conduct the entire dynamic driving task in one or more operational design domains. A vehicle may be an AV even if the ADS is not engaged at the time. The term refers to a vehicle which is capable of self-driving, at least in some circumstances.

AVs are currently being developed to operate with both a "user in charge" and "no user in charge". This is an important distinction and for this, we have adopted the British Standards Institute's definitions within their CAV Vocabulary document and which the Government intends to use within legislation[5].

- Having a **user in charge (UIC)** means there is a human in the vehicle who is qualified to drive it and in a position to operate the controls of the vehicle while a relevant automated driving system feature is engaged.
- **No user in charge (NUIC)** means there is no human driver in the vehicle and it is able to operate itself while a relevant automated driving system feature is engaged.

The term "self-driving" does not appear in the SAE's taxonomy, however, it remains a relevant term, as the Law Commission for England and Wales has recommended it is used to indicate a legal threshold. The definition of "self-driving" can be effectively summarised with The Automated and Electric Vehicles Act 2018 refers to vehicles which are capable "in at least some circumstances or situations, of safely driving themselves"[6].

The UK will create new laws for "self-driving" vehicles within a Transport Bill[7]. This Bill is understood to encompass SAE Levels 2-4 (UIC and NUIC). Given active policymaking, it is vital the Committee has a clear understanding of these concepts and their potential impact. The remainder of this evidence is formed under this basis and structured in-line with the Committee's terms of reference[8].

1. Likely uses, including private cars, public transport and commercial vehicles.

techUK members are developing a range of use-cases for AVs across several operational design domains. Their development brings the potential for truly transformative changes in the way people and goods are transported, offering significant improvements in safety, efficiency, mobility, productivity and user experience.

Research conducted by the Connected Places Catapult estimates that the market for AVs with SAE level 3, 4 and 5 automation to be worth £41.7bn in 2035, capturing 6.4% of the £650bn global market. By the same year, they assess that 40% of new UK car sales could have self-driving capabilities. This could in turn create 38,000 new skilled jobs[9].

The Society of Motor Manufacturers and Traders (SMMT) estimates that self-driving vehicles are likely to save 3,900 lives and prevent 47,000 serious accidents in the UK by 2030.[10] We examine the safety benefits of AVs under question 5.

The conversation of current innovation into actual deployment is dependent on several factors, including regulation and technological advancements. Building public confidence and trust technologies will also be critical to achieving this.

More detail on the likely uses of AVs is given below:

Public transport: Public transport will be the first use-case to scale commercially and a variety of models are already being trialled. Many of these take the form of pay-per-use models such as taxi services and shuttles. This model has experienced particularly strong growth in the US given that AVs are allowed to operate on US roads and state law provides the framework for AV ride-hailing services to be deployed. techUK member Waymo launched the world's first SAE level 4 commercial ride-hailing service in Metro Phoenix in

2020, which is fully open to members of the public. It has also scaled up its driverless operations in San Francisco. The EU, France and Germany all have regulations in place to allow for the type-approval of SAE level 4 vehicles, outpacing the UK which will not have a legislative, regulatory and safety framework for deployment in place until 2025.

Automation shows significant promise for buses and other mass transit. In Scotland, the CAVForth project intends to deliver a SAE level 4 automated scheduled passenger service with Stagecoach East Scotland, carrying up to 10,000 passengers per week along a 28-mile route between Edinburgh and Fife, across the Forth Road Bridge. Live road testing commenced in April 2022.

Further similar deployment projects are proposed in several locations across the UK where the focus is increasingly on the delivery of services rather than on the underlying technology. Projects that are considering the full range of integration and operational issues for a viable commercial service include the proposed autonomous passenger shuttle service in Belfast Harbour.

AVs will also enable the creation of new "hybrid modes" of public transport. SAE level 4 automated passenger shuttles are currently being tested. These services carry fewer passengers than buses but are intended to be integrated into Mobility as a Service (MaaS) systems to provide on-demand passenger and goods transportation. Similar vehicles could also be used in workplace settings, transporting workforces on and off site, or moving goods across large private facilities such as airports, military bases and warehouses.

