Early-stage autonomous vehicle opportunities within UK heavy road freight

eFREIGHT Autonomous

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Contents

Executive summary

Autonomous heavy road freight is moving from pilots into early commercial operations internationally, and the UK is approaching a decision point. The Automated Vehicles Act 2024 provides the core legal foundation for deployment, while technology maturity, private site operations, and growing investor interest indicate that driverless freight will become a practical option for some use cases over the next decade. This report assesses what is technically and commercially feasible in the near term, where the UK can capture value, and what actions are needed to introduce autonomous freight safely, transparently and in a way that benefits the UK and strengthens the wider freight system.

Why autonomous freight matters now

Heavy duty road freight is critical to national security, underpinning food supply, manufacturing, construction, healthcare logistics and retail distribution, and it is central to the UK's economic competitiveness. The sector also faces a set of pressures that are unlikely to resolve without targeted intervention and innovation: persistent driver availability and retention challenges, cost inflation (fuel, insurance and compliance), network congestion, and the requirement to decarbonise operations while maintaining service levels.

Autonomy can address a number of these challenges. The benefits of autonomous freight might include:

- relieving pressure from driver shortages,
- lower operating costs and increased operational efficiency,
- enhanced road safety,
- improved supply chain reliability, and
- environmental and sustainability benefits.

Operational efficiency is a key motivation for hauliers. Driverless operation could enable higher vehicle utilisation and lower operating costs, and, in addition, new 'cabless' vehicle designs have potential to carry a greater payload compared to standard articulated HGVs. An example concept, produced by Voltempo, is shown:

Freight is particularly well suited to early deployment because movements are often corridor based, repetitive, and already dependent on tightly managed processes at depots, ports and terminals. This makes it feasible to define the specific operating conditions under which the automated driving system can safely function (known as the operational design domain) and to measure benefits in productivity, safety and emissions. For government, the strategic question is how to enable early deployment in the right places and with the right safeguards, so that the UK captures economic value while protecting public safety, infrastructure integrity and broader transport objectives.

Technology maturity and early deployment

Autonomous heavy duty freight is approaching operational maturity in defined environments. International deployments demonstrate that highly autonomous systems can operate safely and reliably when the operating design domain is tightly specified (for example, motorway corridors, fixed depot-to-depot routes, or geofenced terminal areas) and when the vehicle is supported by robust operating processes. In practice, early deployment is an "end-to-end service" rather than a vehicle feature: it combines onboard autonomy with remote supervision, high-quality mapping and localisation, preventative maintenance and software management, and disciplined procedures for handling exceptions.

In the UK, the strongest evidence base remains private site operations in ports, airports, yards and industrial campuses, where autonomous vehicles are already integrated into live logistics and can be governed by site rules, connectivity and controlled interfaces. These deployments provide learning on safety, productivity, mixed traffic interactions and digital infrastructure (including private 5G). They also clarify what must be proven before scaling to public roads: consistent safety assurance and transparent incident reporting; clear roles and responsibilities for no-user-in-charge operations and remote supervision; resilience to roadworks, weather and sensor degradation; and well-defined interfaces for handover between autonomous trunking/shuttles and conventional first/last mile logistics.

Enabling conditions

In the UK, the Automated Vehicles Act 2024 provides the statutory foundation for authorising self driving systems and clarifying responsibility when the automated system is in control. To make this workable for freight, the implementation programme and secondary legislation will need to translate the Act into clear, repeatable requirements and processes for authorisation, operator licensing for no-user-in-charge services, in use monitoring, incident response, and data access. This will enable fleets, insurers and regulators to make consistent risk decisions and learn quickly from early deployments.

Early deployment will only progress at pace if a minimum set of enabling conditions are put in place and aligned across government, infrastructure owners and industry. These include: proportionate safety assurance, infrastructure readiness, insurability and liability clarity, operational maturity, standards alignment, workforce planning, and public trust.

Priority UK deployment pathways

Autonomous freight is expected to emerge unevenly, starting where operational complexity is manageable and the business case is strongest. Based on the evidence and stakeholder engagement in this study, early UK opportunity concentrates in two priority use cases:

- **Hub-to-hub trunking on the Strategic Road Network** (motorway and high quality A road corridors) between major logistics hubs, where routes are repeatable and interfaces at either end can be controlled.
- **Intermodal shuttle moves** (typically <5 km) linking ports, railheads, inland terminals and nearby distribution facilities – high frequency, low speed movements where time savings and reliability improvements can be captured quickly.

These pathways offer a practical basis for UK trials targeted from 2027, because they combine clear operational design domain boundaries with measurable outcomes (safety performance, utilisation, cost and emissions) and manageable interfaces with other road users and sites. More complex environments such as dense urban delivery with frequent interactions, kerbside constraints and vulnerable road users are likely to follow later as systems, standards and public confidence mature.

Near-term actions for government and industry

Autonomous heavy road freight should be treated as both an industrial opportunity and a critical transport system change. The near term objective is to move from isolated pilots to a small number of well governed, high learning trials that build an evidence base for authorisation, insurance and scaled investment, starting with the priority deployment pathways identified in this report and aligning them with the enabling conditions above.

For Government, the priority is to convert the Automated Vehicle Act 2024 framework into a workable deployment pathway for autonomous freight, while aligning safety, economic competitiveness and net zero objectives. Key actions include:

- **Enable structured trials** in hub-to-hub trunking and intermodal shuttles, with transparent evaluation metrics and clear routes to authorisation where performance is demonstrated.
- **Set clear, proportionate assurance expectations** for early operational design domains (safety case, remote supervision, incident response, in use monitoring and data access), aligned to emerging standards and insurer needs.
- **Coordinate infrastructure readiness** with National Highways, local authorities, ports and freeports (covering road marking quality, work zone practices, digital connectivity, and depot/terminal interfaces).
- **Plan for system impacts**, including potential effects on rail freight competitiveness, network demand, and SME participation, so that automation supports (rather than undermines) wider freight policy goals.
- **Embed cybersecurity and resilience** expectations from the outset, recognising the operational dependence on software, connectivity and remote services.

For industry, early advantage will come from preparing operating models and partnerships that can scale. Priorities include:

- **Form trial consortia** that bring together fleet operators, shippers, vehicle manufacturers, autonomy providers, infrastructure owners and insurers, with shared requirements and clear operational boundaries.
- **Design end-to-end operational processes** (handover, exception handling, maintenance, remote supervision, emergency response) rather than treating autonomy as a vehicle only upgrade.
- **Align autonomy with decarbonisation**, particularly where higher utilisation can improve the economics of zero emission HGVs and optimise charging strategies.
- **Invest in workforce transition**, including new roles in remote operations, fleet monitoring, safety assurance and high skill maintenance.

If pursued in this way, early autonomous freight can strengthen UK supply chain resilience, improve safety outcomes and support productivity growth, while creating an exportable capability in autonomy software, safety assurance, systems integration and operations.

Introduction

eFREIGHT Autonomous

eFREIGHT Autonomous is a strategic study aimed at advancing the development and early deployment of autonomous Heavy Goods Vehicles (HGVs) in the UK freight and logistics sector.

Led by Voltempo, with partners Connected Places Catapult and Berkeley Coachworks, eFREIGHT Autonomous combines research, stakeholder engagement, and business case development to scope UK trials of autonomous technologies to demonstrate the potential benefits, which might include:

- relieving pressure from driver shortages,
- lower operating costs,
- enhanced road safety,
- increased operational efficiency,
- improved supply chain reliability, and
- environmental and sustainability benefits.

The project's ambition is to accelerate the adoption of autonomous HGVs by aligning government and industry around real-world trials, targeted to begin in 2027. This work will inform investment and policy decisions, and contribute to shaping national regulatory frameworks. By enabling autonomous freight, it also supports national decarbonisation goals, improves safety and operational resilience, and reinforces the UK's leadership in connected and automated logistics.

Report scope and structure

This report examines opportunities for automation within heavy duty freight, focusing on vehicles of 32 tonnes gross vehicle weight and above. It assesses the current state and future potential of autonomous technologies across the sector, covering:

- key automation concepts and definitions,
- the maturity of autonomy technologies,
- sector challenges, such as driver shortages, cost pressures, safety concerns, congestion, and the net zero transition,
- how automation could help address these issues, and
- the most promising operational use cases.

The report reviews relevant global and UK trials, regulatory and legislative developments, commercial considerations, and strategic opportunities. It identifies barriers to adoption and the critical enablers required for deployment, concluding with recommended next steps to progress autonomous heavy duty freight in the UK.

The remainder of the report is organised as follows:

Section 3 – Why autonomous freight?

Sets out the role of heavy duty freight in the UK economy, sector challenges, and how autonomy could help address them.

Section 4 – Where are we now?

Provides an overview of autonomous vehicle capabilities, emerging heavy duty platforms, and the current legislative environment.

Section 5 – What is the opportunity for the UK?

Assesses the UK's position, commercial opportunities and potential business models.

Section 6 – Where should we start?

Presents the priority use cases identified through research and engagement, including benefits, challenges, and potential unintended consequences.

Section 7 – What enabling conditions are needed?

