# BETTER DELIVERY: THE CHALLENGE FOR FREIGHT

## Freight Study final report

NATIONAL INFRASTRUCTURE COMMISSION

April 2019

# Contents

# Foreword

The UK's freight system – a network of ports, airports, roads and railways, together with all of the warehousing in between – moves goods quickly, reliably and at low cost. Manufacturers, retailers and shoppers have absolute faith in a complex system that delivers goods from all corners of the globe and all over the country to their assembly line, shop or doorstep.

The world is changing, however, and freight must continue to adapt. Action on carbon emissions is needed across all aspects of the economy and everyday life, and worsening congestion is harming the economy. While freight may only be one of many contributors to these issues, the sector must play its part in the solutions.

Government must set the trajectory for a clean freight system, outlining clear, long term objectives that enable the industry to be zero emissions by 2050 – tackling air pollution and delivering on the UK's climate targets. Managing freight's contribution to congestion will mean properly acknowledging its needs within the planning system so that operators can make efficient choices and maintain excellent levels of service, at low cost.

Delivering change of this scale will require a new relationship between government and the freight industry, taking account of all types of freight transport. This relationship must consider freight's land needs to realise the best outcomes for society and freight.

We are grateful to government, national and local, and the many organisations and individuals who supported the Commission in the development of this study – particularly the ports, airports, parcel depots, rail interchanges, and other freight operators who helped illustrate how the system functions and the challenges and opportunities for change.

The freight system already adapts at phenomenal pace to meet customer demands – a testament to the industry's ability to change. If this ability can be further focused, with help from government, managing congestion and delivering zero emissions freight transport by 2050 is fully within reach.

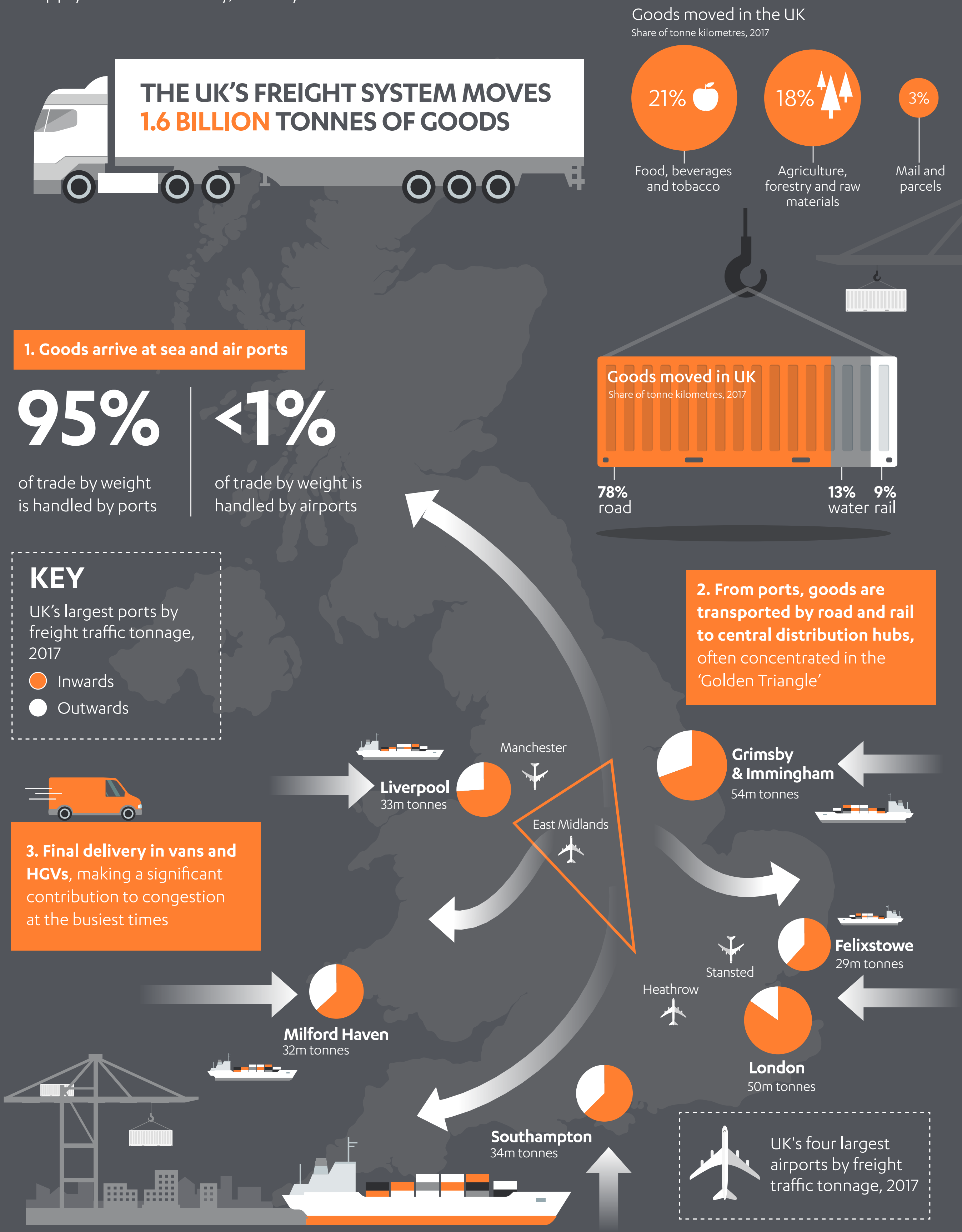
**Sir John Armitt CBE**
**Chair**

**Bridget Rosewell OBE**
**Commissioner**

**Andy Green**
**Commissioner**

# BETTER DELIVERY: THE CHALLENGE FOR FREIGHT

The UK's freight system is one of the most efficient in the world. Supply chains cross city, county and national boundaries.



# FREIGHT'S CARBON EMISSIONS AND CONTRIBUTION TO CONGESTION MUST BE TACKLED

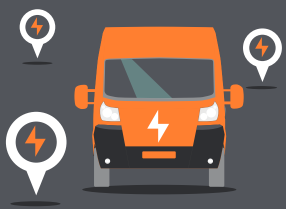
Road and rail freight account for 6% of the UK's greenhouse gas emissions, but this could rise to **20%** of allowed emissions by 2050

HGVs and vans are contributing to worsening traffic congestion in busy towns and cities

The 'last mile' of a delivery is complex and accounts for around **30%** of operators' costs


## A CLEAN FREIGHT SYSTEM IS NEEDED

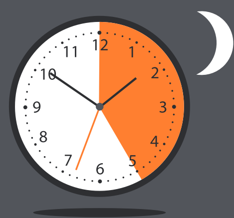
Electric vans are available, but action is needed to get charging networks ready for widespread use



Hydrogen or battery powered HGVs will need different types of infrastructure for refuelling or charging


## BETTER PLANNING CAN HELP MANAGE CONGESTION

Allowing more deliveries at night, where operators commit to quieter practices



More distribution space is needed in cities so that depots are closer to the final delivery destination

## THE COMMISSION RECOMMENDS:

**1**

**Decarbonisation of road and rail freight by 2050**

Tackling environmental impacts by committing to decarbonising road and rail freight by 2050.

**2**

**Better land use planning for freight**

Managing freight's contribution to congestion through better planning.

**3**

**A new partnership for freight**

Establishing a new Freight Leadership Council, bringing together government and industry for accelerated progress on long term issues.

Sources: DfT, CAA, Vivid Economics, Greening, Piecyck, Palmer and Dadhich

# In brief

**The UK's freight system is one of the most efficient in the world, providing seamless transportation of goods into, out of and across the country. However, freight also contributes to pollution and congestion in the UK's urban areas which, left unchecked, will only get worse. It is in the interests of the UK economy and the freight industry to ensure that these issues are tackled while allowing freight to operate effectively.**

**The Commission's central finding is that through the adoption of new technologies and the recognition of freight's needs in the planning system, it is possible to decarbonise road and rail freight by 2050 and manage its contribution to congestion. Achieving this requires government to outline clear, firm objectives, and begin working with the energy sector, freight industry and local areas to ensure that the infrastructure required for alternative fuels and land for efficient freight operations is available when and where it is needed.**

## A clean freight revolution

A clean, low cost freight revolution by 2050 is possible if government and industry work to embrace alternatives to diesel. Battery electric is already emerging as the solution for vans, but the future fuel for HGVs and rail is not yet set. Government should commit to achieving zero freight emissions by 2050 and identify the infrastructure requirements to support the transition, giving the freight and vehicle industries time to plan and adapt. For rail, this will include further detailed work to identify the optimum overall solution.

## Managing freight's contribution to congestion

Managing freight's impacts on congestion requires proper recognition of freight and its needs within the planning system. Clear guidance for local planners from government combined with better freight data will help in developing policies that ultimately embed freight into development plans and city infrastructure planning.

## A new status for freight

Achieving a zero emissions freight system requires a new conversation between government and industry. Whitehall and freight representatives must come together across modes and operations if they are to create policies and plans that deliver against broader UK goals. A mode by mode approach without proper system wide coordination will not suffice.

# Executive summary

The National Infrastructure Commission has been asked by the government to provide advice[1] on how to ensure an efficient, low carbon freight system, that manages its impacts on congestion and utilises technology to continue to provide a world class service that supports the UK's growth and global competitiveness.

Since the beginning of this work, the Commission has engaged with a wide range of organisations across the freight industry, local and national government, academic experts, and technology developers. This engagement has been key to informing the Commission's thinking on the topic as a whole, and on the content of the interim report published in December 2018.

The Commission recognises the importance of shipping and air freight to the UK's freight system and wider economy. The focus of this study has been on road and rail freight, where the Commission has found the need and opportunity for UK-led action to be greatest.

**The Commission's central finding is that through the adoption of new technologies and the recognition of freight's needs in the planning system, it is possible to decarbonise road and rail freight by 2050 and manage its contribution to congestion. Achieving this requires government to outline clear, firm objectives, and begin working with the energy sector, freight industry and local areas to ensure that the infrastructure required for alternative fuels and land for efficient freight operations is available when and where it is needed.**

The terms of reference for this study state that matters relating to border controls and customs, and the UK's exit from the EU, are out of scope. Considering that in 2016 over half of the international tonnage handled in the UK related to trade with the EU, freight will clearly, at least in the short term, be affected in some way by Brexit.[2] The Commission's freight study looks ahead towards 2050, and therefore does not focus on the months and years immediately following Brexit. Regardless of the eventual formal UK-EU relationship, freight will still need to cross borders. In the longer term, HGVs and rail will still need to decarbonise, and freight's contribution to congestion will need to be managed. Achieving these objectives will necessitate working with the EU, and therefore maintaining a relationship with the UK's neighbours will be essential to the future success and operation of freight.

## An evolving freight system

Freight is central to the functioning of the country, operating around the clock to enable everyday life. In 2017, the UK's freight system transported 1.6 billion tonnes of goods[3] by road, rail and water, delivering to businesses and consumers. Freight continues to serve its customers, adapting and changing to ensure a consistent, quality service, and meeting the ever increasing expectations on speed and cost.

The UK already has one of the most efficient freight systems of any developed country, ranking ninth in the world.[4] It comprises around 195,000 enterprises, employing 2.5 million people, and contributing £121 billion gross value added (GVA) to the economy.[5] It operates almost entirely within the private sector, with little government intervention required beyond the provision of roads and rail.

As the population rises, the demand for freight will grow. Over the next 30 years, the weight of goods lifted by heavy freight transport could increase by between 27 and 45 per cent.[6] The nature of this demand will also change, with expected increases in same day delivery, more just-in-time manufacturing, and continued growth of internet shopping. Without action, greater demand risks higher emissions and increased congestion.

While a highly competitive marketplace and tight profit margins provide incentives for the freight industry to drive out inefficient operating practices, this alone is not enough to address freight's impacts on the environment and congestion. Although not the root cause of these issues, freight is still a contributor and timely government intervention as well as action from the industry itself will be necessary if they are to be tackled at the required pace.

# A clean freight revolution

The UK's freight system makes a significant contribution to transport greenhouse gas emissions and is a cause of poor air quality. Transport accounted for 27 per cent of the UK's total greenhouse gas emissions in 2017, the largest single sector. HGVs and vans together contributed 32 per cent of the UK's greenhouse gas emissions from transport in 2016. Without action, emissions from road and rail freight could make up around 20 per cent of the UK's allowed emissions in 2050.[7] Delivering the UK's climate targets will require decarbonisation of many sectors of the economy, including freight transport.

Freight traffic also contributes to poor air quality which has a damaging impact on health and is particularly concentrated in urban areas. Road transport accounted for 32 per cent of total Nitrogen Oxide ($NO_X$) pollution in 2017, with HGVs and vans making up 46 per cent of the contribution from road transport.[8]

Modal shift to rail and water will continue to have a helpful role in managing air quality and carbon emissions from domestic freight transport while HGVs continue to use diesel. But modal shift is not capable of replacing all HGV journeys and will not be the long term solution to decarbonising road freight.

## Accelerating uptake of zero emission vans

Electric vans are emerging as a viable zero emissions alternative to petrol or diesel fuelled vans. Transition is already beginning in the parcel market, with a number of operators now starting to use electric vans for last mile deliveries, though uptake has lagged behind electric cars. There are already a range of national and local incentives to encourage uptake of electric vans, particularly in urban areas where restrictions on vehicle range tend to be less of a concern and where air quality issues are most acute. While electric vans have a higher purchase price than their petrol or diesel equivalents, these are outweighed by their low operating costs. As the choice of vehicles and the travel range of electric vans improves, and importantly as the lifetime costs of electric vans fall even further, uptake will continue to rise.

It is essential that local grid infrastructure is not a barrier to change. The use of smart chargers to control demand and flexibility solutions, such as batteries, as alternatives to reinforcement will be key in minimising the grid upgrades required and reducing the capital expenditure for operators.

## Preparing for the transition to zero emission HGVs

A range of zero emission options are being promoted as the means of decarbonising HGVs, with varying levels of promise. The finite supply of sustainable biofuels, the financial cost and energy intensity of producing synthetic fuels, and the need for significant coverage of overhead electric wires on much of the UK's strategic road network (and highways in Europe) before operators would invest in vehicles, make these options appear less attractive. Battery electric and hydrogen are both emerging as the most viable alternatives to diesel and it is expected that commercially available vehicles will be available from the beginning of the 2020s.

Once the total lifetime costs of zero emission freight vehicles achieve parity with diesel vehicles, uptake of zero emission options could accelerate rapidly. Such an acceleration would have significant and rapid impacts on the UK's networks of transport and energy infrastructure. It is important that government plans the infrastructure requirements of zero emission HGVs, including considering where the demands on the grid would be highest and the minimum network extent to enable the transition to commence, as well as areas where government may have to subsidise and support fuelling infrastructure.

Recharging battery electric HGV fleets is likely to require grid reinforcements, smart charging, energy storage, or a combination of these elements, to enable depot charging. The expenditure required for hauliers to install and maintain charging infrastructure for battery electric HGVs at depots is likely to be significant, though could be outweighed by the cheaper costs of electricity as a fuel. Hydrogen HGVs would require additional hydrogen production facilities, though the infrastructure implications beyond this will depend upon developments outside of the transport sector itself, particularly whether the UK's heating supply network is converted to carry hydrogen.