Delivery, logistics and construction vehicles: AVs are already a reality in selected applications that feature controlled environments, such as mining and farming. In these cases, the restricted nature of operations and the possibility to operate on private roads facilitates adoption. Other adjacent equipment applications, for example, in the construction and warehousing sectors, should see the next AV applications for vehicles such as excavators, forklifts, and loaders. The versatility of AVs also has the potential to offer significant benefits to the logistics and last-mile delivery sector, reducing emissions and congestion through optimised driving. Capabilities are also emerging to introduce SAE level 4 systems in the heavy goods vehicle (HGV) and trucking market.

Private cars: Although AVs are predicted to enter the public transport and commercial vehicle markets first, original equipment manufacturers (OEMs)

are developing higher level of automated systems for use in private cars through setting up AV divisions and subsidiaries. British carmaker Jaguar Land Rover in February 2022 formed multi-year strategic partnership with techUK member NVIDIA to jointly develop and deliver next-generation automated driving systems plus AI-enabled services and experiences for its customers. From 2025, all new Jaguar Land Rover vehicles will be built on the NVIDIA DRIVE software-defined platform, delivering a wide spectrum of active safety, automated driving and parking systems as well as driver assistance systems.

Robotics: The development of robotics for consumer applications and logistics (including humanoid robots) will also continue to grow in tandem with AVs as the two share similar technologies. These include remote advanced sensing, hyperprecise positioning/GPS, image recognition, and advanced artificial intelligence. In addition to sharing technology, AVs and robots could benefit from using the same infrastructure, including recharging stations, service centres, and machine-to-machine communication networks. These commonalities might push multiple players to invest in both applications, as already shown by the significant investments in robotics. techUK member Ocado is also leading a charge, planning to integrate self-driving grocery delivery vehicles to the Ocado Smart Platform, as well as the use of legged robotics. Trials of automated and remote operated vehicles in manufacturing plants have taken place at the Nissan plant in Sunderland in collaboration with techUK member Hitachi Vantara, Streetdrone and the North East Automotive alliance. These trials have demonstrated the technology and support the compelling business case for delivery of components from consolidation centres to the production line. Scaling of this use case is currently being planned.

What are the next steps?

Clearly, automation offers significant opportunities to change and enhance the way people and goods are transported. However, the deployment of these services is dependent on appropriate regulation, the business case and on public acceptance. Considering the importance of cybersecurity in building public and organisational confidence is also critical which we discuss further in the following section.

We welcomed the publication of the Government's regulatory and safety framework; however, the next step must be outlining how it will function in

practice. For instance, developers deploying NUIC services will be required to go through a two-step authorisation process to deploy their vehicle which includes demonstrating it meets technical safety standards and then authorised to drive by the government itself. An additional 'permit' must then be obtained for the authorised NUIC vehicle to deliver public services, similar to bus or taxi permits.

This process has the potential to become complex and, if not streamlined, may deter businesses for choosing to commercialise in the UK. While we agree robust assurance and monitoring processes must be in place, the Government should balance this with a logical and common-sense system which supports business operation[11].

2. Progress of research and trials in the UK and abroad;

To date, the UK has been at the forefront of developing a regulatory framework for the use and development of AVs. Through the establishment of the Centre for Connected and Autonomous Vehicles (CCAV) and the BSI CAV Standards Programme, the UK has positioned itself as a world-leading destination for supporting AV research, development and testing. We welcome the fact that CCAV and BSI together with other public and private sector stakeholders are actively promoting an environment which supports innovation, safety, and public acceptance through the development of clear policies, good practices and standards.

Listing out the complete range of live trials in the UK is beyond the scope of this evidence however we would welcome the opportunity to provide a more detailed overview as an addendum or within oral evidence. We have instead provided recommendations for how the UK can advance its capabilities to ensure we remain a vanguard in the development of this exciting technology.

2.1. Continued investment into CCAV

CCAV has been visionary in its approach to supporting industry R&D for connected and automated mobility (CAM). We urge the Government to continue investing in CCAV to enable its important work and we welcome the additional £20m of funding announced as part of the overall £100 million committed to help kick-start commercial self-driving services[12].

2.2. Working with industry to meet future skills requirements

Investment into R&D is vital, however, investment into future jobs and skills is also a critical element of advancing our capabilities in this sector. CAVPASS workstream 4 aims to ensure that government has the skills, capabilities, and access to assets needed to deliver and implement the CAM safety assurance programme[13]. Through its Transport Employment and Skills Taskforce, the Government is also exploring future skills needed across the transport sector. However, we encourage the Government to closely involve membership organisations such as techUK in this process. Our sister organisation TechSkills is addressing this challenge through bridging the gap between technology businesses and universities, allowing businesses to help shape learning on campuses to ensure the skills learnt have a direct application in the private sector. As the sector's industry body, we are able to meaningfully support this process and would welcome the opportunity to provide consultancy and guidance.