Highlights the technical, regulatory, commercial and operational enablers required for successful deployment.

Section 8 – Recommendations and next steps

Summarises findings and provides recommended actions and priorities for further work.

Approach

Connected Places Catapult undertook a mixed methods approach combining desk based research, interviews, workshops, and site visits.

Desk based literature review

Sources included academic publications, industry reports, news articles, government policy, legislation, and emerging strategies. The review informed understanding of technologies, trial activity, operational barriers, and the stakeholder landscape.

Stakeholder interviews

A total of 16 one to one interviews were conducted with:

- vehicle manufacturers,
- autonomous technology providers,
- fleet operators (various fleet sizes),
- ports,
- National Highways, and
- end users.

Interviews explored operational challenges, the perceived case for automation, any existing development or deployment activity, lessons learned, barriers, and requirements for UK based trials. These insights directly informed this report.

Industry workshop

An in person workshop with over 50 stakeholders tested and refined early findings. Four use cases developed through the literature review were presented:

- **Hub-to-hub trunking** – long distance distribution using the Strategic Road Network,
- **Intermodal shuttles** – short, repetitive movements (<5 km) between ports, railheads, depots, or hubs,
- **On site operations** – container or trailer shunting within closed sites, and
- **Urban deliveries** – last mile deliveries to urban consolidation centres.

Participants validated use cases, contributed operational examples, identified benefits and risks, discussed business model implications, and indicated interest in trial participation. The workshop concluded in the prioritisation of **hub-to-hub trunking** and **intermodal shuttle** operations. On-site operations were also of interest, but can be managed privately, and urban deliveries were deprioritised due to their technical complexity.

Follow on engagement

Further virtual workshops and site visits refined the findings presented here and informed development of trial proposals in response to the CAM Pathfinder funding call.

Why autonomous freight?

The importance of heavy duty freight

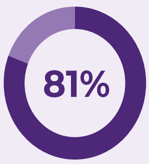
Heavy duty freight refers to the movement of large volumes of goods using vehicles classified as Heavy Goods Vehicles (HGVs), typically those with a gross vehicle weight exceeding 32 tonnes. This category includes both rigid and articulated lorries, which are essential for transporting palletised, containerised, and bulk goods across the UK's road network.

Heavy duty freight is the backbone of the UK's logistics and supply chain infrastructure, underpinning economic growth, national productivity, and societal wellbeing. Its strategic importance is reflected in several key dimensions:

The logistics sector, driven largely by heavy duty freight, generated **£185 billion** in Gross Value Added (GVA) in 2022, representing approximately **12%** of the UK's non-financial economy. The sector's total revenue reached **£1.3 trillion,** highlighting its scale and centrality to national commerce {1}

Key facts and figures

Road Freight



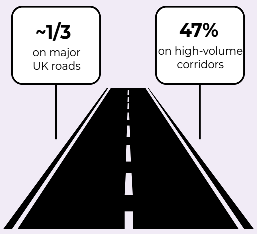
of all domestic freight movements by weight in the UK [2]

Articulated HGVs

70% of all road freight tonne-kilometres [3]

~19 billion vehicle-kilometres travelled annually [3]

Logistics-related traffic



[4]

Enabling just-in-time delivery
Heavy duty freight enables just-in-time delivery for manufacturing, retail, and essential services. It connects ports, distribution centres, factories, and urban centres, ensuring the timely flow of goods across the country and supporting both domestic and international trade.

Vital for food security, healthcare & energency response
The reliability of heavy duty freight is vital for food security, healthcare supply chains, and emergency response. Disruptions to freight flows – whether due to congestion, infrastructure failure, or labour shortages – can have immediate and widespread impacts on the UK economy and society.

Industry challenges and how autonomy can help

Challenge in heavy duty freight sector		How autonomy can help
Driver shortages	• Long, irregular hours, night/ weekend work, fatigue, and time away from home • Pay perceived as misaligned with demands, and variable earnings for agency and contract drivers • Poor roadside facilities (rest areas, secure parking, showers, healthy food) • Physically demanding work with limited progression, leading to poor retention particularly for younger drivers and women • Ageing workforce (48.7% aged 50+ [5]) with few new entrants under 30 [6]	• Reduces reliance on scarce drivers • Shifts tasks from driving to supervision, logistics coordination, and remote operation • Improves operational efficiency by allowing real-time adjustment of plans without need to consider driver breaks • Creates remote monitoring roles accessible to older or mobility restricted workers • Removes more repetitive less desirable driving jobs
Cost	• Very low margins (~2–3% [7]) • Driver wages and associated costs roughly 30% of total operating costs [8] • Fuel is up to 25% of costs and highly volatile, and insurance premiums are rising [8] • SMEs dominate and have limited capacity to absorb cost increases or invest in zero emission or new technologies	• Reduces labour-related cost pressures • Enables higher vehicle utilisation, improving electric vehicle total cost of ownership • Smoother automated driving can cut energy use and reduce brake/tyre wear • Potential for lower insurance costs through improved safety • New business models may unlock investment or shared-risk approaches
Safety	• Large vehicles and long hours create inherently high-risk operations • Human error from fatigue, distraction, and time pressure remains the main cause of incidents [9] • Accident frequency and severity drives rising insurance costs • Increasingly complex safety requirements add training and compliance burdens	• Automated and assisted systems can significantly reduce collision and lane-departure incidents • Removes fatigue- and distraction-related variability • Provides consistent rule-based driving across all conditions • Fewer incidents and potential insurance savings

Challenge in heavy duty freight sector		How autonomy can help
Efficiency	• Freight volumes increasing while road capacity remains constrained • Around one-third of traffic on major UK roads is logistics-related (up to ~47% on busiest sections [4]) • Congestion leads to unreliable journey times and higher costs • Up to ~30% of HGV kilometres travel empty due to poor backhaul matching [10] • Shortage of safe parking/rest facilities increases disruption	• Enables 24/7 operations without driver rest break constraints • Supports higher utilisation and leaner fleets • Optimises routing and operations, and potential for platooning • More consistent driving can ease pressure on congested routes
Environ-mental sustaina-bility	• HGVs contribute significantly to road transport emissions • Charging and hydrogen refuelling infrastructure are currently limited • High-power charging often requires major grid upgrades • High upfront cost of zero emission vehicles and infrastructure	• Works in synergy with electrification; vehicles could drive to charge where grid capacity is higher • Smoother, consistent driving reduces energy use • Automated systems can optimise charging schedules and improve vehicle utilisation • Opportunity to reduce noise and congestion by rescheduling and relocating deliveries, based on efficiencies from new vehicle types as well as operating patterns

Where are we now?

Autonomous vehicle capabilities

Autonomous vehicles (AVs) use a combination of sensors, software and onboard computing to perform some or all of the driving task without human input. Depending on the level of automation, this can include maintaining lane position and speed, responding to traffic and hazards, navigating complex environments, and operating for extended periods without a driver.

Levels of automation are commonly described using the SAE International J3016 framework, which defines six levels from Level 0 (no automation) to Level 5 (full automation in all conditions) [11].