The decision about whether HGVs transition to battery electric, hydrogen, dual fuel (or another zero emission option) will be market led, but the speed of uptake will be determined by government policy, cost and developments in the wider European commercial vehicle market. Regardless of the eventual UK-EU relationship, it is imperative that the UK works with the EU to plan the transition to zero emission fuels, ensuring cross-border road freight continues unhindered and that manufacturers have confidence to produce a sufficient supply of zero emission vehicles.

Ultimately, it is imperative that government provide a clear signal of intent now to give the freight industry time to plan its investments, and automotive manufacturers time to deliver the supply of zero emission freight vehicles, while ensuring that the UK's transport and energy infrastructure are prepared for transition.

**Recommendation 1: government should commit to decarbonising road freight by 2050, announcing plans by the end of 2021 to ban the sale of new diesel powered HGVs no later than 2040. To support this:**

- **government should, in conjunction with distribution and transmission network operators, prepare detailed assessments of the infrastructure required to enable the uptake of battery electric or hydrogen HGVs, including the refuelling requirements at depots and key rest areas on major freight routes. For battery electric, these assessments should include enhancements to distribution networks alongside alternatives to reinforcement, such as energy storage. For hydrogen, these assessments should cover the production, storage and distribution of hydrogen, including any dependency with the decarbonisation of the heating supply system.**
- **Ofgem, as part of the next energy distribution price review (RIIO-ED2) starting in 2023, should include a clear requirement for distribution network operators (in partnership with the freight industry) to map out the infrastructure upgrades and opportunities for alternative solutions, such as energy storage, required to enable large scale freight van charging at depots.**

## Decarbonising rail freight

Delivering the UK's climate targets will require decarbonisation of transport. It is therefore a question of how to decarbonise the railway for both freight and passengers, rather than whether it should be done. Road and rail freight should have a common, single target to decarbonise fully by 2050. No part of the freight system should be indirectly subsidised by being allowed to emit carbon when other parts are decarbonising.

There are different options for how this clean freight revolution could be achieved, and it is unclear which will be the best one. Electrification is expensive and disruptive during construction to all rail users, but is a proven technology and could turn out to be cheaper and quicker than other approaches. New hydrogen or battery powered trains could enable rail freight operations on existing infrastructure, but these are likely to be expensive, could require high levels of public subsidy, and it is not currently clear when or if these could be available.

Delivering carbon free rail freight using either electrification or alternative fuels is likely to entail very significant costs for infrastructure or new locomotives. But without these costs being paid, most likely from public expenditure, the only other way for rail freight to be carbon free would be for it to transfer to other modes, such as zero emission HGVs. The additional traffic and congestion created could come with a very significant economic cost. It may be possible to alleviate some of the congestion impacts through a package of road investments, although the costs are likely to be significant and it may not always be feasible or desirable to create additional road capacity.

All of the options for decarbonisation will need to involve government action: simply setting a zero emissions target and doing nothing else risks rail freight transferring to road with no new capacity, potentially creating more congestion. More detailed work is needed to choose which option, or combination of options, represents the best approach. Assessing the costs and benefits of the different options will require a corridor based approach and extensive cross-modal transport and economic modelling.

Government will need to take a decisive role in determining how emissions from rail freight should be reduced to zero, and consider whether this involves rail freight subsidies to support transition to new zero emission locomotives, further electrification, or road upgrades. The long investment cycles of the railway mean that government must start this detailed work now, setting itself up for a decision by 2021 on which option (or combination of options) it is going to pursue, in advance of Network Rail's Control Period 7 and the third Road Investment Strategy.

**Recommendation 2: government should undertake detailed cross-modal analysis, using a corridor-based approach, of the long term options for rail freight's transition to zero emissions, including low carbon rail services and the scope for road based alternatives. It should then publish, by the end of 2021, a full strategy for rail freight to reach zero emissions by 2050, specifying the investments and/or subsidies that it will provide to get there.**

# Managing freight's contribution to congestion

Congestion is a significant problem in the UK and one that will continue to grow, with the Commission's own analysis forecasting an overall increase in road traffic (road vehicle kilometres travelled) of between 18 per cent and 54 per cent by 2050.[9] Although freight is not the root cause of congestion, it can be a significant contributor in some areas and at certain times. HGVs currently account for 12 per cent of road use on all roads in Great Britain, 25 per cent of road use on motorways, and 19 per cent of road use on urban and rural highways.[10] For road freight alone, congestion costs freight operators at least £3 billion a year.[11] Freight already seeks to manage its exposure to congestion, but as an industry reliant on fast and reliable movement, it is in freight's interest to further manage its contribution to this wider problem.

## Making better use of existing capacity

Increasing capacity by continually building or widening roads is not a long term solution to tackling congestion in urban areas. Extra capacity might provide temporary respite, but it is only a matter of time before it is filled again by people making new and different journeys.[12]

Options for making better use of existing capacity are already being trialled and adopted by the freight industry and local areas. Evidence suggests that demand management through road pricing would be most effective in reducing congestion when applied to all road users, not just freight. Innovative ways of altering the model of last mile delivery are likely to become an increasing part of the overall mix and will be important in helping manage freight's contribution to congestion in busy urban areas. National and local regulations that encourage new methods and approaches to come forward and expand will be needed. However, these alone will only tackle some of the problem and will not displace vans or HGVs, which are likely to remain the primary mode for deliveries in towns and cities.

For longer distance haulage, new technologies and efficiency gains are likely to be part of the solution in future, but currently only unlock marginal congestion benefits. The congestion benefits of lorry platooning, which in theory reduces the amount of road space that lorries occupy (among other benefits, such as improved fuel efficiency), are unproven in the context of the UK's road network. Better vehicle loading and less empty running may help reduce the number of freight vehicles, but opportunities for significant improvement are limited.[13]

## Clear and balanced local regulation for innovation in urban freight

There are many emerging approaches to freight in urban areas which could help to reduce the industry's contribution to congestion. Consolidation centres have shown that they can reduce freight trips into congested areas, but commercial viability and industry appetite remain challenges to roll out. Much quieter electric vehicles and the use of codes of practice for quieter deliveries could make retiming far more acceptable in the short to medium term. Emerging schemes such as e-cargo bikes and portering can be an important addition to the last mile mix, helping bring in changes that will support congestion reduction aims.

The freight industry is innovative and efficient in adapting to the environment it operates in. However, in a competitive field, firms will only be able to adopt practices that reduce congestion impacts if this will not put them at a disadvantage. That means there is an important role for urban local authorities in creating the conditions for innovation. Costs to consumers do not need to be high, as the industry will be able to respond efficiently to clear and stable regulation.

The Commission's *National Infrastructure Assessment* recommended that urban local authorities should develop integrated strategies for transport, housing and employment. For the impacts of freight to be managed, these integrated strategies need to set out a clear plan for helping freight operators to reduce the congestion impacts of freight activity. This means reviewing their local regulations to ensure they strike the right balance in different situations. Peak time kerbside restrictions may need to be tighter, encouraging more efficient activity when the road is busy. But this may be offset by a more relaxed approach to night time activity, especially for businesses meeting high standards for sensitive operation.

Temporary rule changes could help operators looking to trial new techniques. Authorities should be empowered to make funding decisions where innovation requires new local investment, which can best be achieved by giving them devolved infrastructure budgets as recommended in the *National Infrastructure Assessment*.

Where the business case supports consolidation centres, authorities should use the planning system to make land available and consider the case for funding land and construction or subsidising operations in the short term. The case for consolidation centres can be made stronger by building incentives for operators to make use of them, through planning restrictions on new build properties and giving consolidated services preferential regulatory treatment such as reduced loading/unloading restrictions at the kerbside.

**Recommendation 3: to help manage peak time congestion on the urban transport network, local authorities should include a plan for urban freight within the infrastructure strategies they are developing. These plans should review local regulations to incentivise low congestion operations, consider the case for investments in infrastructure such as consolidation centres, and identify the land and regulatory requirements of new and innovative low congestion initiatives.**

The Commission is already working with many of England's cities through its Next Steps for Cities programme, helping them to develop ambitious, effective infrastructure strategies. This will include work aimed at helping cities to implement this recommendation through sharing expertise and good practice on addressing urban freight within an infrastructure strategy. The Commission has identified five pilot cities, each of which is committed to a locally-led policy review on how best to support innovation in freight with the objective of reducing the impacts on congestion. The cities and city regions – Bath, Brighton and Hove, Liverpool, Southampton and the West Midlands – will set out their updated approach to freight within their own local infrastructure strategies by the end of 2020.

## Better planning to enable optimisation

Availability of land for freight distribution centres and other infrastructure is crucial for the efficient operation of the sector, and will be even more important in future for enabling optimised last mile operations. The most effective way of managing freight's impacts on congestion while allowing efficient operations is by planning for the needs of freight at an early stage of statutory planning processes.

For major new developments, this should be part of the thinking from the outset, recognising freight as an essential part of enabling and supporting infrastructure. In existing urban areas where land is scarce, freight operations may not always be able to compete with housing development values, leading to longer distances to travel from depots to delivery destinations (and wasted mileage) – a particular barrier to the uptake of innovative delivery methods such as e-cargo bikes. In some circumstances, there will be wider societal and economic benefits that justify preserving land for freight distribution or encouraging a greater mix of land uses.

Decisions on when to allocate and protect land for freight activities will always depend on the local context. However, the right decisions will only be made if this is looked at explicitly as an issue and a conscious strategy adopted on the basis of evidence.

**Recommendation 4: government should produce new planning practice guidance on freight for strategic policy making authorities. The guidance should better support these authorities in planning for efficient freight networks to service homes and businesses as part of their plan making processes. This new planning practice guidance, which should be prepared by the end of 2020, should give further detail on appropriate considerations when planning for freight, such as the need to:**

- **provide and protect sufficient land/floorspace for storage and distribution activities on the basis of population and economic need, with particular consideration for the floorspace requirements for last mile distribution and consolidation centres;**
- **support the clustering of related activities within a supply chain, minimising the distance that goods must be moved and maximising the potential for efficient operations;**
- **maximise the potential for freight trips to be made at off peak times; and**
- **accommodate deliveries and servicing activity at the point of delivery.**

## New and better data

For areas to deliver congestion management policies and schemes as part of their development and transport plans, new and better data will be key. Data collected at a national level is important in identifying overall trends, but with movement data local policy makers can deliver targeted solutions. As outlined in the interim report, existing technologies such as mobile phone GPS data, or intelligent Automatic Number Plate Recognition, already provide viable collection methods for freight data, particularly in urban areas where camera networks are in place. However, local areas may struggle to identify viable technologies, develop the protocols to utilise these technologies for data collection, or ensure a format that allows easy comparison across historical data and with neighbours. Even where such solutions at a local level are developed, wider rollout to other urban areas remains a problem.

Government can play an important role in unlocking this. Ensuring that data is produced in a consistent format, and providing local authorities with minimum standards for freight data and collection will be key in ensuring good, useful data that can inform priorities and decisions.

**Recommendation 5: government should develop a data standard for freight data collection to support local authorities, outlining the requirements for technological capability, data requirements, and data format. Such a standard**

**must seek to ensure consistent data quality and format across technologies to allow regional and national aggregation, and should be complete by the end of 2020.**

## A new status for freight

Achieving zero emissions freight, accelerating innovation, and delivering positive change requires a new conversation between government and industry, where both work in partnership to deliver lasting change quickly. The current model of engagement on a modal basis risks missing opportunities to deliver against challenging aims in the most efficient and cost effective way.

At a sub national transport level, the importance of planning for freight is already emerging, with Transport for the North, England's Economic Heartland, and the West Midlands Combined Authority all developing freight strategies for their areas. At a national level, the publication of long term strategies such as Maritime 2050 and Road to Zero, along with the creation of the Department for Transport's 'virtual freight team' are all positive moves in recognising freight's role in supporting the economy and helping tackle key challenges such as climate change. However, more needs to be done. Multi modal, cross-government, and pan industry discussions are required to achieve the stretching goals being faced.

**Recommendation 6: government should establish a new bi-annual 'Freight Leadership Council', inviting representatives from BEIS, DfT, MHCLG, DEFRA and HM Treasury, devolved administrations, all freight modes and parts of the supply chain. This Council's main focus should be on strategic, long term issues – specifically supporting decarbonisation of road and rail freight by 2050. This Council should hold its first meeting before the end of 2020.**

# 1. AN EVOLVING FREIGHT SYSTEM

**Freight enables the global economy to function. Its efficiency allows consumers to access goods from all corners of the world with ease and little cost – whether a business manufacturing goods or an individual receiving a parcel. As the demand for goods increases, ports, airports, roads and railways will need to respond and adapt to help freight meet the needs of the UK. New technologies such as cleaner fuels and robotics will be a key part of the solution, but also bring their own challenges. Government, the freight industry and infrastructure providers need to start planning now to consider how to utilise emerging technologies, address barriers to their deployment, and deliver a sustainable and efficient freight system that is fit for the future.**

**As the population increases the demand for goods, and therefore freight, will grow. The freight industry will undoubtedly respond to this demand, finding efficiencies through innovative practices to continue to deliver a high quality and cost effective service. But ensuring success without compromising on sustainability requires national and local government to start preparing to enable change. Planning for the adoption and rollout of new technologies from an early stage, and considering how these may change freight operations will be key to ensuring a green and prosperous freight future for the UK.**

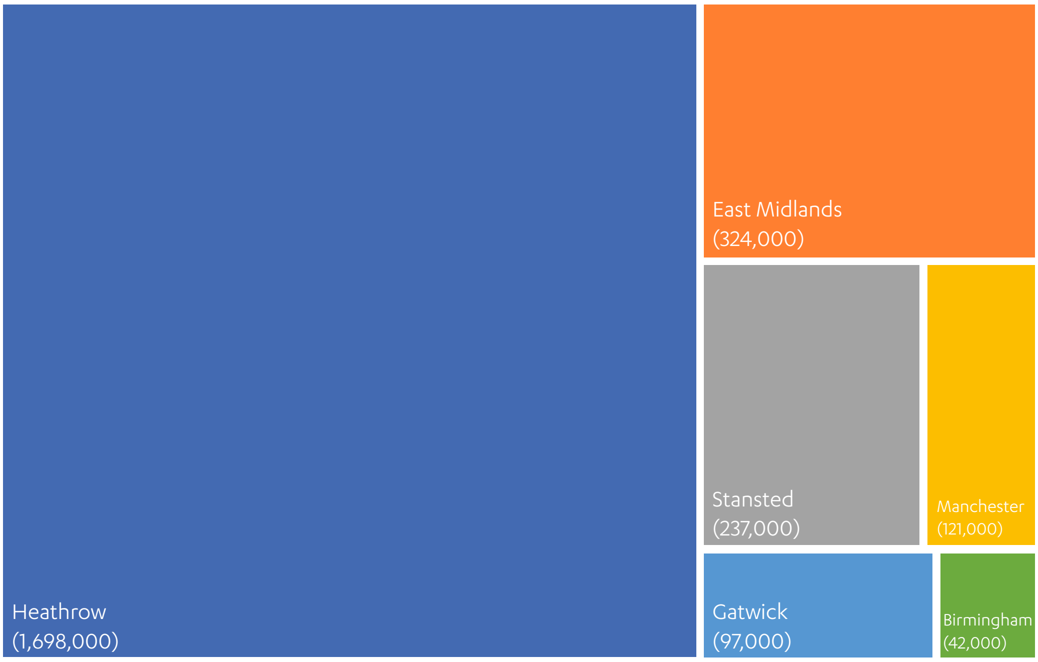
## The freight system today

The UK already has one of the most efficient freight systems of any developed country, ranking ninth in the world on the Logistics Performance Indicator.[14] It comprises around 195,000 enterprises, employing 2.5 million people, and contributing £121 billion gross value added (GVA) to the economy.[15] It operates almost entirely within the private sector with little government intervention required beyond the provision of roads and rail.