2.3. Reform to The Trialling Code of Practice

techUK is keen to ensure support for UK R&D in AV testing continues to lead the world, and that our competitiveness in this space can be marketed clearly overseas.

Currently, UK testing regulation permits the teleoperation of vehicles through the Trialling Code of Practice but doesn't allow NUIC testing, where human drivers are taken out the equation[14]. NUIC testing is permitted in several other jurisdictions including the US, Israel, South Korea, China and several EU Member States including France and Germany. Here in the UK, there is a growing desire to conduct more advanced trials without human drivers, however, currently such trials are currently outside of the law and require support and facilitation from the Department for Transport to proceed, the process for which has not been set out for companies to follow.

The Government's recently published framework does not address this issue and while significant exemption powers do apply to facilitate testing, the process a business would need to undergo to conduct NUIC trials remains unclear[15]. When primary legislation is enacted, we need to ensure the Trialling Code of Practice is updated to provide trialling organisations with clarity that proper NUIC testing can happen, as well as a clear process for setting out how they can obtain authorisation to do so.

3. Potential implications for infrastructure, both physical and digital

SAE level 4 vehicles are currently being developed to seamlessly integrate into existing infrastructure. This is due to the fact AV developers tend to work on a basis of an AV taking the environment as it finds it and can deal with the complexity of a shared road infrastructure. The most critical demand on existing road infrastructure is that it is properly maintained, such as roads clearly marked and wayfinding visible, based on the same demands and expectations of conventional human driving.

3.1. Digital infrastructure

SAE level 4 vehicles must be capable of handling the entire dynamic driving task by themselves and without reliance on advanced communications, such as vehicle-to-vehicle (V2V) or vehicle-to-everything (V2X). V2V and V2X will likely rely on 4G or 5G networks and while support for 4G/5G is helpful for these capabilities (and connection to smart cities more broadly), it is not a prerequisite of AV deployment and transition.

We welcome the Government's recognition that there is more to be done to ensure 4G in-vehicle coverage is extended. Currently, only 60% of UK roads have 4G in-vehicle coverage from all four mobile network operators (MNOs), with 96% coverage from at least one operator[16]. We hope to see this coverage extended through the Shared Rural Network Programme.

Local authorities have also spearheaded their own investments into connectivity, with Sunderland City Council recently completing a full fibre roll out across the city in partnership with techUK member BAI Communications[17]. Visionary leadership within the council helped drive this change, however, this approach to investment into 'smart cities', capable of facilitating AV use-cases, is an exception, not the norm. An education exercise to help local authority leaders better understand the value in investing in communications infrastructure, with practical guidance by DCMS and industry in developing business-cases, will not only facilitate the delivery of connected vehicles, but a multitude of other smart city use-cases which can help address economic, environmental, and social ambitions. We must also ensure that access to grant funding remains available and that UKRI and InnovateUK continue to receive budgets to help local areas invest in technology.

The DCMS Secure Connected Places Directorate has been leading the development of cybersecurity guidance for those working in connected places[18] . The National Cyber Security Centre (NCSC) published a set of principles which

are designed to help ensure the security of connected places and their underlying infrastructure, so that they are both more resilient to cyber-attack and easier to manage. We welcome the impetus placed on cybersecurity within AVs and smart cities more broadly, however, cybersecurity and achieving secure-by-design requires cultural change within both our public and private sectors. This requires investment in upskilling and attracting new talent to the sector and embedding security principles through all operational processes. We explain this further in our smart cities report launched earlier this year[19].

3.2. Physical infrastructure

As mentioned, AVs are designed to take the environment as they find it meaning that physical road infrastructure should not need to undergo major transformation to support their arrival. The Government has stated that guidance will be required to ensure that road authorities can invest in their existing traffic control systems to both deliver dynamic data services and benefit from the richer source of network intelligence offered by connected vehicles[20]. We are supportive of the work being undertaken through the National Highways Digital Roads programme and we would be happy to leverage the expertise of our membership base as part of this initiative[21].