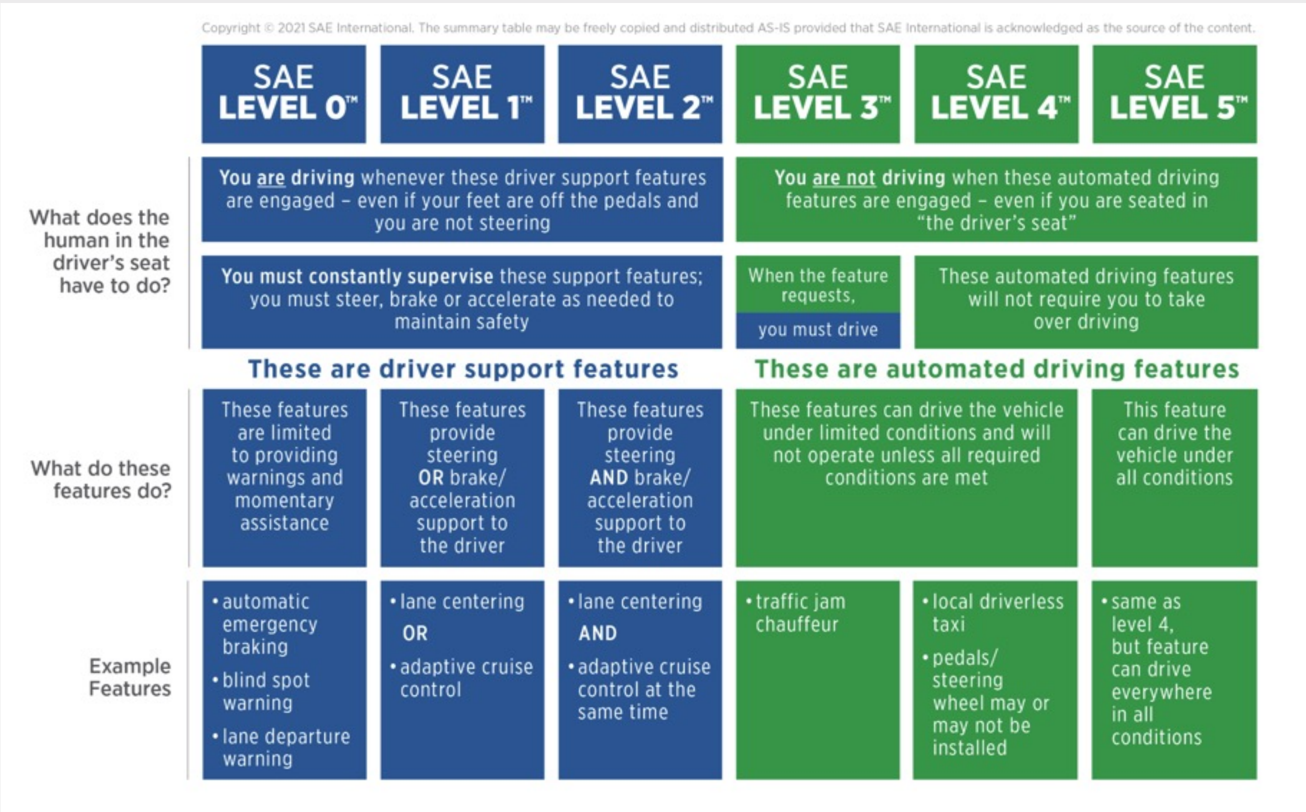


Figure 1: SAE J3016 Levels of Driving Automation

Passenger car connected and automated vehicle technologies are the most visible area of AV development globally. Level 2 systems, termed 'Driver support features', are now commonplace in new vehicles, and level 4 autonomous taxi services are operating in a small number of cities around the world. These services demonstrate the technical capability of autonomous vehicles today within an operational design domain. Current deployments rely on high-definition mapping, remote support, and operational oversight.

Autonomous heavy duty vehicles

While passenger car autonomy and robotaxi services are the most visible applications of automated driving globally, progress in freight autonomy has been ongoing in parallel, focussed on commercially beneficial use cases. This includes autonomous operations at intermodal depots, ports and logistics hubs, which have been established for a number of years, often with light or medium duty vehicles. These environments enable vehicles to operate within clearly defined operational design domains, supporting safe interaction with people, infrastructure and other automated systems while delivering measurable productivity and efficiency benefits. The majority of autonomous heavy duty freight deployments to date have focused on highway operations between transfer hubs or distribution centres, with human drivers typically taking over for first and last mile segments.

Internationally, heavy duty autonomy is now progressing into sustained commercial operation across a wide range of use cases. Smaller autonomous vehicles have been deployed for first and last mile logistics in constrained environments, and larger heavy duty vehicles are operating on fixed hub-to-hub routes on public highways in the United States, Europe and China. These deployments remain bounded by defined operating conditions, but demonstrate that Level 4 autonomy for freight is technically viable today and increasingly ready for scaled deployment where regulation, infrastructure and commercial models align.

In the UK, deployment has so far been largely confined to depots and intermodal hubs, reflecting the constraints of existing legislation. Examples include autonomous cargo handling at East Midlands Airport [12], and commercial autonomous yard tractors at the Port of Felixstowe [13]. Autonomous vehicles in these environments have demonstrated high-precision manoeuvring, integration with live operations and delivery of real productivity and decarbonisation benefits. Forthcoming regulatory changes under the Automated Vehicles Act are expected to enable a broader set of use cases beyond confined sites.

Further details of international and UK projects are provided in the Appendix to this report.

Legislation

Importance of legislation

Legislation determines the conditions under which autonomous vehicles can be tested, authorised and deployed, creating the confidence and predictability that industry needs to invest. A clear legal framework enables safe innovation by defining what constitutes a "self-driving" feature in law, how safety is demonstrated before and during deployment, and who is responsible when the system is driving.

A well-designed regulatory framework also balances innovation with public safety and trust. Automated systems must be deployed gradually, in controlled operational domains, and under transparent safety expectations. Independent oversight, clear allocation of responsibilities, and mechanisms for investigating incidents help ensure that new technologies are introduced in a way that protects road users and builds confidence over time. This principle has been central to international regulatory efforts, including the work of the Law Commission in Great Britain on the legal distinction between driver assistance and self-driving capabilities, and the need for transparent safety standards [14].

Harmonisation is critical given the cross-border nature of freight and the global nature of vehicle manufacturing. International bodies such as the United Nations Economic Commission for Europe (UNECE) are developing common safety approaches, technical requirements and validation methods for Automated Driving Systems through dedicated workstreams (for example the Working Party on Automated/Autonomous and Connected Vehicles and the ADS global technical regulation process) [15]. These efforts aim to reduce divergence between countries, support interoperability and allow automated freight vehicles to operate across different jurisdictions with consistent expectations.

International regulatory landscape

Regulatory approaches vary across regions.

United States	There is no single federal AV trucking law yet; operations are enabled through a patchwork of state rules plus federal guidance. In 2025 a federal bill (AMERICA DRIVES Act) was introduced to create a national framework for Level 4–5 autonomous trucks, including directing the Federal Motor Carrier Safety Administration (FMCSA) to update rules by 2027, and exempting fully autonomous trucks from human specific requirements (e.g. hours of service) [16]. Multiple industry and trade sources summarise the bill's aim to pre empt conflicting state restrictions and standardise interstate operation [17] [18].
European Union	The EU has established a route to type approve fully automated vehicles' automated driving systems (ADS) via Regulation (EU) 2022/1426, with the Commission's Joint Research Centre issuing interpretation guidance to operationalise testing, operational design domain definition and safety management [19] [20]. National authorities (e.g. Germany's KBA) can now grant EU type approval for Level 4 ADS in small series for defined use cases, including freight vehicles (category N) operating on fixed routes or specified areas [21].
China	China's approach to autonomous vehicles is supportive but decentralised, relying on national standards and ministerial regulations rather than a single AV law, with automated driving defined under the national GB/T 40429-2021 driving automation taxonomy issued in 2021 [22]. Central government permits road testing and pilot operations, while local governments (e.g. Beijing, Shanghai, Shenzhen, Wuhan) have enacted binding rules that enable on-road trials and early commercial services, including freight and logistics [23]. AVs engaged in transport services must comply with existing vehicle registration, safety, insurance and transport licensing regimes, with liability handled mainly through general traffic and product liability law rather than AV-specific legislation. Overall, the regulatory system is explicitly deployment-oriented, enabling Level-4 autonomous trucking to move from pilots into early commercialisation on highways and logistics corridors, giving China one of the most permissive large-market environments globally [24].
International harmonisation (UNECE)	UNECE WP.29 is developing a worldwide ADS safety regulation and Global Technical Regulation, building on workstreams for functional requirements and validation methods. Draft texts were tabled for review at WP.29 in March 2026 [25] [26].

UK legislative framework

At present (March 2026), UK law does not allow commercial deployment of autonomous vehicles on public roads. Trials are permitted, based on the *Code of Practice: automated vehicle trialling* [27], and those planning to conduct advanced trials should contact the Centre for Connected and Autonomous Vehicles (CCAV) in advance [28].

Commercial deployment is due to be allowed in the coming years thanks to the *Automated Vehicles Act 2024* (AVA). The act establishes the legal framework for the safe deployment of self-driving vehicles in Great Britain, setting out rules for authorisation, safety oversight, liability, and marketing restrictions. The AVA defines a vehicle as "self-driving" or "no-user-in-charge" if it can safely drive itself without human monitoring for at least part of a journey, and places clear legal responsibility on the authorised self-driving system rather than the human user during those periods.

Since the AVA is primary legislation, an Implementation Programme was launched alongside it to produce the secondary legislation and guidance required to establish the act's regulatory framework. The programme will also develop processes to approve and authorise AVs, and ongoing requirements to maintain the validity of this authorisation.

A draft of the statutory instrument *The Automated Vehicles (Permits for Automated Passenger Services) Regulations 2026* was consulted on in 2025 and the updated version is due to be passed in the second half of 2026 [29]. This is expected to allow companies such as Waymo to operate autonomous taxi services in the UK.

Until secondary legislation enters into force, insurance for automated operation continues to rely on the *Automated and Electric Vehicles Act 2018* [30]. When a listed automated vehicle is "driving itself", the insurer is directly liable to compensate victims and can recover from responsible parties afterwards (e.g. product liability). This complements AVA's shift of legal responsibility to the authorised self-driving entity (ASDE) and away from the user during automated operation, as envisaged by the Law Commission [14].

Further legislative considerations

UK HGV Construction and Use legislation will need to be considered as new types of HGVs become possible due to autonomy. Without a cab, fully autonomous HGVs may be very different to the vehicles of today. A typical HGV cab weighs approximately two tonnes and takes a significant amount of space. Whilst an autonomous articulated tractor unit could be built within existing construction and use legislation, the 'smart trailer' concept, based around a self-powered trailer that would replace many articulated HGVs does require changes to legislation.

Specifically, a five-axle rigid HGV with a 42-tonne gross vehicle weight and a 15.6 metre overall length would create significant advantages for autonomous HGVs over today's vehicles, whilst being lighter than today's articulated HGVs. This specification of vehicle is already available in some other parts of Europe. A comparison between a current articulated HGVs and an autonomous 'smart trailer' is shown below.