Coastal ports are the principal gateway for international trade, handling 95 per cent of the country's imports and exports by weight in 2017 and the vast majority of the UK's international road freight, with 98 per cent of this freight (by weight) concentrated at a small number of major ports.[16] In general, the UK's ports are private enterprises, undertaking investments such as the £400 million Liverpool2 container terminal, the major investment into the Tilbury2 terminal at the Port of Tilbury, and £50 million container terminal expansion at the Port of Hull and Port of Immingham, to ensure the continued operation and success of these gateways.[17] These investments are key to enabling the growth and expansion of freight, and in accommodating the changing world of shipping, which has seen container vessel sizes increase around six fold in the last half century.[18]

Air freight provides an alternative to sea freight, providing high speed services across the world. It represents approximately 40 per cent of UK trade by value with non-EU countries.[19] Almost 70 per cent of air freight by weight travels in the 'belly holds' of passenger jets,[20] rather than in dedicated freight aircraft. Air freight movements therefore tend to be concentrated at the airports with the greatest number of long haul passenger flights – resulting in Heathrow accounting for 65 per cent of all air freight in the UK.[21]

**Figure 1: Freight handled at the UK's six largest freight airports (tonnes, 2017)[22]**



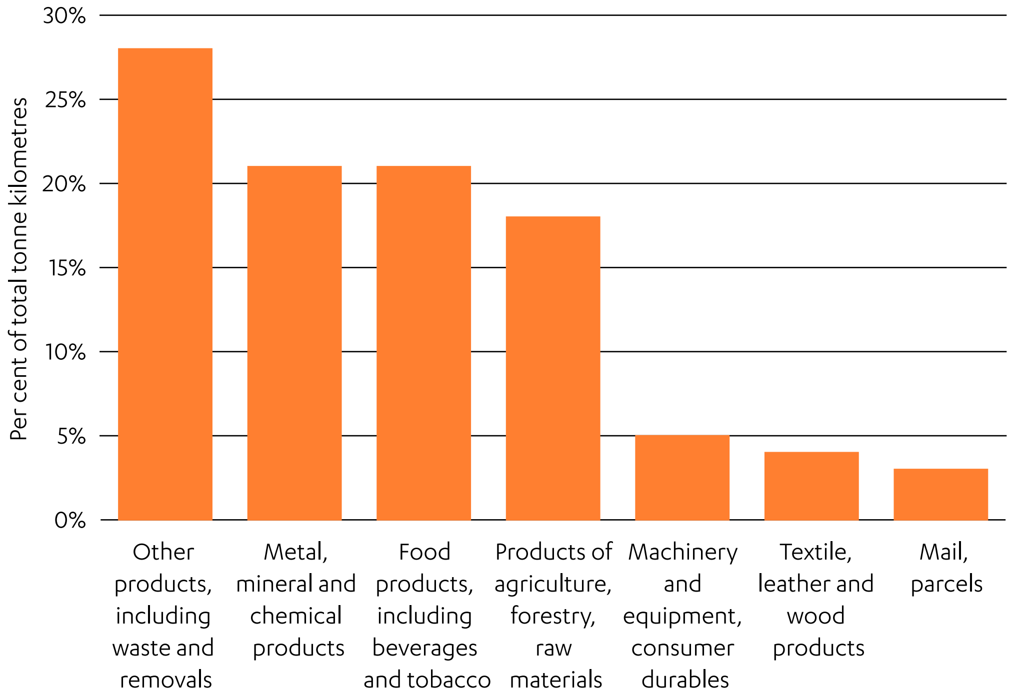

International rail freight volumes are relatively small, operating through the Channel Tunnel to move around 4.5 per cent of international goods by weight.[23]

Both air and sea freight emit greenhouse gases in significant quantities. In 2011, international shipping and aviation (passengers and freight) made up 2.1 per cent and 5.9 per cent of UK greenhouse gas emissions respectively.[24 25] As outlined in the Freight Study interim report, action through multilateral forums remains the most appropriate approach to tackling emissions from these global industries. The UK can still play an important role and should lead the way towards change, seeking progress through negotiations and trialling and adopting new approaches that help reduce the carbon impacts of air and sea freight.

## Domestic freight

In the main, the UK has a centralised freight system structure, with goods moving from points of production and international gateways to a central location, where they can be consolidated with other goods for onward transport to regional and then urban distribution centres before they reach their final destination. In 2017, an estimated 189 billion tonne kilometres of domestic freight was moved within the UK, ranging from large amounts of waste and agricultural products, to much smaller amounts of mail and parcels.[26 *]

**Figure 2: Goods moved domestically by product type (per cent of total tonne kilometres, 2017)[27]**




While rail and water continue to play an important role in the freight system, they represent relatively small amounts, moving nine per cent and 13 per cent of goods by weight respectively. Since the late 1950s road haulage has dominated the freight market (due to the expansion of the motorway network, in large part), with HGVs moving 78 per cent of all goods in the UK in 2017 (147 billion tonne kilometres).[28]

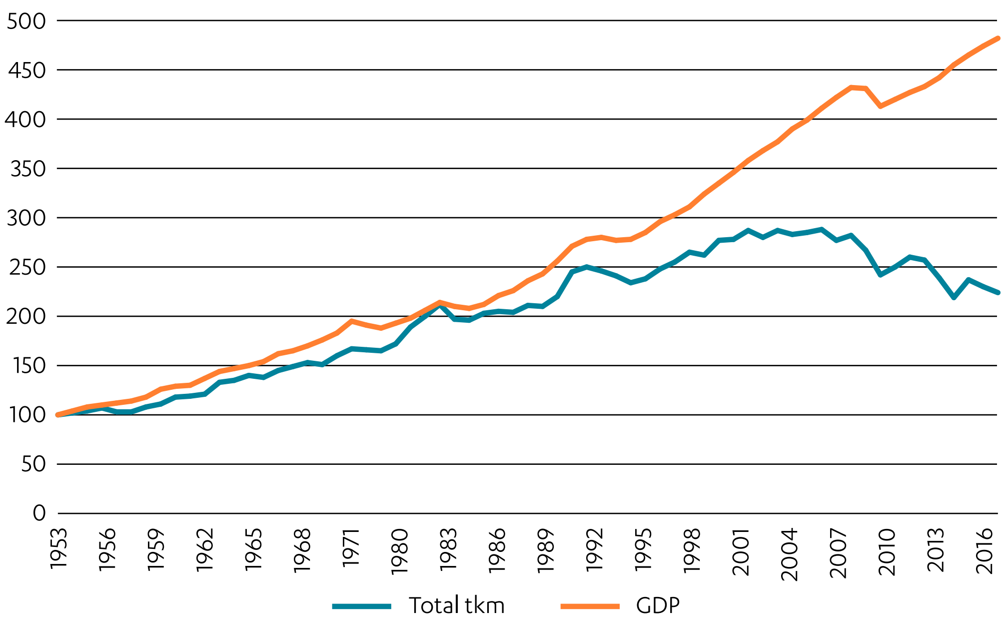
Urban freight (sometimes referred to as the last mile), is the most labour intensive and the least efficient part of the freight system.[29 30] Almost all urban freight travels by road, mostly in Heavy Goods Vehicles (HGVs) and Light Goods Vehicles (LGVs).[31 †] Only around six per cent of total freight kilometres in 2016 were for urban distribution, however this is where around 30 per cent of logistics costs are incurred and where levels of $CO_2$ per tonne moved are highest.[32 33] While HGV tonne kilometres have, in general, been declining, van use has increased over the last 20 years, tracking growth in Gross Domestic Product (GDP). Most of these vans will be for the provision of services, with the data from Department for Transport's 2008 van activity baseline survey suggesting that around a quarter of vans are for moving goods.

* Amounts are measured in tonne kilometres

† A HGV is a vehicle with a gross laden weight of greater than 3.5 tonnes. A LGV is a vehicle with a gross laden weight of less than 3.5 tonnes.

The overall state and structure of the economy determines the volume and mix of freight flows generated by different industrial sectors and affects the location of production and consumption. The UK's move away from heavy manufacturing towards a service based economy has resulted in the decoupling of freight demand and Gross Domestic Product (GDP) since the late 1990s.

**Figure 3: UK GDP and tonne kilometres 1953-2016 (indexed, 1953 = 100)[34]**




## The future drivers of freight demand

As the UK is now primarily a service based economy, the demand for freight is likely to reflect consumption and growth in population.[35] According to national projections, population will increase from the 66 million recorded in mid-2017, to almost 73 million by 2041 – more than a ten per cent increase.[36] Although this will be the driving factor of demand growth, it will not be the only thing affecting demand or how freight delivers on this demand.

Consumer behaviour and the desire for faster and more convenient freight will mean greater challenges for the freight industry and changing operations, as can be seen today through increases in the 'fulfilment from store' model commonly used by supermarkets for home deliveries of online shopping.[37] Technological change (which reduces the cost of freight) has already delivered, or could deliver in future, significant change in freight, from the use of telematics and GPS tracking to optimise routing, to wholly new methods of delivery such as air drones. Underlying all of these will be public policy and regulation which can force changes or set standards – such as the upcoming introduction of Clean Air Zones in cities – and therefore the shape of freight operations.

All of these elements, along with other changes such as methods of propulsion, have meant major changes to the freight system over the last 100 years. Now on the horizon are a series of inter-connected transformational changes that could have significant implications for how the freight system works in the future. While it is not possible to predict with certainty what the demand for freight will look like in 2050, it is important to consider what the driving factors of change may be as a basis for planning.

## The key factors affecting the freight system in 2050

### Growth in internet shopping

The UK already has the second highest market penetration of ecommerce in the world, making up around 20 per cent of sales as a percentage of all retail sales.[38] Under a scenario of ecommerce accounting for 65 per cent of all retail sales by 2050, combined with a continued growth in the number of companies offering next day, same day and on demand deliveries, the existing centralised approach to freight may need to adapt to incorporate more regional and local level storage to meet customer demands – as is currently demonstrated in Amazon's model for achieving next and same day delivery. [39] Such a move in both retail and business markets could have a significant impact on the shape and operation of the freight system and vehicle miles.[40]

### Zero emissions vehicles

Road and rail freight must decarbonise by 2050 for the UK to meet its challenging climate change targets. The implications of this are discussed in detail in Chapter 2, but it is clear that diesel cannot be the fuel of the freight industry for much longer. This is unlikely in the long term to have major impact on freight demand, but the transition towards alternative fuels could see short and medium term changes in the way that freight operates – from the vehicles it uses and their impacts on the highway, to the fuelling infrastructure required.

### Disruptive new technologies

While most technologies look likely to have marginal impacts on the freight system, robotics and automation, and connected and autonomous vehicles (CAVs) could fundamentally alter the operation of freight in the UK. The costs of robotics and automation have fallen by half over the last thirty years, and CAVs could help improve driver safety, address the issue of HGV driver shortages, and potentially make journeys more efficient with vehicles able to run long distances without stopping.[41] Importantly, both of these could deliver cost savings of up to a third of the total costs of warehousing and transport respectively. Such a major change in the structure of costs could mean significant change in the geography of the freight system, including the main ports of entry and exit.[42]

Although the speed of such technological change and adoption is not certain, it is feasible to think that by 2050 many of these changes could have occurred. Each of them would have infrastructure impacts – on the roads in urban areas, on capacity at ports, and on the electricity network. Accommodating positive changes that support efficient freight while achieving climate goals and managing congestion will require early and coordinated planning which must start now. Considering these changes in isolation from one another, or waiting for them to emerge, may mean the UK is left behind its international competitors.

# 2. A CLEAN FREIGHT REVOLUTION

**Freight makes a significant contribution to the UK's carbon emissions and local air pollution. A clean, low cost freight revolution by 2050 is possible if government and industry work together to embrace alternatives to diesel. Government must provide long term clarity to the freight industry and commit to a common objective for road and rail freight to be zero emission by 2050. Forward planning will be required to ensure that infrastructure is not the barrier to achieving clean road and rail freight.**

Vans are already beginning to transition to battery electric power within the freight market. Uptake of electric vans is likely to increase as range improves, larger models become available and prices fall. It is essential that infrastructure is not a barrier to change. Government, Ofgem, and Distribution Network Operators will need to proactively work to determine how best to support van charging at depots.

For HGVs, both battery electric and hydrogen are emerging as the most viable potential alternatives to diesel, with models expected to become commercially available from the early 2020s. Government will need to ensure that it is prepared and should begin early assessments of the likely infrastructure requirements of both hydrogen and battery electric HGVs.

Government will need to take a decisive role in determining how rail freight should reach zero emissions. Further electrification, new hydrogen or battery powered trains or transferring rail freight onto zero emission HGVs could all be feasible options. The costs of inaction appear to be significant and, by comparison, investing in infrastructure to reduce these impacts might be cost effective.

Providing clear long term targets for decarbonisation, preparing the nation's infrastructure and working in partnership with industry, manufacturers as well as neighbouring countries will be key to allowing the freight industry to plan its investments and achieve decarbonisation by 2050.

## The case for action

Limiting the global temperature increase to 1.5 degrees Celsius above pre-industrial levels, as outlined in the Paris climate deal, will mean domestic transport will need to decarbonise. Following large declines in emissions from the energy sector, domestic transport now makes up the largest sectoral contribution to the UK's greenhouse gas emissions, accounting for 27 per cent of total greenhouse gas emissions in 2017.[43] Total greenhouse gas emissions from transport have only decreased by two per cent since 1990.[44]

The UK's freight system makes a significant contribution to the UK's greenhouse gas emissions. Road and rail freight are together responsible for around six per cent of the UK's greenhouse gas emissions today but, without action, they could account for around 20 per cent of allowed emissions in 2050.[45] [‡] Freight traffic also contributes to poor air quality which has a damaging impact on health and is particularly concentrated in urban areas. Road transport accounted for 32 per cent of total Nitrogen Oxide ($NO_X$) pollution in 2017, with HGVs and vans making up 46 per cent of the contribution from road transport.[46] [47]

## Decarbonising road freight

Road freight makes a greater contribution to the UK's transport emissions than any other part of the domestic freight system. HGVs and vans together contributed 32 per cent of the UK's greenhouse gas emissions from transport in 2017 (16.5 per cent and 15.4 per cent respectively).[48] Long haul and regional distribution[§] make up the majority of greenhouse gas emissions from HGVs and it is in these sectors where there is the most substantial opportunity from decarbonisation.[49]

## Modal shift

The traditional method of combatting both carbon and congestion from lorries in the UK has been to transfer these trips onto less congested and less polluting forms of transport – namely rail and water, which produce lower emissions per tonne of goods moved. Through the Mode Shift Revenue Support scheme (MSRS), the Department for Transport provided c.£15 million of grants in 2017/18 for the movement of containerised traffic by rail and water rather than road, and claims this helps to remove around 800,000 HGVs from the road each year.