4. The regulatory framework, including legal status and approval and authorisation processes

techUK's position is that legislation should act as an enabler for the roll-out of AV technology that allows use-cases to advance and businesses to innovate. We called for new laws for self-driving vehicles within its Queen's Speech in May 2022 and are pleased to see the Law Commission for England and Wales' recommendations taken forward into primary legislation[22].

Following the publication of the Law Commission for England and Wales paper, proposals have emerged that the AV approval and operation process is handled by two regulators: the Vehicle Certification Agency (VCA) and the Driver and Vehicle Licensing Agency (DVLA). For this system to work, clear and efficient pathways to approval and in-use monitoring need to be established between the two regulators.

This clarity is vital not just for AV companies but for the insurance and legal ecosystem which will enables the sector. The Law Commission for England and

Wales has proposed an open framework which can be evolved over time. This is a good approach, however, clarity over governance and civil liability processes is vital for the insurance and legal sector which will enable self-driving.

4.1. International policymaking and standards

Despite the recent progress made in UK policymaking, the reality is that the UK has fallen behind other jurisdictions in bringing this legislation forward. EU Member States are moving forward with legislation for actual commercial deployment of AV technology on public roads. This comes despite the Government's recognition that the ability to design our own regulatory and legislative framework as a benefit of the UK's departure from the European Union[23].

Germany and France have introduced national rules permitting the operation of SAE level 4 vehicles on their roads, while the EU itself has also created a bloc-wide framework for the type-approval of AVs, which will take effect in September this year.

The work being achieved within the European Union is complemented by work at the United Nations, as well as international standards bodies. The UK is a key contributor to these global initiatives which is being used to inform how we design domestic policies.

4.2. Broadening participation within CAVPASS

The Government's CAVPASS scheme has been successful in driving forward safety assurance and security within the sector. The aim of CAVPASS is to put in place the processes, systems and capabilities necessary for government assurance of the safety and cyber resilience of connected and self-driving vehicles by 2025.

Although the team's skills are wide ranging and represent a broad base of government agencies, private sector participation and involvement within the programme has been limited. Work has been undertaken in a relative silo and its priorities have not always been clearly communicated. The private sector developing AV systems, and the supporting infrastructure, has a great deal of expertise which can be shared within the programme. The Government itself recognises that the road to autonomy will require strong and trusting relationships between industry and public sector agencies and widening

participation of CAVPASS by, for instance, establishing an industry council, is a good step towards achieving this before the programme concludes in 2025.

5. Safety and perceptions of safety, including the relationship with other road users such as pedestrians, cyclists and conventionally driven vehicles;

Government data reports that 88% of UK road traffic collisions are caused by human drivers. Through removing the need for human drivers, AV's can make a significant improvement to road safety and helping move towards Vision Zero.

In August, the Government announced it will consult on a new 'safety aspiration' for AVs, which we welcome. The Centre for Data and Ethics and Innovation has also argued improvements in road safety, even if they can be clearly demonstrated, will not engender public trust if crashes are seen as the fault of faceless technology companies or lax regulation rather than fallible human drivers. The inference is that it not possible to empirically measure a safety standard. They suggest there should instead be a safety assurance framework and Safe and Ethical Operating Concept (SEOC) which would be a set of constraints on vehicle behaviour, including motion, signalling to other road users, and actions to preserve their own safety.

ADS systems already in operation are biased towards safety and SEOC in many cases are already being developed. Given that this recommendation was published by Government close to this inquiry closing, we would welcome the opportunity to explore the concept of SEOCs with our membership in detail and provide the committee with a written addendum of our findings.

In terms of data analysis, especially information published from the US' National Highway Traffic Safety Administration (NHTSA), it is vital to also consider this within the wider context of the trials[24]. For example, knowing whether a trial is UIC or NUIC changes what is expected of the rider or driver. Without making this distinction clear risks reporting appearing skewed and can lead to poorer public perceptions of safety.

As mentioned previously, improving the public perfection of safety is vital in the deployment of AVs. Project Endeavour, undertaken by DG Cities, Oxbotica and Immense found that self-driving or autonomous vehicles are a technology that many members of the public have little or no awareness of[25].