Autonomous Smart Trailer	Articulated HGV
	
42-tonne Gross Vehicle Weight	44-tonne Gross Vehicle Weight
10-12 tonne unladen weight	15-17 tonne unladen weight
30-tonne payload	27-29 tonne payload
117m³ volumetric load space	102m³ volumetric load space
15.6m overall vehicle length	16.7m overall vehicle weight
18.4 tonne average payload	16 tonne average payload
29 tonne average on-road weight	32 tonne average on-road weight

Compared to today's articulated HGVs, an autonomous 'smart trailer' would be:

- 1.1 metres shorter
- 7% greater weight payload
- 15% greater volumetric payload
- 2 tonnes lighter gross vehicle weight
- 3 tonnes lighter average on-road weight
- Allow an average payload increase from 16 tonnes to 18.4 tonnes
- Have no increase on axle weights over today's 32-tonne rigid HGVs

As a driven vehicle, this configuration of HGV has an immediate benefit for the construction sector that currently uses 32 tonne rigid HGVs, providing a 50% uplift in payload over their current vehicles. Based on investigations carried out as part of the eFREIGHT Autonomous project, 86,987 of these vehicles are currently on UK roads. There is the potential to remove around 25% – 21,747 vehicles – off UK roads with this configuration.

As an articulated HGV, this configuration of vehicle is of particular use for hub-to-hub trunking (approximately 70,000 vehicles), container movements (17,760 vehicles), construction and aggregates (86,987) and hire-and-reward (25,891 vehicles): a total of 200,638 vehicles. With automation plus the increased payload, we believe this configuration of smart trailers could equate to around 160,000 vehicles in these sectors, and take approximately 22,500 heavier, articulated HGVs off the roads.

What is the opportunity for the UK?

UK position

The UK is well placed to be an early deployment market for autonomous freight and to shape its development internationally. This position is underpinned by a combination of strong logistics demand, a clear legislative and standards framework, and active innovation and testing capability.

Strong logistics market and sector coordination

The UK has a large, complex and time critical logistics economy with heavy reliance on road freight. In 2024 the UK moved around 206 billion tonne kilometres of domestic freight, of which 82% was by road. GB registered HGVs lifted around 1.59 billion tonnes, underscoring the centrality of trucking to national supply chains [3]. Sector bodies estimate logistics contributes on the order of £185 billion to the economy and employs over 8% of the workforce, highlighting both scale and the potential productivity gains from automation [1] [31]. Department for Transport (DfT) data shows 2024 HGV traffic at ~16.6 billion vehicle miles and HGVs responsible for ~16% of domestic transport emissions, framing both the efficiency and decarbonisation opportunity that autonomy can support alongside zero emission vehicles [2].

The structure of the UK freight network creates favourable conditions for early deployment. Flows are concentrated along a relatively small number of strategic corridors and between major logistics hubs, ports and air cargo centres, supporting clearly defined operational design domains and repeatable routes. The East Midlands cluster illustrates this clearly: East Midlands Airport is the UK's leading express freight hub, handling approximately 375,000 tonnes annually and sitting within two hours of 80% of the UK warehouse footprint, with ongoing expansion under Freeport status [32].

Legislative, regulatory and standards leadership

The UK has established a clear and pragmatic pathway from trialling to commercial deployment of self-driving vehicles. The current Code of Practice enables on road trials with appropriate safety assurance, insurance and engagement with local authorities. National Highways has also published safety case guidance for operation on the Strategic Road Network, supporting a consistent and structured approach to risk management [33]. This is complemented by a defined implementation programme to bring the primary legal framework for automated vehicles into force from 2027, including processes for authorisation, in-use oversight, and consumer protection.

The UK is also actively engaged in international standards development through UNECE work on automated driving systems, supporting alignment with emerging global technical regulations. At a national level, the British Standards Institution plays a key role in developing standards relevant to autonomous systems, safety and interoperability. Alongside this, wider decarbonisation policy, including the ZEV Mandate and the phase out of new non zero emission HGVs (≤26t by 2035 and all HGVs by 2040), provides a clear long term signal for zero emission platforms that are well aligned with autonomous operation. Taken together, this provides regulatory clarity for investors and a credible framework for safe deployment, positioning the UK as a leading jurisdiction for autonomous freight.

Innovation, testing and industrial capability

The UK has a strong base of innovation programmes, real world trials, and test environments that de risk deployment and support capability development.

At ports and logistics terminals, autonomous vehicle operations are already being deployed in live environments. At the Port of Felixstowe, battery electric autonomous terminal tractors are operating in mixed traffic using private 5G connectivity and automated battery swap systems [13]. In industrial settings, trials in Sunderland are progressing driver out autonomous HGV movements on private roads between Vantec and Nissan, supported by remote supervision and integrated into wider smart city and mobility pilots [34]. These deployments are supported by enabling infrastructure, including private 5G networks at ports and freeports, and a growing set of digital and physical testbeds.

On the Strategic Road Network, the UK's multi year HGV platooning programme demonstrated safety comparable to adaptive cruise control and fuel savings of 2.5-4.1% in optimised conditions, providing a stepping stone towards higher levels of automation [35].

Where the UK can capture value

The UK opportunity spans multiple layers of the autonomous freight value chain, from vehicle and technology supply through to infrastructure and operational services.

Vehicle and platform supply

Autonomous freight deployment will require vehicles that are both zero emission and autonomy ready. OEMs are expected to supply base platforms with integrated sensor suites and drive by wire capability, while additional integration, validation and adaptation will be required for specific use cases.

The UK is not a large scale HGV manufacturer, but it does have strengths in vehicle integration, niche autonomous platforms and test and validation. There is an opportunity to position the UK as a centre for integrating zero emission and autonomous systems, particularly for defined operational domains such as ports, airports, yards and short range logistics applications. UK examples include Aurrigo, which develops autonomous airside baggage and cargo vehicles including Auto-DollyTug and Auto-Cargo, and Conigital, which focuses on zero emission and autonomous commercial and industrial fleets in ports, yards and airports.

Autonomy technology and software

Significant value sits in the autonomy stack and supporting software systems. This includes perception and decision making systems, simulation and validation environments, safety case tooling, telematics, fleet optimisation and data platforms.

The UK has strong capabilities in AI, safety engineering and assurance, supported by a growing SME base and publicly funded programmes. These capabilities are directly applicable to autonomous freight and are already being developed through live deployments and industrial logistics programmes. Relevant UK companies include:

- Oxa, which provides self-driving software, modular autonomy hardware and fleet management software
- Fusion Processing, which develops automated driving and ADAS systems including remote operator interfaces
- dRISK, which develops scenario databases and risk assessment tools for AV developers, fleet operators and infrastructure planners
- rFpro, which provides engineering-grade simulation software for the development, testing and validation of ADAS and autonomous vehicle systems.

Infrastructure and enabling systems

Autonomous freight depends on enabling infrastructure, particularly in early deployment. This includes depot and yard automation, charging infrastructure for zero emission vehicles, connectivity including private 5G networks, and digital infrastructure to support safe and efficient operation.

The UK's investment in ports, freeports and logistics hubs, combined with ongoing private network deployment, creates an opportunity to develop and export integrated infrastructure solutions that support both autonomy and decarbonisation. Relevant UK suppliers include BT, which has developed private 5G port solutions and positions private networks as an enabler of automated logistics and supply chain operations, and Zeetta Networks, a UK software company whose orchestration products are designed to manage heterogeneous enterprise networks including private LTE and 5G environments.

Operations and service layer

Early deployment of autonomous HGVs creates a commercial opportunity that sits between the vehicle manufacturer, the autonomy technology provider and the fleet operator. Many OEMs are expected to prefer supplying an autonomous-ready vehicle rather than operating the day-to-day service themselves, while fleet operators are unlikely to want to build full No-user-in-charge (NUiC) capability from first adoption. This creates space for an independent autonomy operations provider able to offer a consistent operational interface across vehicles, software suppliers, and customers.

The commercial role of this intermediary is to combine regulatory responsibility, operational monitoring and system integration. Depending on the commercial structure, the provider may act as the Authorised Self-Driving Entity (ASDE) (for OEMs that choose not to hold that role themselves), act as the NUiC operator for fleet customers, and provide the off-board systems needed to manage autonomous freight at fleet scale. These capabilities include fleet optimisation and dispatch, remote supervision, safety governance, integration with operator systems, data exchange and performance reporting, with selected charging or site services added where relevant. This operations layer forms the basis of the primary commercial model emerging in autonomous freight.