Most destinations are not accessible by rail or water and therefore still require HGV movements, at least at one end of the journey. Rail and water freight have struggled to compete with the inherent flexibility of road transport and are less suited to smaller consignments and shorter journeys. Modal shift to rail and water will continue to have a helpful role in managing air quality and carbon emissions from domestic freight transport while HGVs continue to use diesel, but modal shift is not capable of replacing all HGV journeys and will not be the long term solution to decarbonising road freight.

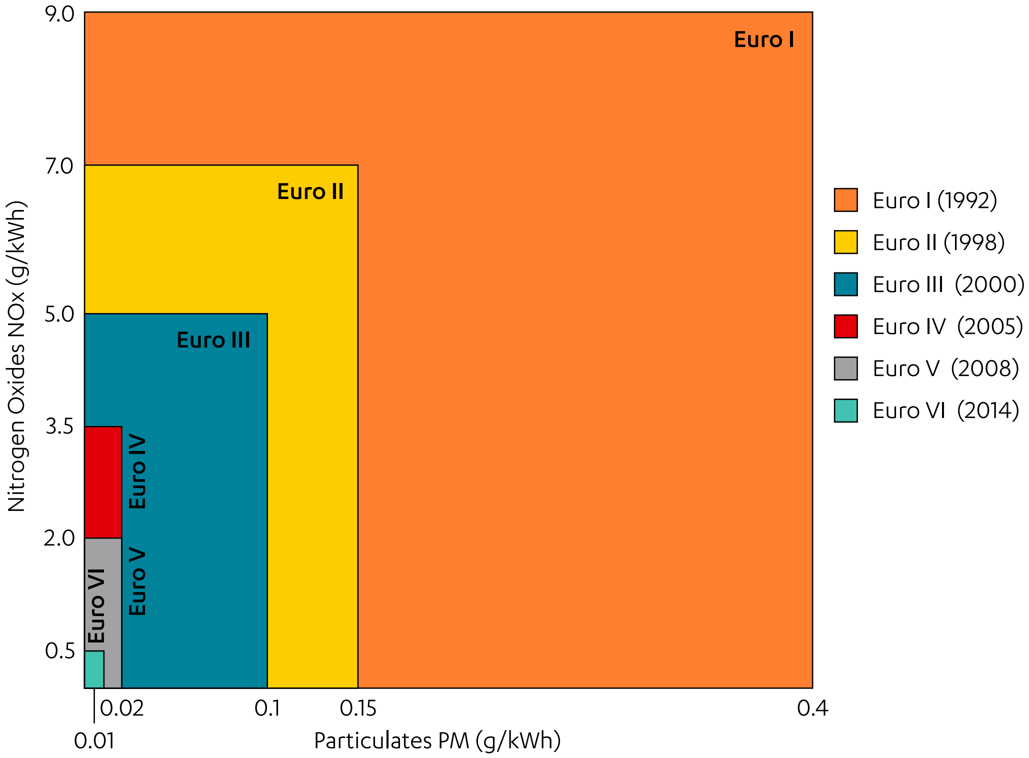
## Emissions improvements to date

The regulatory focus over the past 20 years has been on reducing emissions of air pollutants. The EURO standards have forced HGV manufacturers to reduce emissions of particulate matter (PM), Nitrogen Oxides ($NO_X$), and other air pollutants.[50] While the EURO standards have significantly reduced emissions of local air pollutants (see Figure 4), progress reducing carbon emissions has been slower.[51]

‡ Based on complying with the Climate Change Act target of 80% reductions by 2050, against 1990 levels.

§ Long haul: Delivery to national and international sites (mainly motorway operation and regional roads). Regional: Delivery of consumer goods from a central warehouse to local stores (inner-city, suburban, regional).

Figure 4: European emission standards for HGVs




Reducing carbon emissions from HGVs is now starting to be brought into focus as a priority. The European Commission has proposed new mandatory targets to reduce carbon emissions from HGVs by 15 per cent by 2025, and 30 per cent by 2030, compared to 2019 levels.[52] While these are welcome steps, it is only by removing diesel entirely that it will be possible to achieve net zero emissions of greenhouse gases.

Decarbonisation and adoption of zero emission freight transport will also help address air quality concerns, eliminating emissions of Nitrogen Oxide, Sulphur Dioxide and reducing emissions of particulate matter.

New vehicle fuels are only one part of the process. Without the infrastructure to support these fuels, operators will be reluctant to change. Government must play a key role in encouraging the transition, planning for the infrastructure requirements and working with other governments, to ensure that road freight can decarbonise as early as possible.

## Accelerating uptake of zero emission vans

Electric vans are emerging as a viable zero emissions alternative to petrol or diesel fuelled vans. Uptake has however lagged significantly behind electric cars, with only 0.2 per cent of the UK's vans and only 0.3 per cent of new van sales being electrically powered in 2017.[53 54] Slow uptake is, in part, likely to be a consequence of the limited choice and range of electric vans currently available, particularly at the larger and heavier end of the market. Only 10 models of electric van are currently available, half of which are small vans with lower payload capacity.[55] It is expected that a greater choice of electric vans between 2.5-4.25t gross vehicle weight (GVW)[¶] with a longer range will emerge in the coming years.

While electric vans have a higher purchase price than their petrol or diesel equivalents, particularly for larger models, these are outweighed by their low operating costs. Electric vans benefit from the efficiency and relatively low cost of electricity compared with diesel. The cost per mile of an electric van could be around 60 per cent lower than an equivalent diesel van, significantly reducing fuel costs for operators.[56]

There are already a range of national and local incentives to encourage uptake of electric vans, including the plug-in van grant and exemption from Clean Air Zones, the London Congestion Charge and low emissions zones in London and other cities. These are all positive steps to encourage transition, particularly in urban areas where restrictions on range tend to be less of a concern and where air quality issues are most acute.

As the choice of vehicles and the travel range of electric vans improves, and importantly as the price difference between electric and diesel vans narrows, it is likely that uptake could increase rapidly. Although this increase in uptake of electric vans is not certain, it is clear that electric vehicles reduce the cost of driving, lower air pollution, and reduce emissions, in addition to supporting a highly renewable energy system. Government should therefore encourage and facilitate the swiftest possible adoption of electric vans.

## Encouraging uptake through infrastructure

Enabling the freight industry to move to electric vans could mean significant and rapid impacts on the UK's infrastructure networks, for which they will need to be prepared. Allaying concerns about recharging and vehicle range will require sufficient infrastructure provision.[57] Electricity distribution and recharging facilities are the two main infrastructure factors that will need to be considered.[58] The transition of all vans to battery power could create an additional annual demand of between 22-28TWh, of which between 6-8TWh could be specifically due to the demand for freight vans.[59] [**]

The *National Infrastructure Assessment* has already recommended that government, Ofgem and local authorities should enable the roll out of charging infrastructure to allow consumer demand to reach close to 100 per cent electric new vehicle sales by 2030. However, electric vans are likely to have different infrastructure requirements to cars and recharging infrastructure will need to effectively complement their full range of uses.

¶ Government is legislating to allow category B licence holders to drive certain alternatively fuelled vehicles up to a maximum weight of 4.25 tonnes, to accommodate the additional weight of their batteries.

** Range derived from the Future Energy Scenarios (National Grid, 2017) & Power Sector Modelling (Aurora Energy Research, for the National Infrastructure Commission, 2018) assuming 28 per cent of vans are used specifically for freight (the ratio shown by the DfT's 2008 Van Activity Baseline Survey).

For freight, the most significant infrastructure impacts of the transition to electric vans are likely to come from concentrated vehicle fleets recharging simultaneously at a single depot and multiple fleets charging on the same local grid. The specific requirements will depend on the blend of rapid and smart chargers. New connections can trigger the need for network reinforcement, for which the customer pays a proportion of the cost.[60] Distribution Network Operators (DNOs), who are responsible for the distribution of electricity from the national transmission grid to consumers, already have an obligation to provide a connection when one is requested. However, a requirement to minimise the risk of stranded assets[††] means there is a reluctance to provide new connections or upgrades in advance of demand.

It is essential that local grid restrictions are not the barrier to change. Encouraging the uptake of electric vans by the freight industry may not require pre-emptive investment; more proactive engagement with freight operators on what electricity upgrades at their depots will involve and clear planning on how this would be delivered is needed Such an approach would help give operators confidence to plan the transition of their fleets to electric vans. The exact approach to how the electricity requirements of different depots are met will need to be determined on a case-by-case basis, considering both network upgrades and alternatives, such as storage and smart charging. The use of smart chargers to control demand and flexibility solutions, such as batteries, as alternatives to reinforcement will be key in minimising the grid upgrades required and reducing the capital expenditure for operators. Vehicle to grid technologies may also reduce the operational expenditure of charging van fleets.

## Case study: Using smart charging to manage peak electricity demand

The UPS depot in Kentish Town, North London had a fleet of 52 electric vehicles. However, constraints in the existing grid infrastructure were restricting the company's ability to introduce more electric vehicles without grid reinforcements and upgrades.

The installation of a smart charging system will allow a full depot of electric vehicles with an uncontrolled peak demand of 2,200kVA to be charged on a 1,250kVA grid connection. Charging demand on the site is dynamically controlled by smart chargers, a network management system and an energy storage system. The operational profile of the fleet provides a 12-hour time window to charge the vehicles, which means that vehicle charging demand can be spread throughout this time window to lower peak energy demand. This has enabled the number of battery electric vehicles in the depot's fleet to increase without the need for further physical grid reinforcement, optimising the use of existing infrastructure assets.[61]

[††] Assets delivered in anticipation of demand that does not materialise.

The lower operating costs of electric vans could mean that freight is one of the first parts of the commercial vehicle fleet to move to zero emission power. Infrastructure to support depot charging is therefore likely to be needed within the next energy distribution price control period (RIIO-ED2), which will run from 2023-2028. To start this process, Ofgem should include within the RIIO-ED2 strategy document clear requirements for DNOs to outline as part of their business cases what it may mean to provide the electricity upgrades to deliver mass uptake of freight electric vans by the end of the RIIO-ED2 period. This will involve working proactively with freight operators to understand their needs and plans, and identifying the best solutions for each location.

## Preparing for the transition to zero emission HGVs

HGVs will be more challenging to decarbonise because of the heavy loads they haul and the longer distances they travel and there remains uncertainty about the pathway to decarbonisation. There is currently no commercially available solution to decarbonise the heaviest HGVs. A range of zero emission options are being promoted as an alternative to diesel, including synthetic diesel, biofuels and e-highways, but the most promising technologies appear to be battery and hydrogen.

### Synthetic diesel

Electricity can be used to produce synthetic fuel which can be used as a direct substitute to diesel, with little or no changes to existing engine technology and existing filling stations. It is at an early stage of technological development and, to date, only small amounts of fuel has been produced for limited engine tests.[62]

It is estimated that synthetic fuels are only 18 per cent as energy efficient as direct electric motors.[63] Synthetic fuels currently have higher whole-life emissions than diesel, though they are likely to reduce as electricity generation decarbonises. Emissions of air pollutants are generally considered to be reduced, but there remains uncertainty about $NO_X$ emissions.[64] The cost of producing synthetic fuels today is reported to be around £4 per litre, more than eight times the cost of diesel production.[65] Reducing the cost to match diesel would require larger scale production and significant efficiency improvements, though the energy intensity of production means that the cost is likely to remain higher than other alternatives.[66]

### Biofuels

Biofuels are alternative fuels that are generated from harvesting biological matter that have similar properties to fossil fuels. Biofuels are already in use to reduce the carbon intensity of transport, principally through the Renewable Transport Fuel Obligation (RTFO) which sets a trajectory for the proportion of liquid biofuels being blended into existing fuels, with a minimum percentage of biofuel content increasing over time and exceeding 12 per cent of total fuel for fuel and vehicle suppliers by 2032.[67] Currently, 8.5 per cent of all fuel must come from sustainable renewal sources.[68]

Biofuels are unlikely, however, to be the long term solution to decarbonising HGVs. Biofuels are neither strictly zero carbon, nor zero emission as they emit other pollutants at the point of use.[69] There is a finite supply of sustainable biofuels, limited production capacity and competing uses. The Committee on Climate Change recommends that the UK should transition away from using biofuels in surface transport by 2030, noting that not doing so could risk delaying the transition to other low carbon options and that these resources should increasingly be directed towards hard to decarbonise sectors.[70]

## E-highways

E-highways utilise overhead wires on a catenary, wires embedded in the road, or in-road induction charging to deliver constant power to a battery aboard the HGV. They are being developed in a number of countries, with live trials underway in Sweden, Germany and California.[71] While at an advanced stage of development, the practicalities of e-highways remain challenging. It is likely that large stretches of the UK's Strategic Road Network (SRN) and highways in Europe would need to be electrified before hauliers had sufficient confidence to invest in compatible vehicles. It will also not be practical or cost efficient to electrify the entire road network and vehicles will require another source of power when they are running on non-electrified routes.

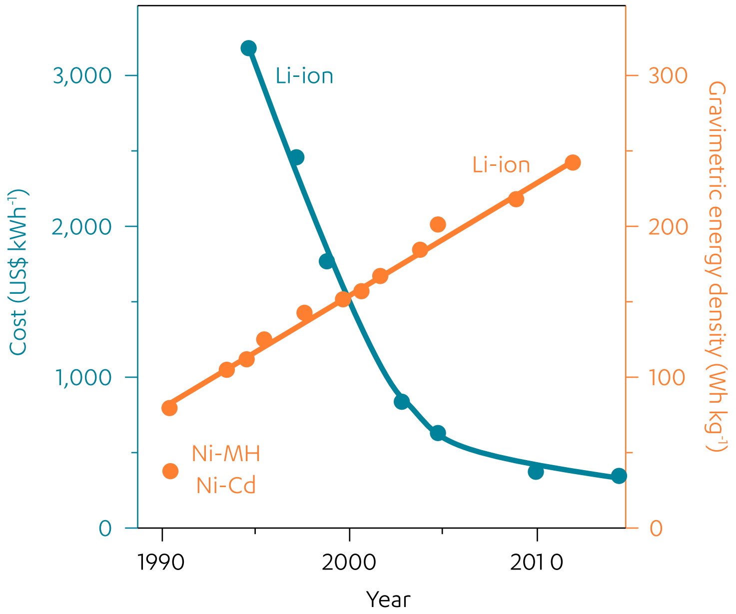
E-highways will, to a greater extent than other options, be more dependent on public provision of infrastructure, which is likely to be expensive and disruptive to other road users. There is a risk of e-highways becoming stranded assets as competing zero emission options continue to develop and fall in price in the time between infrastructure being delivered and before hauliers have confidence to invest in compatible vehicles. While it is possible that e-highways could provide at least part of the decarbonisation solution, particularly for long-haul activities, they alone will not decarbonise all HGVs.