The project tested attitudes and perceptions of AV safety with participants before and after a live trial experience in Greenwich. It found that the live trial improved people's perceptions of the safety potential of AVs: before the trial, 68.3% agreed that AVs would be safer than human driven vehicles, whilst after the trial 83.6% agreeing, illustrating a 15-percentage-point improvement. This evidences that live trials make it possible to measure and create improvements in people's understanding, views and trust of AVs. Attitudes and perceptions of AVs appeared to differ between groups and data showed that younger people are more open to adopting AVs, whilst older people are more sceptical. Those with mobility needs related to age are more likely to say they will adopt an AV which is likely to driven by a desire for greater independence.

Overall research around AVs, and the technology's safety is integral to enabling the public to make an informed decision regarding the adoption of AV technology. More live trials, including with NUIC, will help address barriers around the performance of AVs in more complex road environments, reducing hesitancy towards using AVs when they enter into commercial service. Surveys, workshops, and other forms of direct public engagement would help to further clarify the barriers to using AVs in place of personal owned vehicles in the future.

6. The role of Government and other responsible bodies, such as National Highways and local authorities; and potential effects on patterns of car ownership, vehicle taxation and decarbonisation in the car market.

The Government, as part of its "Realising the Benefits for Self-Driving Vehicles" document has published a range of helpful measures and estimations in relation to the issues raised within this question, as well as the role of Government and other bodies[26].

It is, however, important to highlight that the benefits of AVs cannot be truly realised or measured until we introduce a framework to support deployment at scale. Information relating to the impact on car ownership, decarbonisation and taxation will emerge over a number of years, which will mature our understanding and allow the industry to optimise processes and for the Government to take appropriate policy decisions.

Conclusion

AVs can be as transformative and disruptive as the invention of the automobile itself. The rapid pace of innovation is giving rise to an exciting array of use-cases which can drive improvements in safety, efficiency, mobility, productivity, and user experience. The UK has been a vanguard for the development of this technology, with exciting trials underway across the country. However, the rate that this innovation turns into actual deployment is dependent upon the business case, technological advancement, regulation, and public acceptance. AVs offer significant potential for UK exports and domestic growth; however, we are rapidly losing pace with other jurisdictions. We welcome the Government's commitment to a full regulatory, legislative and safety framework by 2025 but as outlined in this evidence, what happens in the next few years will be critical.

August 2022

Endnotes

[1] Connected Places Catapult market forecast for connected and autonomous vehicles (publishing.service.gov.uk)
[2] SMMT-CONNECTED-REPORT-2019.pdf
[3] SAE J3016 automated-driving graphic
[4] Automated-vehicles-joint-report-cvr-03-02-22.pdf
[5] bsi-flex-1890-v4-2022-03.pdf (bsigroup.com)
[6] Automated and Electric Vehicles Act 2018 (legislation.gov.uk)
[7] Queen's Speech 2022: background briefing notes - GOV.UK (www.gov.uk)
[8] Self-driving vehicles - Committees - UK Parliament
[9] Connected Places Catapult market forecast for connected and autonomous vehicles (publishing.service.gov.uk)
[10] SMMT-CONNECTED-REPORT-2019.pdf
[11] cam-2025-realising-benefits-self-driving-vehicles.pdf (publishing.service.gov.uk)
[12] Self-driving revolution to boost economy and improve road safety - GOV.UK (www.gov.uk)
[13] cam-2025-realising-benefits-self-driving-vehicles.pdf (publishing.service.gov.uk)
[14] Code of Practice: automated vehicle trialling - GOV.UK (www.gov.uk)
[15] Code of Practice: automated vehicle trialling - GOV.UK (www.gov.uk)
[16] Connected Nations 2021 - Ofcom
[17] Sunderland City Council and BAI announce new partnership | Smart cities (baicommunications.com)
[18] Secure connected places (smart cities) guidance collection - GOV.UK (www.gov.uk)
[19] Demystifying the Smart City - working towards better implementation (techuk.org)
[20] cam-2025-realising-benefits-self-driving-vehicles.pdf (publishing.service.gov.uk)
[21] Digital Roads - National Highways
[22] cam-2025-realising-benefits-self-driving-vehicles.pdf (publishing.service.gov.uk)
[23] The benefits of Brexit - GOV.UK (www.gov.uk)
[24] NHTSA | National Highway Traffic Safety Administration
[25] Project Endeavour – DG Cities
[26] cam-2025-realising-benefits-self-driving-vehicles.pdf (publishing.service.gov.uk)