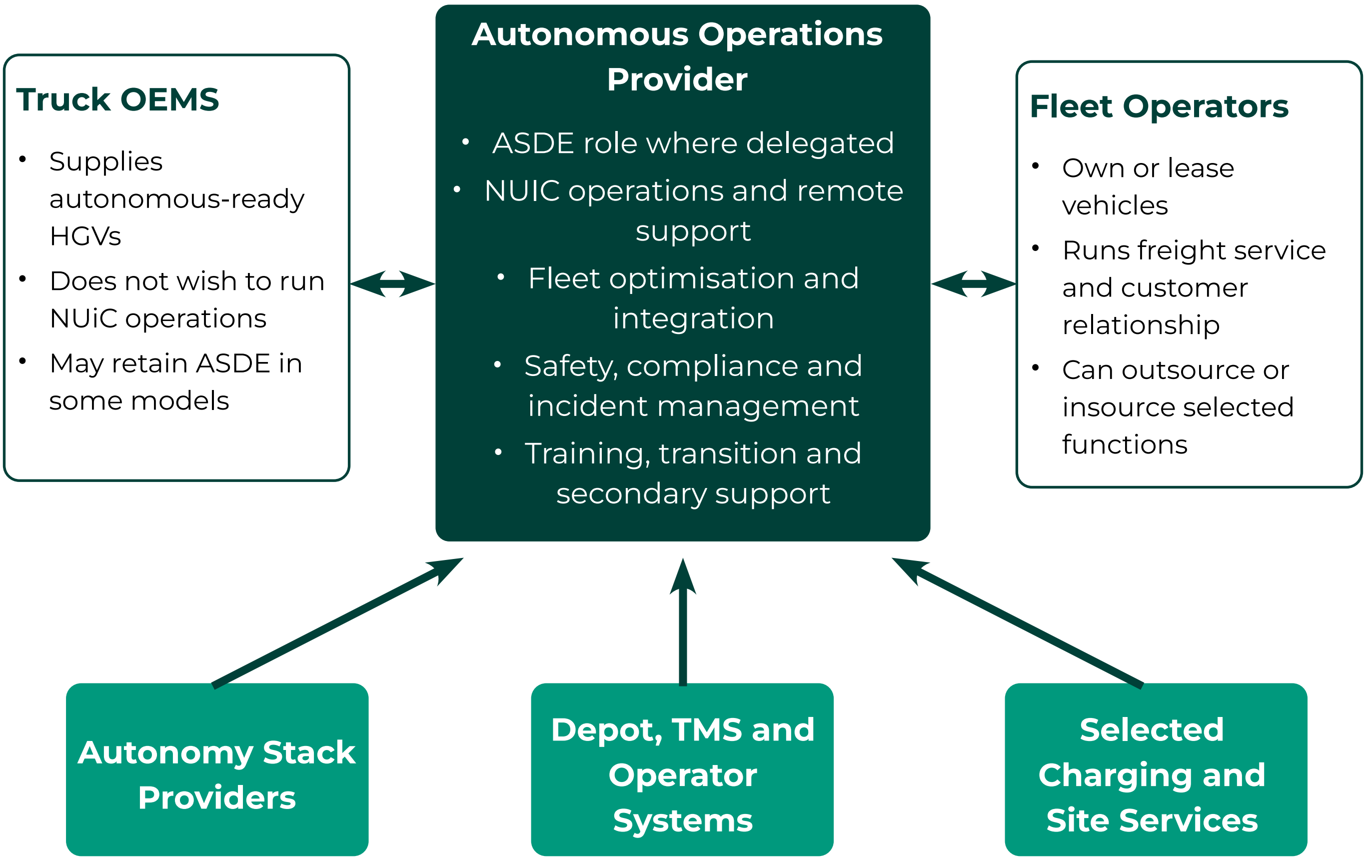


Figure 6: Indicative commercial position of an independent autonomy operations provider within the autonomous freight value chain

Business models and revenue potential

Core model: Autonomy as a Service

A likely early business model is Autonomy as a Service. Under this model, the fleet operator continues to procure or lease the vehicle in the normal way, while the autonomy service provider supplies the operational and digital layer required for driverless operation. That service can include ASDE responsibilities where delegated by the OEM, NUiC operations, remote monitoring, compliance management, software access, operational reporting and second-line support.

This model is attractive in early deployment because it converts a complex capability challenge into a contracted service. It lowers barriers to entry for fleets, avoids duplication of specialist operational teams across the market, and allows deployment to scale across multiple OEM and software platforms. For OEMs that choose to retain the ASDE role themselves, the same model can still apply, with the independent provider focusing on NUiC operations, software integration and support services.

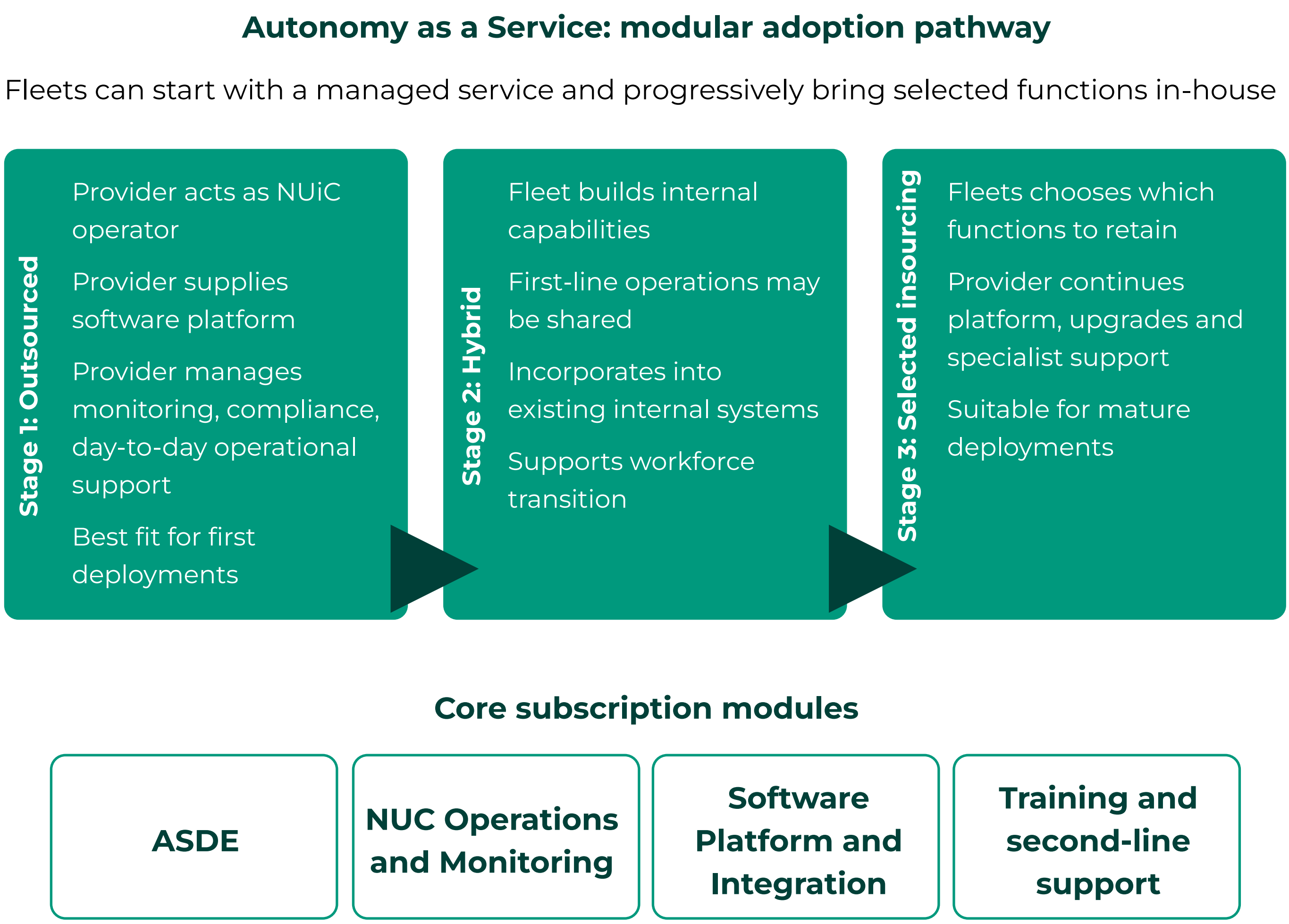


Figure 7: Indicative Autonomy as a Service model showing modular adoption and transition from outsourced to hybrid and selected in-house operation

Market size and revenue potential

Market sizing modelling undertaken as part of the eFREIGHT Autonomous project indicates that the two priority use cases (hub-to-hub trunking and intermodal shuttle) alone already represent a material recurring-revenue opportunity. For hub-to-hub trunking, around 70,000 driven vehicles are in service today, equivalent to an estimated 52,500 autonomous vehicles once higher utilisation is taken into account. For intermodal shuttles, around 17,760 driven vehicles correspond to an estimated 13,320 autonomous vehicles. Combined, this implies an addressable autonomous fleet of around 65,820 vehicles across the two use cases.

Under the optimistic uptake scenario in the sizing modelling, the active autonomous fleet across these two use cases grows from around 330 vehicles in 2030 to 52,656 by 2035 and 65,820 by 2040. At an illustrative Autonomy-as-a-Service price of £2,000 per vehicle per month, this equates to annual revenue potential of approximately £7.9 million in 2030, £1.26 billion in 2035 and £1.58 billion by 2040. This suggests that the two use cases prioritised in this report are sufficient on their own to support a sizeable standalone UK service market.