## Battery electric

Battery electric could be a promising option for decarbonising HGVs. A small number of lighter electric models designed for shorter urban journeys have been available commercially since 2010. Heavy battery electric HGVs are currently at an advanced stage of development, with Tesla and Daimler scheduled to launch heavy battery electric HGVs at the beginning of the 2020s, with the former claiming an 800km range from a single charge.[72]

Though battery electric HGVs are likely to have a shorter range than hydrogen HGVs, regulations on driver's hours and the time spent loading and unloading the vehicle provide opportunities to charge at either end of the journey and 'top up' en route, providing sufficient and rapid charging infrastructure is available.

**Figure 5: Development of lithium batteries during the period 1991-2015, showing the cost and gravimetric energy density[73]**




The energy density of batteries has increased while their costs have fallen rapidly, as can be seen in Figure 5, and this trend is expected to continue.

Battery electric HGVs will initially be more expensive to purchase than diesel HGVs, however the inherent energy efficiency of using electricity instead of diesel could lead to substantial fuel savings, even over relatively short periods.

## Hydrogen fuel cells

Hydrogen fuel cell HGVs convert compressed hydrogen into electric energy to drive motors, with water being the only by-product. Hydrogen powered vehicles promise minimal disruption to existing practices. They have a long range, rapid refuelling times and hydrogen can be dispensed from refuelling stations in a similar way to the existing network of diesel stations. Very limited numbers of hydrogen powered cars and buses have been in use since the early 2000s and vehicles are still produced in very small numbers. There are currently no commercially available hydrogen HGVs, but a number of manufacturers, including Toyota, Nikola and Hyundai have been demonstrating and testing the technology, and it is expected that the first models will become commercially available from the start of the 2020s.[74 75]

The case for hydrogen HGVs depends upon substantial falls in the costs of both vehicles and their fuel, both of which remain substantially higher than battery equivalents. At today's prices, a hydrogen vehicle would not pay back the additional investment and the cost per mile of a hydrogen HGV could be 25-30 per cent more expensive than diesel. The price of hydrogen would have to fall by around 20 per cent to bring costs per mile in line with diesel and significantly further to be close to battery electric.[76] The cost of hydrogen is likely to be determined by factors outside of transport, including the use of hydrogen to decarbonise the UK's heating supply network and the emergence of a global hydrogen market.

## Preparing infrastructure for zero emission HGVs

It is not yet possible to make investment decisions about the infrastructure required to make the transition to zero emission road freight. Despite this, it is important that government begin planning what the infrastructure required to achieve zero emission heavy road freight might look like – particularly given that both hydrogen and battery electric options are both close to market.[77] Government must start to identify where the demands on the grid will be highest, the minimum network extent to enable transition, as well as the gaps where government may have to subsidise and support fuelling infrastructure.

### Battery electric HGVs

There are three aspects to the infrastructure required to support battery electric HGVs; total electricity demand; the grid to deliver the electricity; and the charging infrastructure for HGVs. Indicative estimates prepared for the Commission suggest that the annual electricity demand from a fully electric fleet of HGVs could equate to approximately 80TWh, equivalent to a quarter of the UK's electricity consumption in 2017.[78] [79] [ll] An increase in the UK's electricity generation capacity may therefore be required to support widespread adoption of battery electric HGVs.

The transition to electric HGVs is likely to require grid reinforcements , smart charging, energy storage, or a combination of these elements, to enable high capacity connections that will support HGV recharging at depots and at strategic locations on the road network.

The bulk of HGV charging will take place at depots, where a high vehicle-to-charger ratio is likely to be required. The need for reinforcement could be minimised if smart charging and solutions to enable flexibility are employed to manage peak demand and respond to dynamic price signals. The extent to which smart charging is adopted by HGV operators will depend on the duty cycles of their vehicles, the incentives to adopt smart charging and the attitudes of hauliers.

Provision of rapid charging infrastructure will be required at many rest areas along the SRN to support long haul electric HGV journeys and reduce 'range anxiety'. These chargers will be much fewer in number compared to the number of depot chargers.[80] Assessing whether driver rest areas have spare capacity in their grid connection will prevent grid issues from slowing the provision of rapid charging infrastructure, while also supporting the electrification of passenger transport.

The capital and operational expenditure required for hauliers to install and maintain charging infrastructure at depots is likely to be significant, though the costs will

[ll] Increasing energy consumption by a quarter would not necessarily require electricity generation to increase as much as a quarter to meet the demand. Several factors, including the time of day that electricity is used, would determine the actual energy required.

depend upon the ratio of vehicles to chargers required and the specification of these chargers. Charging stations could cost between £1,000-£40,000 each. While these costs are very significant, they could be outweighed by the cheaper costs of electricity as a fuel.

## Hydrogen fuel cell HGVs

The infrastructure required to enable hydrogen HGVs relates to four main areas: the production of the hydrogen, total electricity demand from producing hydrogen (if using electrolysis), and the distribution of hydrogen and refuelling facilities. Hydrogen is one of the least efficient methods for providing propulsion from electricity with a through-chain efficiency of around 22 per cent, compared to around 73 per cent for battery electric vehicles.[81]

### Principal methods of producing hydrogen

**Steam Methane Reformation:** combines methane and water and converts these to hydrogen and carbon dioxide. Steam Methane Reformation is currently significantly cheaper than any other method of hydrogen production and is the most widely used method today. This production method needs to be paired with carbon capture and storage, otherwise it still emits significant amounts of carbon dioxide.[82] Steam Methane Reformation is well suited to centralised production, though the hydrogen needs further purification before it can be used in fuel cells.[83]

**Electrolysis:** uses an electric current to split water into hydrogen and oxygen. Provided that the electricity is from a low carbon source electrolysis has the potential to produce hydrogen with minimal carbon emissions. However, electrolysis is a much more expensive and energy intensive method of hydrogen production than Steam Methane Reformation (though it produces hydrogen pure enough for fuel cell use). A HGV fleet using hydrogen produced using electrolysis would use around 3.3 times more electrical energy than a battery electric fleet, requiring a significant amount of additional grid capacity and low carbon energy generation.[84]

The precise infrastructure implications of hydrogen HGVs will depend upon developments outside of the transport sector itself, particularly other industrial uses of hydrogen and whether the gas grid is converted to carry hydrogen for the UK's heating supply network. If the heating supply network carries hydrogen, it is likely that hydrogen will be mass-produced in centralised facilities through Steam Methane Reformation (with carbon capture and storage) which can then be distributed nationally via the gas network to be purified close to the point of use. If a global hydrogen market emerges, hydrogen may be produced overseas, imported to the UK in ships and then distributed to refuelling stations via the gas grid (though it is possible that some refuelling stations would be served by road tanker).

If the heating supply network was not converted to carry hydrogen and a global hydrogen market did not emerge, it is likely that Steam Methane Reformation would still be the primary method of producing hydrogen, though distribution would have to be via road tanker or specific pipelines, both of which would increase the transport costs of the fuel. While electrolysis enables decentralised production, potentially at refueling stations, it is highly unlikely to provide sufficient hydrogen for a national rollout of hydrogen HGVs at reasonable cost.[85] On-site electrolysers could be an option in some locations if the cost of electricity is low but, given their energy intensity, they are unlikely to be deployed on a large-scale and would require sufficient electrical power supply.

Irrespective of whether the gas grid is converted to hydrogen, the vehicles would be refuelled from stations using a similar model to today's filling stations, some of which may be converted to cater for hydrogen. It is estimated that 350-700 refuelling stations would be required to serve the whole HGV fleet.[86]

Hydrogen HGVs would require significant capital expenditure to invest in production facilities, though it is possible that the costs of refuelling infrastructure will be lower than those for battery electric HGVs. The Commission will be undertaking further work on using hydrogen to decarbonise the UK's heating supply network in advance of its next National Infrastructure Assessment.

## Factors affecting uptake

The decision about whether HGVs transition to battery electric, hydrogen, dual fuel (or another zero emission option) is likely to be principally market led, but the speed of uptake will be determined by a range of factors, including government policy, how technologies and infrastructure are perceived by potential users, and cost (or change in profitability).[87]

It is likely that the transition to zero emission road freight will be strongly driven by regulatory developments in the European Union and the direction of the wider European commercial vehicle market, of which the United Kingdom is a relatively small part. Regardless of the eventual UK-EU relationship, it is imperative that the UK works with the EU to plan the transition to zero emission fuels, ensuring cross-border road freight continues unhindered and that manufacturers are given confidence to produce a sufficient supply of zero emission vehicles.

Government has already begun to act to put in place early incentives for the adoption of zero emission HGVs. In October 2016, government extended the plug-in vehicle grant to cover all vehicles weighing more than 3.5 tonnes. There may also be a need to increase the permitted weight of zero emission HGVs so that the increased weight of their powertrains does not compromise the payload of the vehicle (this approach is already being adopted by the EU) – though this will increase stress on roads and bridges.

It may be possible for the freight system to begin a rapid transition to zero emission vehicles before parity on vehicle purchase price is achieved. Freight operators assess investment decisions on the basis of total lifetime costs (including fuel, maintenance and its residual market value when sold). Once the total lifetime costs of zero emission freight vehicles achieve parity with diesel vehicles, uptake of zero emission options could accelerate rapidly.

## Residual values

The second-hand market will have implications for the adoption of zero emission HGVs and vans. Residual values (the price a vehicle can be sold for second-hand) play an important role in determining the purchase and lease costs of new vehicles and make second-hand zero emission vehicles an option for those unable to afford new vehicles.

The structure of this market is linked to the size of operators. Large road freight firms mainly purchase new HGVs, while smaller firms tend to purchase HGVs second-hand. In companies with more than 150 vehicles, 87 per cent were new or leased and three per cent second-hand, whereas in firms with less than five vehicles, 29 per cent were new or leased and 70 per cent second-hand.[88]

This structure means that the purchasing decisions of a relatively small number of large firms control which new vehicles enter and remain part of the HGV fleet (and, to a lesser extent the van fleet) until the end of their useful life around 10-12 years later – therefore the transition to zero emission vehicles is likely to be led initially by the largest fleets. Older, less efficient vehicles tend to be owned by smaller firms, which means that if attempts are made to transition towards zero emission road freight too quickly (or without adequate support), these measures are likely to have a disproportionate impact upon smaller operators.

## Long term clarity

Although challenging, the Commission believes that it is possible to achieve a zero emission road freight system by 2050. In order for the HGV fleet to have transitioned to zero emission vehicles, this would require 100 per cent of sales to be zero emission by the end of the 2030s and it is likely that the rollout of supporting infrastructure would need to take place during the 2020s to support these ambitions.[89]

The key to encouraging rapid market change is through government providing a clear long term decarbonisation target to the vehicle market and freight industry. It is therefore imperative that government commits to clear, long term targets on decarbonisation of vehicles, giving the road freight industry time to plan their long term fleet investments and vehicle manufacturers the time and incentive to develop and deliver the supply of vehicles, while ensuring that the UK's energy and transport infrastructure is prepared for transition.

**Recommendation 1: government should commit to decarbonising road freight by 2050, announcing plans by the end of 2021 to ban the sale of new diesel powered HGVs no later than 2040. To support this:**

- **government should, in conjunction with distribution and transmission network operators, prepare detailed assessments of the infrastructure required to enable the uptake of battery electric or hydrogen HGVs, including the refuelling requirements at depots and key rest areas on major freight routes. For battery electric, these assessments should include enhancements to distribution networks alongside alternatives to reinforcement, such as energy storage. For hydrogen, these assessments should cover the production, storage and distribution of hydrogen, including any dependency with the decarbonisation of the heating supply system.**
- **Ofgem, as part of the next energy distribution price review (RIIO-ED2) starting in 2023, should include a clear requirement for distribution network operators (in partnership with the freight industry) to map out the infrastructure upgrades and opportunities for alternative solutions, such as energy storage, required to enable large scale freight van charging at depots.**

## Decarbonising rail freight

Delivering the UK's climate targets will require decarbonisation of many sectors of the economy, including transport. It is therefore a question of how to decarbonise the railway for both freight and passengers, rather than whether to do so. The government has already outlined its ambition to remove diesel-only trains from the railway by 2040. However, more important than this ambition will be the principle that road and rail freight should have a common, single target to decarbonise fully by 2050. No part of the freight system should be indirectly subsidised by being allowed to emit carbon when other parts are decarbonising.

The vast majority of rail freight services are diesel hauled and around 87 per cent of the locomotive fleet is diesel powered. The replacement rate for freight locomotives is currently averaging about 3.5 per cent of the total freight locomotive fleet per year and, at this rate, only around 70 per cent of the current fleet will have been replaced by 2040.[90]

**Table 1: Freight locomotive fleet by traction type[91]**

| Freight locomotive fleet | Number | Percentage |
|---|---|---|
| Diesel | 747 | 87% |
| Diesel bi-mode | 25 | 3% |
| Electric (incl. parcel trains) | 84 | 10% |
| **Total** | **856** | **100%** |

At present, the key competitive advantages of rail are its low unit costs for longer distance journeys, its inherent energy efficiency, and its low carbon intensity.[92] Although the rapid decline of the coal market has meant a drop in total rail freight volumes, other markets such as containers have been growing.[93] For certain bulk products – such as aggregates for construction – rail is the obvious choice. It is likely that rail freight will continue to play an important role in the UK's freight mix, but it must make progress on decarbonisation.

## Electrification

Electrification is currently the only proven method of decarbonising rail freight, but only around 42 per cent of the UK's rail network is electrified and only a minority of rail freight services are electrically hauled because of gaps in the electrified network and an operational expectation that rail freight locomotives should be capable of travelling anywhere on the network.[94] By 2039, it is expected that still only between 48 and 50 per cent of the railway will be electrified, following the cancellation of three major electrification schemes.[95]

It has been argued that a targeted programme of electrification could fill in gaps in the electrified network to maximise increases in electrically hauled freight. A proposal to electrify 515 kilometres of track has been estimated to allow nearly two thirds of existing services to be electrically hauled.[96]

However, electrifying the railway is expensive and disruptive to all rail users during construction. Data from previous projects suggests that electrification could cost between £2 million and £4 million per single track kilometre, resulting in a significant cost that would come out of the budget for strategic transport identified in the *National Infrastructure Assessment*.[97] However, when considering the potential wider costs involved in other methods of decarbonising rail freight, electrification could turn out to be cheaper and quicker, improving network efficiency and providing wider benefits for passenger services.

## Battery or hydrogen powered locomotives

New technologies could enable zero emission rail freight operations without further electrification. Hydrogen and battery electric power show promise for lightweight passenger trains and could become options for freight in the longer term, possibly in bi-mode locomotives capable of bridging electrified and non-electrified sections.