Use case	Driven vehicles today	Autonomous vehicles required	Illustrative annual AaaS revenue at full uptake
Hub-to-hub trunking	70,000	52,500	£1.26bn
Intermodal shuttles	17,760	13,320	£319.7m
Combined priority use cases	87,760	65,820	£1.58bn

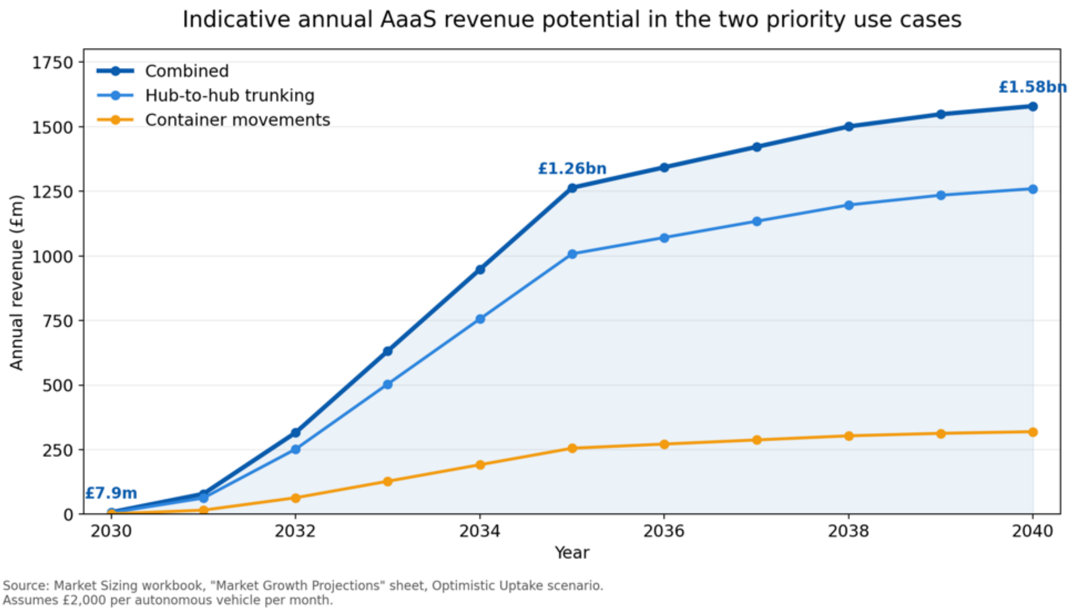


Figure 8: Illustrative annual AaaS revenue potential for priority use cases, based on Market Growth Projections worksheet (Optimistic Uptake, £2,000 per vehicle per month)

Additional use cases were modelled as part of market sizing, including regional distribution, construction and aggregate movements and hire-and-reward 'tramping' movements. These use cases add an additional 143,348 vehicles to the total number of autonomous vehicles that will be required by 2040.

More details regarding the modelling carried out are available on request.

Modular adoption and transition

The business model is likely to be modular rather than all-or-nothing. In the early stages, many fleets are likely to contract for a full managed service, particularly for NUiC operations, safety monitoring and incident response. As capability matures, some operators may wish to bring selected functions in-house, for example first-line NUiC oversight or local operational control, while continuing to license software platforms and retain specialist assurance, training and second-line support externally.

This transition pathway is commercially important. It allows early adopters to start with minimal internal capability, while preserving a route to deeper internal ownership later. It also creates additional service lines in training, consultancy, operational readiness and change management, supporting workforce transition alongside technology deployment.

Revenue model and allocation of responsibility

The core commercial structure is a recurring monthly subscription paid per autonomous vehicle, potentially complemented by one-off integration fees, training packages and premium support services. This aligns supplier revenues with fleet deployment and utilisation rather than depending solely on capital sales. It also provides a practical route for SMEs and larger operators to adopt autonomous capability without making all supporting investments upfront.

Responsibilities within this model should remain clearly separated. The OEM provides the base vehicle and, in some cases, may retain ASDE responsibility. The fleet operator remains responsible for the logistics service, customer relationship and asset procurement. The autonomy operations provider sits between these parties, operating the NUiC function, managing day-to-day operational oversight and providing the software and systems needed to run the autonomous fleet. This separation of roles is consistent with the emerging regulatory structure and supports a more open, competitive ecosystem.

This structure enables a more open market: OEMs can supply vehicles without operating services, fleet operators can procure across multiple suppliers without managing separate systems, and technology providers can integrate through a common operational layer.

Where should we start?

Bring industry together through trials

A trial programme would generate the operational, economic, and policy evidence required to enable large-scale deployment of autonomous freight vehicles in the UK.

Experience from previous programmes such as the Zero Emission HGVs and Infrastructure Demonstrator (ZEHID) Programme demonstrates that well-structured trials can accelerate technology adoption, unlock private investment, and create long-term industrial capability and confidence in emerging transport sectors.

Trials should therefore aim to:

- Demonstrate safe autonomous freight operations in real logistics environments
- Quantify operational and economic benefits of autonomous freight
- Generate evidence to support and inform regulatory and insurance frameworks
- Develop UK capability and supply chains in autonomous freight technology
- Accelerate commercial deployment following trials
- Strengthen the UK's position in the global autonomous freight market

Focus on key use cases

When planning trials, infrastructure, and legislation, it is important to focus on use cases with the most early commercial opportunity.

Heavy freight operations can broadly be grouped into the following use cases:

- **Hub-to-hub trunking** – long distance distribution via the strategic road network
- **Intermodal shuttles** – repetitive short journeys less than 5km between ports, railheads, depots or distribution hubs
- **On-site operations** – the shunting of containers or trailers on site
- **Urban deliveries** – last mile deliveries to urban consolidation centres or retail locations

Industry stakeholder engagement and modelling analysis suggests the highest feasibility and UK commercial opportunity will come from **hub-to-hub trunking** and **intermodal shuttles.** On-site operations also offer benefits, but are already starting to be actioned by industry and do not need to wait for changes in legislation since they are on private land. As with automation within factories, market forces are expected to drive progression of on-site automation with limited need for extra intervention. Urban deliveries are the most technically complex use case, and are therefore likely to follow on after other use cases are well established.

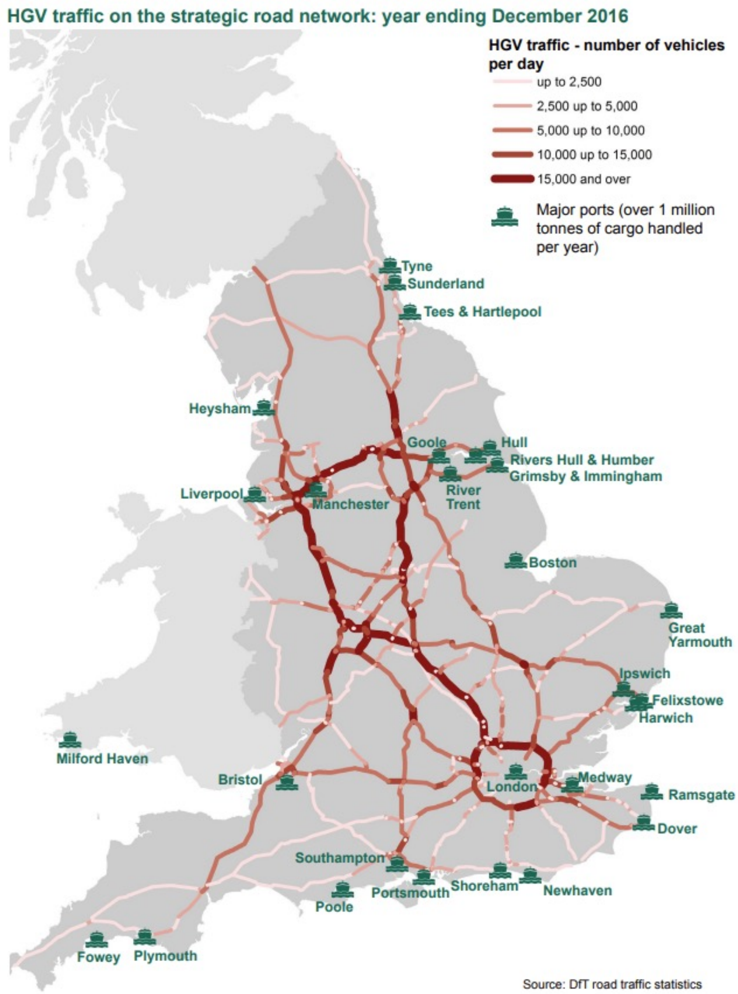
Hub-to-hub trunking

Trials of hub-to-hub automation could involve high-frequency movements between national distribution centres and intermodal hubs, using autonomous vehicles on motorways and A-roads with controlled loading/unloading environments at each hub.

This use case includes palletised freight networks and is applicable to a wide range of fleets, with significant potential to address driver shortages and maximise productivity. The average haul length in 2024 was 106 km (tonne-km per tonne lifted).

By focusing on key freight corridors, learnings from trials would be applicable to many other operators.