However, the high energy requirements of freight trains mean the low energy densities of hydrogen and batteries could involve replacing revenue-earning cars with a fuel tank or batteries, or increasing the lengths of trains to accommodate the onboard energy (though this would likely have infrastructure costs). The volume of hydrogen required to power a freight train could require at least one, if not two additional wagons to carry fuel. The weight of batteries could require three wagons.[98]

While the energy density of fuel cells and batteries will continue to improve, the compromises these may make to the payload and what these locomotives might cost remains uncertain. Hydrogen and battery electric traction are likely to be expensive technologies which could require high levels of public subsidy and, because there are no proven models available, the transition costs are hard to quantify. Zero emission traction is likely to increase the costs of rail freight due to more expensive locomotives.

## Alternative modes

Delivering zero emissions rail freight using either electrification or alternative fuels is likely to have very significant costs on infrastructure or new locomotives. But without these costs being paid, most likely from public expenditure, the only other way for rail freight to be zero emissions is for it to transfer to other modes, such as zero emission HGVs.

It is estimated that rail freight removes 1.7 billion kilometres of HGV mileage from the roads each year, around six per cent of HGV mileage in 2017.[99] Reversing this would lead to more traffic and congestion.[100] Replacing all current rail freight with HGVs could mean an increase of around one per cent in all current traffic on major roads, or a two per cent increase in traffic using the SRN.[101]

The effects of transferring rail freight to the road would not manifest equally over the road network. Certain corridors could experience more significant problems – stretches of the SRN that run adjacent to major rail freight routes (such as the A14 to Felixstowe) could experience greater increases in traffic due to more HGVs, and roads which already have very high levels of congestion (such as the M6) would be particularly vulnerable to the effects of any increase in HGV traffic.[102] It may be possible to alleviate some of the congestion impacts through a package of road investments, although it may not always be feasible or desirable to create additional road capacity in all locations. The costs of such a package are likely to be significant.

## A decisive role for government

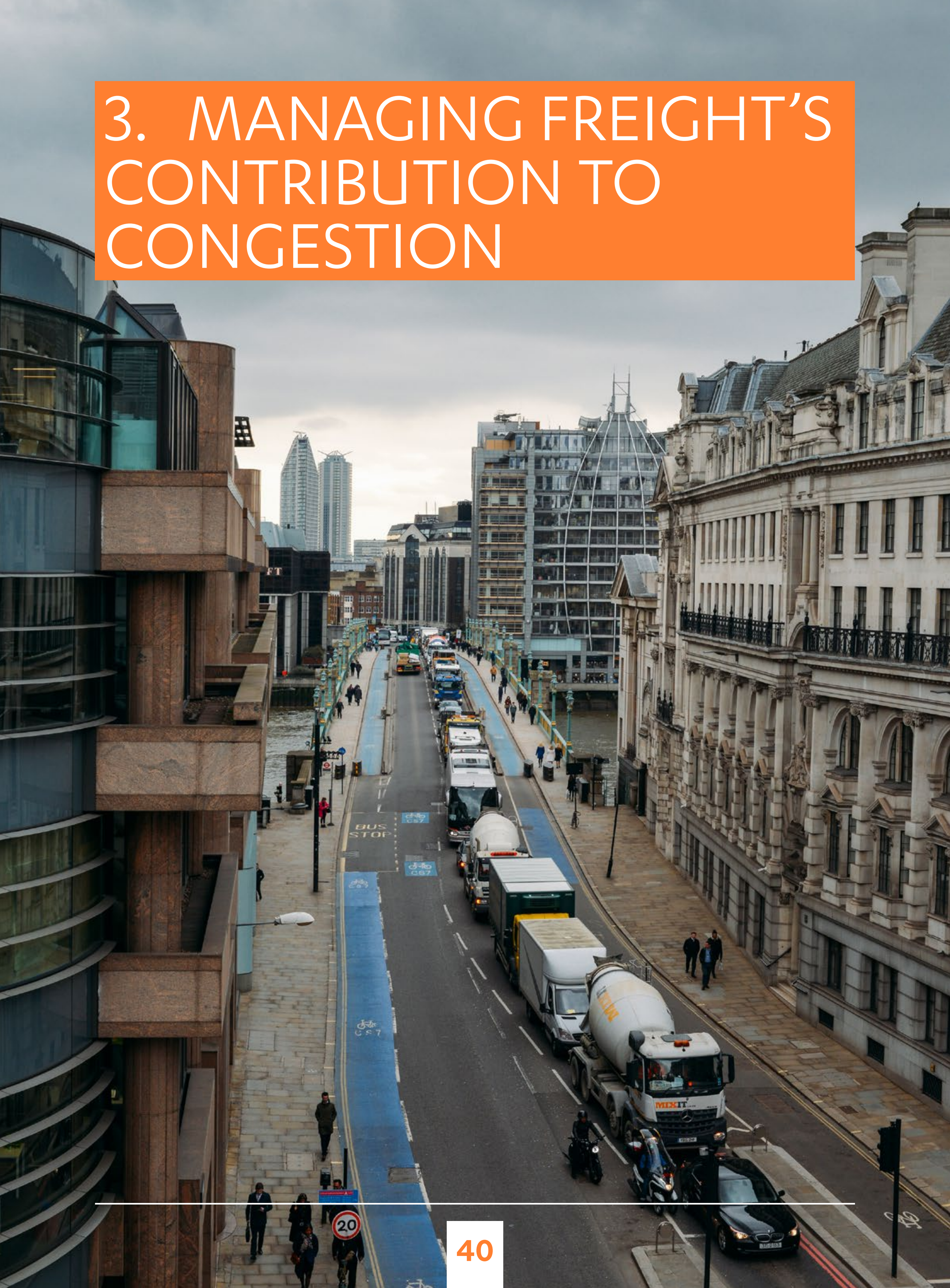
All of the options outlined above need government action: simply setting a zero emissions target and doing nothing else risks rail freight transferring to road with no new capacity, potentially creating more congestion.

Detailed work will be needed to assess the costs of inaction and the cost effectiveness of potential infrastructure interventions. Assessing the costs and benefits of the different options (or combination of options) will require a corridor based approach and extensive cross-modal transport and economic modelling. This should seek to identify where either road or rail freight present the most cost effective zero carbon option, including where roads can take more traffic as well as more technical work to understand the capabilities and costs of hydrogen and battery electric locomotives. This work will also need to assess the impacts on rail and road passenger transport.

Government will need to take a decisive role in determining how rail freight should reach zero emissions, and consider where and to what extent this involves rail freight subsidies to support transition to new zero emission locomotives, investment in further electrification, or road upgrades. The long investment cycles of both railway infrastructure and rolling stock mean that the next replacement cycle across the rail freight industry is likely to be the only opportunity before 2050. Government must therefore start detailed this work now, setting itself up for a decision by 2021 on which option (or combination of options) it is going to pursue, in advance of Network Rail's Control Period 7 and the third Road Investment Strategy.

**Recommendation 2: government should undertake detailed cross-modal analysis, using a corridor-based approach, of the long term options for rail freight's transition to zero emissions, including low carbon rail services and the scope for road based alternatives. It should then publish, by the end of 2021, a full strategy for rail freight to reach zero emissions by 2050, specifying the investments and/or subsidies that it will provide to get there.**

# 3. MANAGING FREIGHT’S CONTRIBUTION TO CONGESTION



**Road congestion is severe, and time lost as a result of congestion is a significant cost to the economy every year. The delay experienced because of congestion is the same for all road users in the queue, but the consequences are varied – for the travelling public, congestion can mean a stressful end to a busy day and an erosion of leisure time. For freight, delay can mean parts for the assembly line do not arrive in time, supermarket shelves are not stocked, or legal contracts miss deadlines. The cost of congestion to the road freight industry is estimated to be between £3-6 billion a year.[103] Holistic action is needed to manage congestion. With clear direction from government and local authorities, freight can both reduce its contribution to the problem of congestion, and take further steps to manage its exposure to it.**

Congestion is a significant problem in the UK and one that will continue to grow. Although freight is not the root cause of congestion, it can be a significant contributor, in some areas and at certain times.

There are clear, affordable actions that government, local authorities, cities and the freight industry can take that can reduce freight's contribution to road congestion at the same time as enhancing its efficiency.

Better planning for freight will mean that the right facilities can be in the right places, reducing journey distances and wasted mileage, and allowing the use of the cleanest mode of transport for the journey. Planning for optimised freight operations will require:

- city-led plans for urban freight, including reviews of local regulations that restrict freight's access to the network at the least congested times;
- new planning guidance to support local authorities in planning for freight; and
- a government-developed method to allow local decision makers to access freight vehicle movement data.

# The case for action

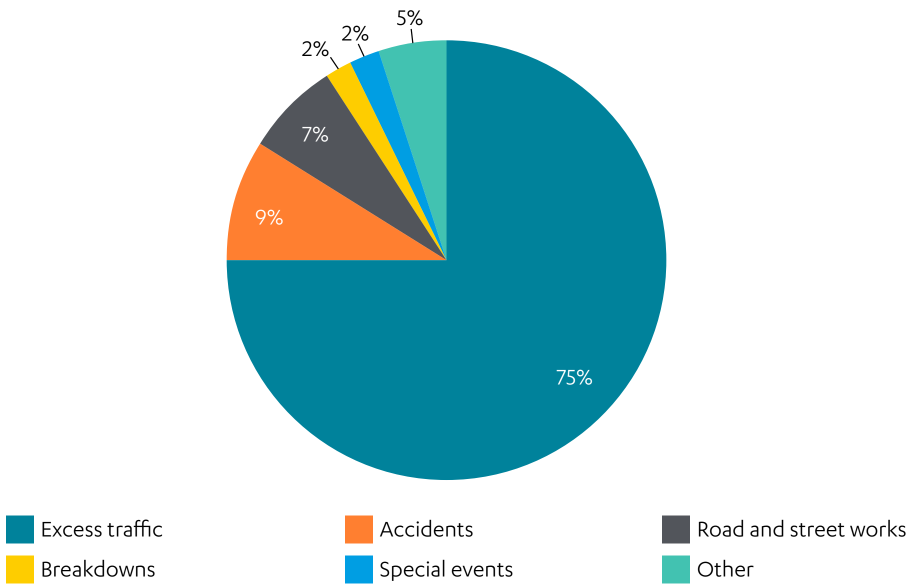
Congestion occurs on the road network when the number of vehicles being driven approaches or exceeds the capacity that can be handled by the infrastructure. It can be localised, occurring at a set of traffic lights or in a narrow street, or over longer distances. The effects of congestion include queuing traffic and less predictable journey times.

In the UK, road congestion tends to be worst on roads in urban areas. The average delay per vehicle mile on urban A roads is 81 seconds, compared to nine seconds per mile on the strategic road network.[104 105]

The Commission's own analysis forecasts an overall increase in road traffic (road vehicle kilometres travelled) of between 18 per cent and 54 per cent by 2050.[106]

In London, the most congested city in the UK,[107] it is estimated that three quarters of congestion instances are caused by there being more traffic than the network can handle.[108] The remaining 25 per cent of congestion has been assessed to be caused by a mix of incidents which temporarily restrict or stop the normal flow of traffic.

**Figure 6: Estimated causes of road congestion in London[109]**

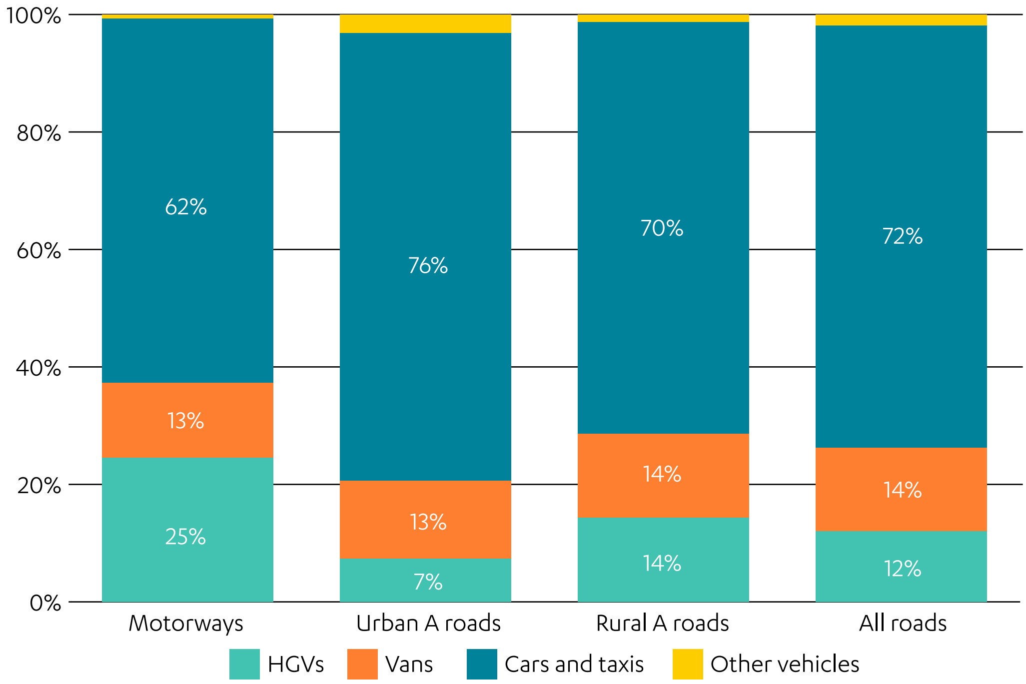



# The contribution of HGVs to road congestion

Only five per cent of all vehicle kilometres were completed by HGVs in Great Britain in 2017, and almost half (46 per cent) of HGV distance driven is on motorways.[110] Fewer than one in ten HGV kilometres are driven on urban A roads.[111] Once translated into road capacity, HGVs account for 12 per cent of traffic across all roads in Great Britain, 25 per cent of traffic on motorways, seven per cent on urban A roads and 14 per cent on rural A roads. [§§ 112]

§§ This uses 2017 road traffic (vehicle kilometres) numbers and multiplies them by 2.5 to convert them to Passenger Car Unit (PCU) equivalents, as is done for the purposes of traffic modelling.

Figure 7: Road space used by vehicle and road type[113]




In addition to the space they occupy on the road network, HGVs have slower speeds, longer braking distances and are more likely to be involved in critical highway incidents[114] – all of which amplify the impact of HGVs on the traffic in which they are driven.

However, HGVs are typically used on the network less intensively during the morning and evening peaks, making a far smaller contribution to peak time congestion than cars and vans. There is no evening peak for HGV movements as there is for cars and vans.[115] HGVs use roads more intensively than cars and vans overnight, when there is less or no congestion – for example, on the M6, 42 per cent of HGV traffic travels between 19:00 and 06:30.[116]

Therefore, though HGVs account for up to a quarter of road space use on motorways they do not make an equivalent contribution to congestion. HGVs represent a much lower proportion of traffic on the most congested roads, and they are driven on the network at less congested times.

## The contribution of vans to road congestion

Vans represent a substantial and fast-growing proportion of traffic. Between 2000 and 2017, van kilometres increased by 56 per cent.[117] In London, an increase in van traffic is driving an overall increase in total traffic levels, while car and HGV traffic levels are declining.[118]

Van traffic peaks at the same time as car traffic.[119] Van traffic therefore makes a considerable contribution to congestion at either side of the working day.

Vans carrying freight need to stop at the kerbside to make deliveries. In busy towns and cities, delivery drivers can be forced to park outside designated loading areas. This can mean that the capacity of the road is temporarily reduced, disrupting normal traffic flow and creating a local congestion issue.

Only a minority of vans are used to carry freight, however. The Department for Transport's 2008 survey of van use found that the most common use for vans was for carrying equipment (for servicing activity), which accounted for half of total van mileage.[120] Just over a quarter of van mileage was for the delivery or collection of goods.[121]

It may be reasonable to assume that the growth in online shopping and home deliveries is changing the overall picture of how vans are used, but research into freight activity and ecommerce suggests that there are a range of factors behind the growth of vans, with online shopping and home delivery being only one part of the story.[122]

**Figure 8: Explanations for the growth in van use[123]**


As more and more people go on online to make purchases, the need for last mile delivery services increases. While this has led to more vans on the roads delivering parcels to homes, workplaces and other parcel drop-off points, detailed analysis has found that there is not a strong interaction between online shopping levels, van volumes and traffic congestion.[124] Vans involved in parcel delivery are generally used efficiently and intensively.[125] The increasing use of click-and-collect services helps manage journey distances and minimise the rate of failed deliveries, a large proportion of vans engaged in parcel delivery operate outside of peak traffic periods, and, in some instances, online shopping replaces shopping trips by car. Only one in ten vans on the road are parcel vans, and in London it is estimated that vans servicing online shopping orders account for just 1.5 per cent of traffic.[126]

## Congestion on the railway

The railway is different to the roads because it is timetabled and the number of trains permitted and scheduled on the network is kept within the level which can be safely handled. Rail congestion is therefore better considered as an issue of rail capacity and access to scheduled 'paths', which itself is determined by a range of factors, including the number of tracks, signalling, loading gauge and the layout of junctions and terminals. Rail freight uses only a small amount of capacity, often away from busy passenger routes. However, capacity issues can mean an insufficient number of paths allocated for freight, or having to use routes which are circuitous and/or involve several stops to allow other services to pass. For example, moving biomass from the Port of Liverpool to Drax power station by rail can take up to 11 hours.[127]

## Freight's exposure and response to congestion

Deliveries which take longer than they would under free flow traffic conditions cost more in fuel and staff costs. Analysis undertaken for the Commission suggests that congestion increases the cost of road freight for road freight operators by 8-16 per cent.[128] There can be severe penalties incurred if deliveries are late, such is the time-limited nature or value of some goods and the supply chains into which they fit. This can mean operators schedule driving time to avoid the worst periods of congestion, load vehicles as efficiently as possible, and even make location decisions based on traffic conditions.

Another possible response by freight operators to congestion can be to use more vehicles to continue to be able to guarantee an agreed level of service. For example, a parcel courier may need to despatch an extra van to complete a pick-up job within the agreed time window if the other van out on the route is stuck in traffic.[129] As the number of parcels that need to be delivered on the same day or next day increases, and the time windows in which they will be delivered are narrowed, the opportunity to consolidate loads and fill up vans diminishes, because vans will be able to complete fewer drops and pick-ups per trip.[130]

Congestion is a complex problem and it is appealing to look for a single cause. However, freight mostly has a minor role in the overall picture of congestion – it is a minority user of scarce capacity on the congested road network, and one which is already incentivised to avoid congestion as far as possible.

Nonetheless, while not the root cause of congestion, action on freight can help overall. It is both in the interests of society and freight operators themselves to consider how to minimise freight's contribution and exposure to congestion, and help manage congestion in urban areas.

## Making better use of existing capacity

On the strategic road network, the Commission's analysis found that the places in which freight usually experiences congestion are the same as for other traffic. Highways England plan, prioritise and deliver targeted schemes to relieve congestion pinch points across the Strategic Route Network, and the pinch points that freight users experience (including around ports and airports) are considered as part of this. The process to identify and prioritise remedial action gives due consideration to freight movements and the benefit unlocked by allowing freight traffic to flow more smoothly, as part of the balanced consideration of the anticipated costs and benefits of delivering the scheme. There is therefore little justification for a separate process to identify and plan for road improvements for freight specifically.

In urban areas, increasing capacity by continually building or widening roads is not a long term solution to tackling congestion. Extra capacity might provide temporary respite, but it is only a matter of time before it is filled again by people making new and different journeys.[131] A higher priority option for managing freight's contribution and exposure to congestion is to ensure that freight draws upon scarce road capacity as efficiently as possible, making better use of the existing capacity both on the road network and in the vehicles used for freight.

## Demand management through road pricing

Road pricing is a major policy option that is often considered as part of the solution to effective management of congestion.

Evidence from London following the implementation of the central London Congestion Charge in 2003 shows that freight was less responsive to the charge than other road users. During the period from 2002 to 2007, all vehicle traffic entering the central London Charging Zone fell by 16 per cent, car and minicab traffic fell by 36 per cent, but HGV traffic only fell by five per cent.[132] This suggests that charges capable of forcing considerably different road use behaviours by freight would have to be more significant than the original congestion charge (£5, then £8 daily charge between 2002 and 2007). Some operators might be able to change their operations to avoid or minimise charges, but many others would not, and it is likely that a higher cost of doing business would be passed on to customers.

The issue of paying for road use was identified in the *National Infrastructure Assessment* and is the subject of ongoing work by the Commission, particularly to identify options which are fair, sustainable and able to reduce the negative impacts of road use. The Commission will return to this subject in the second National Infrastructure Assessment.

## Optimising freight on the strategic network

Though the individual impact of optimisation measures for long distance freight movements is limited in terms of congestion, a combination of such measures, together with the fact that freight operators avoid congestion as far as possible, is key to the continuing management of freight's contribution to congestion on strategic roads.

### Modal shift

Moving freight transported by HGVs off the road and on to less congested networks is a possible mechanism through which to manage road congestion (known as modal shift). Of the alternative modes emerging and currently available, it is only rail which currently offers a credible alternative for some types of road freight in terms of network coverage, and speed and cost of haulage.

While it is theoretically possible to shift a further proportion of road freight to rail, on most routes significant enabling and complementary investment is required to prepare the alternative network or corridor for freight use – and the expense of decarbonising rail freight, as discussed in Chapter 2, must also be considered. One recent study for the Department for Transport estimated that there was potential for approximately 20 per cent of current road freight volumes to transfer to rail, however it was concluded that this would only be possible with very significant enabling investment in infrastructure and terminals.[133] The total cost of the investment required was not calculated.

Transporting significantly higher volumes of freight by rail would deliver a congestion benefit on some busy road corridors, but at considerable – and currently unquantified – cost. There would also have to be trade-offs between the capacity available for passenger services and rail freight services on the railway. The right mix of road and rail freight is a complex issue, and a decision on where to make investment to achieve congestion and environmental benefits is one which must be carefully considered by government.

### Utilising technology

Reducing the gaps between HGVs travelling on the strategic road network through 'platooning' – the process whereby two or more vehicles wirelessly connect and operate as a single unit – theoretically reduces the amount of road space that HGVs occupy on the network, as well as substantially reducing energy use and improving safety. While platooning trials are underway in the UK, it is not clear whether there will be a congestion reduction benefit.[134] The case for platooning may change significantly with Connected Autonomous Vehicles (CAVs) – HGVs could platoon in the outside lane, which would reduce the frequency with which platoons would need to break and reform.

'Smart motorways' are sections of motorway which use technology to monitor traffic levels, change the speed limit to smooth traffic flow, and open lanes when needed to provide extra capacity.[135] Providing extra capacity through smart motorway interventions is a proven intervention for managing congestion – when the first smart motorway scheme opened on the M42 in 2006, journey time reliability improved by 22 per cent.[136] Technology enabled capacity improvements such as smart motorways provide congestion reduction benefits to all road users, not just freight.

### Improved loading

Not all HGVs are full all of the time. The proportion of HGVs that ran empty in 2017 was 29.9 per cent.[137]

Some studies have sought to understand the potential for optimising HGV use through 'backhauling' – finding and moving return loads to minimise empty running legs. While they identified that some reduction in empty running was possible through increasing backhauling, they concluded that there was only potential for a marginal increase in levels of backhauling.[138] Some empty running is necessary for efficient operations overall. Cities are net consumers of finished products and as such there will be an imbalance between the products moving into and out of them. With the freight system already incentivised to load as optimally as possible, a marginal improvement in loading and increased backhauling is unlikely to deliver any notable congestion benefit.

## Freight optimisation in urban areas

### Utilising rail and water

Moving freight by modes other than road (by rail or by water) can be an efficient and cost effective option for some types of freight, and can help to reduce freight's need for road space. At present it is mostly low value, bulk material such as mineral products for construction and waste which is currently transported by rail or water within urban areas – in London, 97 per cent of primary aggregate material for construction is delivered into the city by rail and water.[139]

But few construction sites are directly rail or water connected, and so most freight by rail or by water involves a final transport leg by road. The same issue applies to the use of rail or water for other types of freight – both ends of the journey must be rail or water connected, and a door-to-door connection is unusual. The additional handling cost associated with transferring a load arriving by rail or water to road for the final leg can be prohibitive – for certain types of goods it is cheaper and quicker to use road for the whole journey.

### Multi-operator consolidation centres

Freight operators already consolidate. Individual companies or supply chains bring together goods from a range of different sources and put them together into location specific consignments to help load vehicles efficiently and minimise journeys. However, consolidation across multiple and often competing operators is rare. Such an operation involves different organisations bringing their freight into a single centre for consolidation by a single supplier who will then deliver the goods to the customer, creating fewer and fuller vehicles for the final part of the journey. These types of consolidation centres have been proven to help reduce total distance travelled, improve vehicle utilisation, and allow for loads to be transported by cleaner vehicles for the last mile.[140 141]

There are issues to overcome, however. There can be a wariness from operators about sharing a facility with competitors, and land suitable for a consolidation centre in urban areas is often in short supply. The extent to which consolidation centres can operate without support from the public sector is also uncertain.[142]

### Retiming urban freight

Making greater use of the road network overnight would mean fewer freight trips occur at the most congested times during the day, and would allow freight trips to be completed more efficiently, without start-stop journeys through congestion. But even if customers are able and willing to receive deliveries overnight, either through having premises staffed or having a secure place to leave goods, there are often additional barriers to overcome.

Most towns and cities have local restrictions designed to protect residents from noise during anti-social hours. These can prohibit, or make it difficult, to make deliveries to certain premises in the overnight period. In London, the London Lorry Control Scheme (LLCS) restricts the movement of the heaviest lorries to a small number of routes around central London overnight and at weekends. Penalty Charge Notices (PCNs) are issued to operators and drivers if heavy vehicles are found to be being driven on routes other than those which are permitted. It is likely that the London Lorry Control Scheme does prevent some overnight and early morning deliveries from taking place. Targeted relaxation of the scheme – where operators can demonstrate residents will still be protected from noise – may help to smooth the peak of HGVs entering central London in the early morning.

### The role of new delivery methods in optimising the last mile

Operators, local authorities and government are already rolling-out and facilitating innovative solutions for optimised last mile deliveries, and further innovations which could reduce freight's need for road space at the busiest times are in the pipeline.

Drones and pavement-based droids avoid traffic congestion by avoiding roads altogether. However, such solutions are likely to only ever be niche in the context of last mile deliveries in urban areas. Recent research suggests that most consumers do not want to pay a premium for the same-day or instant delivery option offered by drones or droids,[143] and there are significant public acceptability and regulatory barriers to increased and widespread use. In addition, city pavements and pedestrian spaces do not have much extra capacity to accommodate delivery droids. Importantly, such solutions only apply to small and light weight deliveries, such as takeaways and small parcels.

Some of the most effective and promising solutions for an optimised last mile are not particularly 'new'. A recent trial of 'portering', where a person meets a van at the roadside and collects a consignment of parcels to deliver before the van leaves to drop off another consignment, effectively separating the driving and delivering tasks, reduced the amount of time that vans were parked at the kerbside by 50 per cent, and reduced the vehicle distance travelled per consignee by 30 per cent.[144]

The recent introduction of electrical assistance to traditional cargo bikes has significantly improved their ability to carry heavy loads over longer distances. Electrically assisted cargo bikes, or e-cargo bikes, have been the subject of trials in various cities in Europe, including London. Some e-cargo bikes can carry payloads of up to 125kg, and they are more manoeuvrable in towns and cities than vans or HGVs. They can be used in cycle lanes, are cleaner and quieter than motor vehicles, and occupy a much smaller footprint than a van or HGV when loading and unloading at the kerbside. E-cargo bikes may well become a regular feature of deliveries in urban areas.[145]

Both portering and e-cargo bikes offer some marginal improvement on the standard model of last mile delivery in dense urban areas. Optimisations such as these could contribute to managing freight's contribution and exposure to congestion. But the ways in which last mile freight movements in urban areas can be optimised points to an evolution rather than revolution in future last mile delivery operations and methods.

Transporting goods by HGV or van is still the most efficient way of moving goods when vehicles are optimally loaded. Vans are particularly efficient in urban areas when it is more difficult to use vehicles which have a higher payload, but are far less manoeuvrable. None of the current or emerging alternative delivery vehicles for the last mile – e-cargo bikes, droids or drones – have payloads equivalent to a standard van. It is therefore clear that vans and HGVs will continue to have the dominant role in freight in urban areas.

## Clear and balanced local regulation for innovation in urban freight

The congestion problem is greatest in urban areas. It follows that this is where the need and opportunity for freight to optimise and reduce its contribution and exposure to congestion is most significant.

The freight industry is innovative and efficient at adapting to the environment it operates in – it is the freight industry which drives the majority of innovations in last mile operations and methods. Sometimes innovation can be hindered by the policy environment, however.

Local authorities should therefore better support the freight industry in tackling congestion issues by creating a regulatory environment which both encourages increased uptake of proven and emerging congestion management solutions and enables further innovation.

Using consolidation centres allows better loading of vehicles, the use of cleaner and smaller vehicles for the last leg of the journey, and a reduction in the number of vehicles accessing the final destination. However, sometimes the extra handling of goods involved because of a consolidation centre, as well as freight operators' wariness to share any aspect of their operations with their competitors, makes the commercial case for using a consolidation centre less viable. Finding land for consolidation centres in cities can be difficult, too.

There is a role for local authorities in supporting freight operators to come together to use consolidation centres. Where a business case supports consolidation centres, authorities should make land available and consider the case for funding land and construction or subsidising the operation of the centre itself in the short term. The case for consolidation centres can be made stronger by building incentives for operators to make use of them, through planning restrictions on new build properties, like the City of London Corporation,[146] and by giving consolidated services preferential regulatory treatment such as reduced loading restrictions at the kerbside.

## Case study: Berlin KoMoDo – a cooperative urban consolidation centre

KoMoDo is a one-year pilot project between several different logistics operators in central Berlin, that makes use of a shared micro-consolidation centre, managed by a neutral provider, to facilitate zero emissions, low congestion last mile distribution.

The pilot is small in scale, but strategically significant – it involves the five biggest delivery operators co-locating and sharing a distribution facility – something which is normally avoided due to competition concerns. The participating companies are increasingly keen to explore opportunities to collaborate to meet environmental and congestion objectives.