Figure 9: HGV traffic on the strategic road network



Intermodal shuttles

This use case covers shuttles between strategic ports or railheads and nearby depots. Trial operations could involve predictable, high-frequency shuttles within ~5 miles, relocating trailers and containers to their point of pick-up.

An example of this use case is container movements on the East Midlands Gateway site. Here and at other similar sites, short 1-2 mile journeys are common. The roads on the site are public and maybe more complex than SRN driving, as vehicles will need to negotiate junctions and roundabouts, though lower vehicle speeds may help the safety case.

Figure 10: Map of East Midlands Gateway intermodal logistics park

Early stage trials in construction industry

While not in the scope of 'heavy duty freight', construction activities such as road building offer a useful setting for early stage trials and early commercial application of autonomous heavy vehicles. Projects led by construction and materials operators such as Tarmac can provide controlled, repeatable operating conditions. Movements are often between known points, at lower speeds, and within agreed site rules. This can reduce complexity while still testing real world interactions with people, plant and changing layouts.

These trials can help prove the wider system needed for autonomous freight. This includes how the operational design domain is defined, how remote supervision works in practice, how exceptions are handled, and how incidents are recorded and investigated. Learning from construction environments can then be carried into the priority use cases described above.

Consider unintended consequences of autonomous freight

Autonomous freight technologies have the potential to improve logistics efficiency, reduce costs and enhance road safety. However, their deployment may also produce unintended economic, operational and policy consequences. Understanding these effects will be important when designing regulatory frameworks, trials, and large-scale deployment strategies.

Potential impacts on rail freight competitiveness

One potential system-level effect is the impact of autonomous road freight on the competitiveness of rail freight. Road freight currently dominates domestic freight movement in the UK. Approximately 82% of domestic freight (measured in tonne-kilometres) is transported by road, while rail freight accounts for around 8% of total freight movement [2].

Rail freight can provide cost advantages for long-distance bulk transport, but it often requires significant fixed infrastructure, terminal facilities and sufficient volumes to operate efficiently. In addition, rail freight typically relies on road transport to complete first- and last-mile movements between rail terminals and final destinations.

Automation has the potential to reduce the cost of road freight transport. Modelling by the International Transport Forum suggests that driverless trucks could reduce freight transport costs by up to 30% under certain operating conditions [34]. If the cost of road freight falls significantly, autonomous trucks could strengthen the competitive position of road transport relative to rail for some freight flows. This could lead to a degree of modal shift from rail to road unless rail freight competitiveness also improves or intentional efforts are made to link autonomous road freight to rail services. Conversely, reduced rail freight demand could potentially release capacity on the rail network for passenger services or alternative freight uses.

Workforce and labour market impacts

Freight automation could also have implications for the logistics workforce. Road freight currently supports a large number of driving roles across the UK economy. According to the International Road Transport Union, the global trucking sector faces persistent driver shortages, while at the same time employing millions of professional drivers worldwide [35].

Automation may reduce the demand for some driving roles over time while creating new roles in areas such as remote supervision, fleet monitoring, vehicle maintenance and logistics system management. This highlights the importance of workforce transition planning and skills development.

Impacts on smaller operators and market structure

The road freight sector includes many small and medium-sized operators. In the UK, these businesses typically have a fleet of less than six vehicles [36]. The introduction of autonomous vehicle technology could require significant upfront investment in vehicles, software systems, and digital infrastructure. These costs may create barriers to adoption for smaller operators, particularly during the early phases of deployment.

Larger logistics providers may be better positioned to adopt autonomous technologies at scale, potentially increasing market consolidation within the freight sector. Smaller fleet operators are gradually becoming aware of what will be required as part of the transition to net zero, but are less knowledgeable about the automation transition. Coupling the two together to ensure new vehicle purchases are futureproof could be beneficial.

Infrastructure and system pressures

Large-scale deployment of autonomous freight could also increase demand for supporting infrastructure. This may include:

- depot and logistics hub redesign for automated operations
- high-reliability digital connectivity and positioning systems
- expanded charging or refuelling infrastructure for zero emission freight vehicles.

Government projections suggest that road freight traffic could increase by around 22% between 2025 and 2060 under a central scenario [37]. Increased freight movement, combined with automation-driven productivity gains, could therefore place additional pressure on road infrastructure if demand grows faster than capacity.

Cybersecurity and system resilience

Autonomous freight vehicles rely on complex software systems, connectivity and remote data services. This increases the importance of cybersecurity and system resilience. International vehicle regulations developed through the United Nations Economic Commission for Europe require manufacturers to implement cybersecurity management systems and secure software update processes for connected vehicles [38] [39]. Ensuring that these protections are implemented effectively will be important for maintaining operational resilience and public confidence in autonomous freight systems.

Regulatory and liability considerations

The deployment of autonomous vehicles also raises questions around regulation, liability and insurance frameworks. In the UK, the Automated Vehicles Act 2024 establishes a legal framework for authorising automated driving systems and clarifying responsibilities when automated driving systems are in control of the vehicle. However, detailed regulatory guidance, operational standards and insurance frameworks are still evolving. Clear regulatory oversight and safety assurance processes will be important to support safe deployment and public trust during the transition to autonomous freight operations.

What enabling conditions are needed?

For UK development and deployment of autonomous heavy freight to maximise the potential benefits to the logistics sector and wider economy, a clear set of enabling principles are required as set out in the table below.

Enabling principle	Implications for deployment
Safety validation and assurance	Deployment of autonomous HGVs requires robust validation and structured, evidence based safety cases. Autonomous systems must demonstrate safety performance at least equivalent to a careful and competent human driver within defined operational design domains.
Trust, transparency and accountability	Public and insurer confidence depends on transparent reporting, clear incident investigation processes and well defined accountability when the automated system is in control. Clear legislation is required to assign responsibility to different actors.
Safe operation in real world conditions	Autonomous systems must safely integrate into mixed traffic and address edge cases such as adverse weather, roadworks and unexpected behaviour, alongside managing cybersecurity risks.
Management of human and automated risks	Full safety benefits depend on managing both traditional human operation risks and automation specific risks together, rather than treating them in isolation.
Systems level alignment	Benefits depend on aligning automation with infrastructure, energy and operational planning. Poor alignment risks fragmented investment, under utilised assets and slower progress towards a low carbon, resilient freight system.

Specific enabling actions will be needed to overcome specific barriers, as set out in the table below:

Enabling principle	Barriers	Enablers
Safety validation and assurance	Deployment requires structured safety cases, independent audits and continuous monitoring to demonstrate performance equivalent to a careful and competent human driver within the defined operational design domain (ODD). The validation burden for demonstrating safety at scale remains significant.	Established safety frameworks including Goal Structured Notation (GSN), Safety Management Systems, ISO 26262/21448 and PAS 1880–1883 provide structured approaches for demonstrating safety and building regulator and insurer confidence.
Trust, transpar-ency and accounta-bility	Regulatory maturity and liability clarity for public road deployment are still evolving. Secondary legislation, operator licensing for No-user-in-charge (NUIC), insurance underwriting and data sharing protocols are not yet developed. Concerns around safety incidents, job displacement and workforce impacts may also affect industry and public acceptance.	The Automated Vehicles Act 2024 establishes a statutory framework for authorising automated driving systems, including defined responsibilities for authorised self-driving entities and regulatory oversight. Transparent reporting, safety data sharing and workforce transition pathways can help maintain trust. Raising industry awareness of the technical capability and benefits of autonomous freight vehicles will benefit UK logistics industry.
Safe operation in real world conditions	Technology maturity remains a challenge in complex environments. Edge cases such as adverse weather, temporary roadworks, mixed traffic conditions and sensor degradation remain difficult to address reliably at scale. Infrastructure readiness can also limit safe deployment, including inconsistent road markings and signage.	Early deployment in predictable environments such as private-site shunting, intermodal shuttles, or hub-to-hub motorway operations provides clearly defined operational design domains and allows safe scaling of autonomous freight systems. Infrastructure improvements including intelligent roadside systems and connectivity upgrades can further support safe operations.

Enabling principle	Barriers	Enablers
Manage-ment of human and au-tomated risks	Integrating autonomous and manually driven vehicles introduces operational complexity. Coordinating tele-operations, emergency procedures and mixed fleet management can increase operational risk if not carefully managed. Cybersecurity risks and software update management are also critical considerations for connected autonomous vehicles.	Experience and evidence-based operational frameworks for mixed fleets, remote supervision and incident response are being developed through pilot programmes and industry guidance. Cybersecurity frameworks and secure software update requirements also support risk management.
Systems level align-ment	High upfront capital costs for autonomous vehicles, tele-operation systems and depot reconfiguration present challenges, particularly in a sector dominated by SMEs. Energy infrastructure constraints, including grid capacity and charging infrastructure for zero emission HGVs, may also limit deployment. Road congestion, empty running and limited safe parking infrastructure further affect freight system performance.	Public-private pilot programmes and corridor initiatives can help align infrastructure investment, regulation and industry capability. Service-based commercial models such as Autonomy-as-a-Service may lower barriers to adoption. Evidence from global deployments also demonstrates potential productivity and safety benefits of autonomous freight operations.

Recommendations and next steps

Report summary

This report finds that autonomous heavy road freight has the potential to transform the UK logistics industry in a short period of time. International evidence demonstrates that Level 4 autonomous freight operations are already viable in constrained environments, particularly hub-to-hub trunking and intermodal shuttle operations. In the UK, deployment has so far been limited by legislation, but the Automated Vehicles Act 2024 establishes a clear pathway to commercial operation, with secondary legislation now in development.

The analysis shows that autonomous freight is most likely to emerge incrementally, beginning with predictable routes, controlled interfaces and mixed human–automated operations. Early adoption will be shaped as much by regulation, infrastructure readiness, safety assurance and commercial models as by vehicle technology itself. Decisions taken in the next few years will influence where deployment occurs, who benefits, and how risks and impacts are managed.

Actions

In light of these findings, the following actions would support informed and proportionate progress:

Action	Action owners
Support structured, real world trials of autonomous freight in priority use cases, particularly hub-to-hub trunking and intermodal shuttles, to generate operational, safety and economic evidence relevant to UK conditions.	CCAV
Ensure that secondary legislation and guidance under the Automated Vehicles Act provide sufficient clarity for freight use cases, including authorisation processes, in use monitoring, data requirements, and the role of remote supervision. Use learnings from trials to inform legislation and guidance.	Department for Transport
Align trial activity with infrastructure owners, local authorities and network operators to ensure that physical and digital infrastructure readiness is considered alongside vehicle capability.	CCAV
Engage early with insurers, regulators and safety and standards bodies to establish shared expectations around safety cases, incident reporting and data access for autonomous freight operations.	CCAV, project and trial participants
Raise industry awareness of the technical capability and benefits of autonomous freight vehicles. Where appropriate, link automation and decarbonisation transitions.	CCAV, project and trial participants, RHA, Logistics UK
Support dialogue between government, industry, workforce representatives and affected sectors to anticipate and manage potential unintended consequences, including impacts on skills, market structure and other freight modes.	CCAV, RHA, Logistics UK

Priorities for further work

Further work is needed in several areas to support evidence based decision making:

- Detailed assessment of the economic and operational impacts of autonomous freight across different fleet sizes, business models and regions, including implications for SMEs.
- Development of standardised approaches to safety assurance, data recording and performance reporting that are proportionate to freight use cases and aligned with international practice.
- Analysis of infrastructure and energy system requirements for autonomous zero emission HGVs, including depot design, charging strategies and corridor level constraints.
- Examination of workforce transition pathways, including new roles enabled by automation and the skills required to support mixed fleets and remote operations.
- Continued monitoring of international deployments and regulatory developments to ensure that UK policy and practice remain aligned with emerging global norms.

Together, these actions and priorities would enable government and industry to engage proactively with autonomous freight, shaping its introduction in a way that supports safety, productivity, decarbonisation and resilience, while retaining flexibility as the technology and its impacts continue to evolve.

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Appendix:

Heavy duty autonomous vehicle trials and deployments

The maturity of autonomous technology is high in terms of technical capability, but it does vary across providers. The table on the following pages will highlight the successes of early deployment across global case studies and the UK's current position in the market.

Case Study	Description	Use Case	Organisations	Deployment	Key Outcomes
UK					
HELM UK M5 / M6	HGV platooning trial running up to three HGVs in close convoy using adaptive cruise (ACC) systems to evaluate benefits and impact of technology.	L2 Platooning	TRL, National Highways, DfT, DHL, Scania, Ricardo	Real world trial (2017-2022)	Fuel savings of 2.5-4.1%, safety performance matched ACC, recommendations for low headway regulation and industry deployment.
UPS (Aurrigo) East Midlands Airport	Electric cargo vehicle for airside logistics, transporting ULDs within a geofenced area. Remotely monitored and integrated with airport operations.	L4 Airport Cargo Handling	UPS, Aurrigo, East Midlands Airport	Pilot (2023-2024)	Reduced emissions, faster cargo handling, improved resource utilisation, scalable to other airports.
V-CAL Nissan, Sunderland	Four electric 40 t Terberg HGV retrofitted for driver-out autonomous operations at an industrial campus, used to navigate traffic lights, roundabouts and road users.	L4 Shuttle	North East Automotive Alliance, StreetDrone, Vantec, Nissan, CCAV	Proof of concept pilot (2023)	Driver-out delivery of live loads, high precision reversing into tight bays (15 cm tolerance), improved productivity, safety, and decarbonisation.
Westwell Q-Truck Port of Felixstowe	Battery-powered autonomous yard tractors in mixed-traffic port ops, with high-precision positioning and automated battery swaps.	L4 Port Shunting	Westwell, Hutchison Ports	Commercial (since 2023)	24/7 operation, 50 t CO_2 savings per unit per year, improved safety, reduced idle time.

Case Study	Description	Use Case	Organisations	Deployment	Key Outcomes
EU					
Einride Pod Stockholm, Sweden	Cabless electric trucks on fixed routes between factories, warehouses, and hubs, integrated with digital fleet management and automated loading/unloading.	L4 Shuttle and First-Last Mile Trunking Operations TBC	TRL, National Highways, DfT, DHL, Scania, Ricardo	Real world trial (2017-2022)	Fuel savings of 2.5-4.1%, safety performance matched ACC, recommendations for low headway regulation and industry deployment.
MAN ATLAS-L4 A9, Germany	Hub-to-hub autonomous freight on public motorways, completing a 10km test drive to scale into real customer environments in 2025.	L4 Trunking	MAN Truck & Bus, ATLAS-L4 Consortium	Prototype, pilots (2023–2025)	Achieved 80km/h speed, 10–15% operating cost reduction, , provides blueprint for series production by 2030.
Rotterdam Port of Rotterdam, Netherlands	Six autonomous yard trucks for container shuttling between drop off and pick up points and sharing lane with pedestrians and manual vehicles.	L4 Port Shunting	Kramer Group, StreetDrone, Terberg	Pilot (2023–2025)	900,000 container moves/year, reduced cycle time, scalable model for other terminals.
Volvo Vera Gothenburg, Sweden	Electric, cabless terminal tractor on a fixed, geofenced route between DFDS logistics centre and APM port terminal.	L4 Shuttle	Volvo Autonomous Solutions, DFDS	Pilot (2019)	Continuous operation, reduced labour cost, improved safety, zero emissions and achieved speeds of 40km/h.
MODI EU corridor	Multi-site demonstrations of autonomous heavy-duty trucks across ports, urban roads and cross-border corridors (Rotterdam–Oslo), integrating terminals, highways and logistics hubs.	L4 Trunking and First/Last Mile and Port Operations	Volvo, DAF, Einride, Gruber Logistics, MODI Consortium	Pilot (2023–2026)	End-to-end logistics chain validation, cross-border interoperability, infrastructure readiness insights, supports scale-up of autonomous freight corridors in Europe.

Case Study	Description	Use Case	Organisations	Deployment	Key Outcomes
Global					
Aurora Texas, USA	Commercial driverless heavy-duty trucks on interstate highways (Dallas–Houston) with plans to scale to other locations with DaaS model.	L4 Trunking	Aurora, Continental, NVIDIA	Commercial	Over 1,200 miles without a driver and 3 million autonomous miles. Demonstrating collisions avoidance and pedestrian detection hundreds of meters away.
Bot Auto Texas, USA	Retrofitted Freightliner tractors units completing trunk route testing prior to launching driver out pilot.	L4 Trunking	Bot Auto	Testing (2024) Pilot (late 2025)	Vehicles can pull over autonomously and can be remotely operating by law enforcement.
Gatik California, USA	Autonomous box trucks on fixed middle-mile routes, between distribution centres and retail sites. Over 25 trucks operational.	L4 Last Mile	Gatik, Walmart, Loblaw	Commercial (since 2021)	150,000+ driverless deliveries, zero safety incidents, 30–50% lower labour cost.
Inceptio Shanghai, China	Over 2,000 autonomous trucks on long-haul routes (500–1,500 km), completing over 200 million km using DaaS model.	L3 Trunking	Inceptio Technology	Commercial (since 2021)	Zero accidents, 6,000 L diesel saved/truck/year, 15.8 t CO_2 saved per truck per year, 50% less driver labour.
Torc Robotics New Mexico, Virginia, Texas, USA	Hub-to-hub long-haul trucking recently completing multi-lane, driverless closed-course validation at up to 65 mph with drivers still handling last mile.	L4 Trunking	Torc Robotics, Daimler, Uber Freight	Pilots, commercial rollout by 2027	10% fuel savings, reduced operational costs, tens of thousands of miles driven with no reported delays.
Plus.AI Texas, USA	First coast-to-coast commercial freight delivery by an autonomous truck in the U.S, Hauling refrigerated goods from California to Pennsylvania. Plans for driverless deployment in 2027.	L4 Trunking	Plus.AI, IVECO, FAW, Scania, Bosch	Commercialise following 2026 pilots	2,800-mile US delivery and over 5M+ miles driven, 10% fuel savings.

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