The pilot is designed to test last mile delivery by cargo bikes, but also the practicalities of a network of micro-consolidation centres within a city.


Photo credit: SenVUK/Ralf Rühmeier

Allowing a greater proportion of deliveries to be made at less congested times would allow freight operators to reduce the time spent in congestion, making journeys more efficient. Removing a proportion of freight traffic from peak periods would in turn reduce freight's draw upon scarce road capacity when roads are at their busiest. The Commission has heard that the freight industry wants to, and could, make more deliveries overnight, but that some local regulations that limit night time activities restrict the possibilities for doing so.

Night time noise can be a nuisance, and the Commission understands that residents must be suitably protected. Quieter vehicles (ie electric vehicles) and freight equipment (eg quiet roll cages with rubber wheels, rubber floor mats and soft-close doors) and codes of practice for 'out-of-hours' deliveries[147] can help to reduce noise associated with deliveries to levels which do not disturb residents as they sleep. Local decision making is important on this issue – local authorities are best placed to strike the balance between the impact of noise on communities and the need to manage congestion.

Local authorities should therefore review the local regulations in place and consider the need for clear and balanced regulation that protects residents' quality of life and incentivises low congestion operations. A condition of regulatory relaxation must be that operators meet appropriate standards for quiet deliveries. London Councils, the body which operates the London Lorry Control Scheme (LLCS), has already undertaken a comprehensive review of the effectiveness of the scheme and is investigating whether some targeted relaxation of existing restrictions is possible to support more out-of-hours deliveries and servicing.

A review of such restrictions in other cities should also consider tightening existing kerbside restrictions during peaks to incentivise more efficient activity when the roads are busy.

The Commission's *National Infrastructure Assessment* recommended that urban local authorities should develop integrated strategies for transport, housing and employment. For the impacts of freight to be managed holistically, these strategies need to set out clear plans for helping freight operators to reduce the congestion impacts of freight activity.

**Recommendation 3: to help manage peak time congestion on the urban transport network, local authorities should include a plan for urban freight within the infrastructure strategies they are developing. These plans should review local regulations to incentivise low congestion operations, consider the case for investments in infrastructure such as consolidation centres, and identify the land and regulatory requirements of new and innovative low congestion initiatives.**

The Commission is already working with cities through its Next Steps for Cities programme, helping cities to develop ambitious, effective infrastructure strategies. This will include work aimed at helping cities to implement this recommendation through sharing expertise and good practice on addressing urban freight within an infrastructure strategy. Five cities and city regions have agreed with the Commission that they will act as pilot areas for the approach set out here. The cities and city regions– Bath, Brighton and Hove, Liverpool, Southampton and the West Midlands – will set out their updated approach to freight within their own local infrastructure strategies by the end of 2020.

## Better planning to enable optimisation

The interim report showed how freight is a forgotten element of spatial planning. Gaps in current planning policy and guidance give planners little understanding of why and how to plan for freight, and this results in the freight system having insufficient, or sub-optimally located space from which to run efficient and low congestion operations.

Ensuring that depots and warehouses can locate in places which minimise stem mileages (the distance from the distribution point to the first delivery address) allows for more intensive, optimised use of vehicles. Providing sufficient loading bay capacity at new developments means delivery drivers spend less time looking for space to park and load, and vans or lorries are not parked in a way which restricts traffic flow on the road.

The first step in achieving better planning for freight is to give strategic policy making authorities (local authorities, in the main) guidance about what is meant by good planning for freight. This will allow policy making authorities to prepare good development plans which better recognise the needs of the freight system, which will cascade into more balanced development decisions by local decision makers.

An important part of any such guidance would be to give more direction to local authorities about how to assess the need for land and associated floorspace for distribution facilities, allowing them to strike the right balance between competing development pressures and supporting infrastructure.

Guidance for local authorities should direct them to assess the need for further space for distribution facilities based on what local businesses and communities need for efficient freight operations, now and within the next five years. Every new house built has an implication for the space required throughout supply chains.[148] The requirement for additional logistics space as a result of new development should be properly considered in planning processes.

The Commission recognises that in some areas there is significant pressure on land supply for housing and other uses, and local authorities may find it difficult to allocate sufficient land to satisfy all development needs. Local decision making remains key. But occupier requirements for distribution space are evolving in response to land scarcity, and facilities which make better, smarter use of the available land are increasingly common.

New guidance for strategic policy making authorities about planning for freight must also advise authorities on facilitating low congestion freight operations as part of new developments.

In the context of freight, the local authority may, particularly for larger developments, grant planning permissions with conditions that seek to manage the timing, frequency, volume and/or type of freight movements to the development. Examples of such conditions include the requirement to develop and implement Construction Logistics Plans (CLPs) and Delivery and Servicing Plans (DSPs).

If all local authorities are aware of the full range of mitigation and management measures and the circumstances under which these are likely to be most effective, better development control can take place. The objective must be to properly accommodate and incentivise optimised, low congestion freight operations through the design and ongoing use of the new development.

**Recommendation 4: government should produce new planning practice guidance on freight for strategic policy making authorities. The guidance should better support these authorities in planning for efficient freight networks to service homes and businesses as part of their plan making processes. This new planning practice guidance, which should be prepared by the end of 2020, should give further detail on appropriate considerations when planning for freight, such as the need to:**

- **provide and protect sufficient land/floorspace for storage and distribution activities on the basis of population and economic need, with particular consideration for the floorspace requirements for last mile distribution and consolidation centres;**
- **support the clustering of related activities within a supply chain, minimising the distance that goods must be moved and maximising the potential for efficient operations;**
- **maximise the potential for freight trips to be made at off peak times; and**
- **accommodate deliveries and servicing activity at the point of delivery.**

## New and better data

High quality data will be key in helping areas in managing congestion. The data collected nationally is an important part of the picture in helping to identify strategic trends and issues, but local policy makers need an evidence base for decisions – a national snapshot is not sufficient.

Freight operators collect a significant amount of data on their operations, using this information to continuously monitor and refine their systems. Although attempts to access this data for public policy making continue, this data is generally held privately and not shared with local policy makers. Local authorities realise the issues that a lack of data creates in policy making, and more areas have expanded or are seeking to expand their data collection capability to help them identify local challenges and priorities.

## Data through technology

Existing technologies such as mobile phone GPS data, or intelligent Automatic Number Plate Recognition already provide viable collection methods for traffic data, particularly in urban areas where camera networks are in place. Several urban areas either have or are trialling data solutions that use technology and artificial intelligence to process big data.[¶] Uptake of technology for data collection on the road network is continuing, with cities investing in technology for congestion management, general transport planning, or in the case of new Clean Air Zones, enforcement.

[¶] Big data refers to very large datasets that will often require computer technology to help analyse them.

Whether purchasing existing data from telematics providers, installing new cameras that use artificial intelligence, 'floating' data collected through mobile phones and GPS, or crowd-sourced through mobile phone apps, technology is proving the solution to better data and innovation in traffic data collection continues at pace. Thanks in part to public funding such as the Transport Technology Research and Innovation Grant (T-TRIG), and the recently completed Small Business Research Initiative (funded by GovTech Catalyst), advancements in technology that can provide real time traffic data are emerging and being implemented. For example, Milton Keynes now has around 400 smart sensors funded through Innovate UK.

Ultimately it will be for individual local areas to choose which data collection technology best suits their needs and budgets, and it may be that investment in data collection technology would be for traffic management in general rather than freight vehicles alone.

## Developing a data standard

With technology already advancing and local areas already trialling or investing in new data collection methods, there appears to be little need for intervention in the roll out of technology. But as the proliferation of new technologies begins to make big data possible, the opportunity for misalignment increases. With different technologies delivering different outputs and local areas already investing in solutions, the need for clear standards on quality, format, and compatibility across data is becoming more pressing. Having a common data standard that local authorities can use to identify gaps in their data and ensure a minimum quality when deciding on collection and analysis solutions will help ensure that data remains useful and no one is tied into a single technological solution.

A data standard for freight traffic would need to go beyond simply outlining the format that data should be presented in. It should provide a useful guide for innovators of traffic monitoring technology, and help local authorities design their data collection in accordance with good practice. Areas that guidance should cover include:

- minimum requirements for data collection accuracy;
- minimum collection categories – for example, differentiating HGV types;
- final data format;
- requirements to align with other relevant existing standards (such as the application programme interface (API) technical and data standards); and
- requirements for sharing with government and other local areas, including freedoms and restrictions on data transparency and access by the public.

Such a standard should be developed in consultation with local areas who have invested or intend to invest in new monitoring technology as well as with technology developers and the freight industry. Such a standard should be tested with existing schemes – such as the network of smart cameras in Milton Keynes and the proposed mobile data traffic monitoring trials in York, and refined as technology evolves and more areas adopt new approaches.

## Respecting privacy

The collection of more freight data will almost certainly require the collection of personal data of some form, such as vehicle number plates. Local authorities are already duty bound to comply with data protection legislation, and any future data collection will need to be compliant, too.

As part of protecting the privacy of individuals, data sharing should focus on larger data sets that exclude personal data. Where personal data sharing is required (for example, when tracking the route a van takes across local area boundaries onto the traffic monitoring network of another authority), 'minimum retention periods' should be applied.

**Recommendation 5: government should develop a data standard for freight data collection to support local authorities, outlining the requirements for technological capability, data requirements, and data format. Such a standard must seek to ensure consistent data quality and format across technologies to allow regional and national aggregation, and should be complete by the end of 2020.**

# 4. A NEW STATUS FOR FREIGHT

**The changes to come and the pace at which action is needed present new and significant challenges for freight. Delivering change will require freight as a sector to be better considered in policy making, and its unique challenges surfaced, understood, accommodated and solved. Continuing to try and tackle issues in the freight system by considering them as city or strategic, road or rail, vehicle or infrastructure, transport or planning, misses the pressing need and opportunity for holistic and strategic thinking. Achieving zero emissions freight, accelerating innovation, and delivering positive change requires a new conversation between government and industry, where both work in partnership to deliver lasting change quickly.**

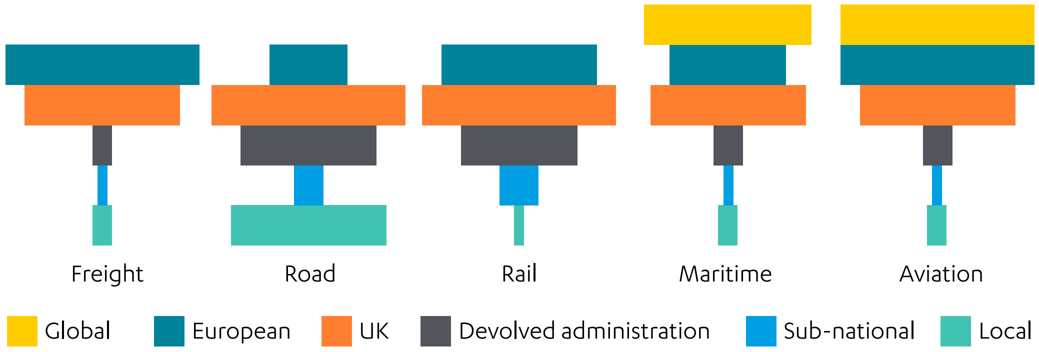
**A new form of engagement between and within government and industry is needed to develop and embed more holistic, informed and collaborative thinking about the freight sector into policy making processes. Multi modal, cross-government and pan-industry discussion and action are required to achieve the stretching decarbonisation objectives faced. However, a new conversation does not mean a new 'talking shop'. Any new forum should be specifically and explicitly tasked with tackling long term and cross-modal challenges, such as the decarbonisation of road and rail freight by 2050.**

## A siloed approach

As a policy area, freight is divided across several central government departments. Currently, most policy relating to freight at the central government level is the responsibility of the Department for Transport (DfT). The Department's responsibilities range from setting policy and regulations, collecting statistics and administering modal shift grants. By design, the Department for Transport has a transport focus, and the movement of goods is usually considered on a modal basis. The creation of the Department for Transport's 'virtual freight team' shows recognition of the need to coordinate across modes, but it is still new and has no decision making authority. Equally, industry groups are also mostly split by modal interests, with only the Freight Transport Association (FTA) representing members from the road, rail, sea and air industries.

There is currently no forum at central government level which seeks to bring the different aspects of freight policy – transport, land, and environment – together. Although a private sector industry, government policy has significant influence over the operation of the freight industry, and better coordination is essential in ensuring that the industry delivers against all measures of efficiency including climate targets and congestion.

Figure 9: Relative influence of different scales of government across modes[149]




## An uncoordinated response to freight issues

A siloed approach to any issue makes it difficult to identify objectives, prioritise action and achieve the right, integrated outcomes without significant risk of both falling short and unintended consequences.[150]

In the case of the freight system, focusing on the transport aspects of the system or on individual transport modes means missing the opportunity for a coordinated response to the issues faced. For example, seeing freight's contribution and exposure to congestion through a transport-only lens could lead to transport focused solutions, but this would miss the role of better land use planning in managing congestion at source. For example, while the recent licence changes from the Department for Transport to allow heavier electric vans to be driven on a standard driving licence is a positive step to try and encourage clean van uptake, there has been little action on other barriers such as land for charging infrastructure and grid capabilities – the responsibilities of other departments, not the Department for Transport.

## Collaboration and action: a Freight Leadership Council

The scale of the issues and opportunities now faced by the freight system requires a coordinated, fast response from local authorities, government, industry and other stakeholders. The response needs to overcome the siloed, freight-is-transport way of working in order to achieve integrated outcomes.

Decarbonising road and rail freight and managing its impacts on congestion are some of the most important, and difficult, issues for the freight system. Although the exact pathway to zero emissions is currently uncertain, the eventual solution and transition will require coordination across central government (including DfT, BEIS, DEFRA and MHCLG in particular), local government, sub national government, devolved administrations and the EU, freight operators and customers and vehicle manufacturers. Leaving each group to come up with their own plans and actions risks piecemeal efforts and slow, if any, change. Equally, in the years ahead new challenges and opportunities such as CAVs, paying for motoring, and smart mobility will undoubtedly have profound impacts on the freight system.

Achieving zero emissions freight, accelerating innovation and delivering positive change requires a new conversation between government and industry, where both work in partnership to deliver lasting change quickly. Partnerships between the government and industry on sector-specific issues are a key aspect of the UK's Industrial Strategy, and several such partnerships have emerged recently as a result – such as the Construction Leadership Council. A similar governance vehicle for the freight sector – a Freight Leadership Council, co-chaired by government and industry, could be the pathway to a new government-industry partnership.

While the precise details and operations of such a council should be left to government and industry to agree, it is imperative that clear objectives and terms of reference are set, underlined by a genuine agreement to work in partnership. Considering the challenge involved in decarbonising road and rail freight, this should be a primary objective, with a focus on developing the pathway to zero emissions.

**Recommendation 6: government should establish a new bi-annual 'Freight Leadership Council', inviting representatives from BEIS, DfT, MHCLG, DEFRA and HM Treasury, devolved administrations and all freight modes and parts of the supply chain. This Council's main focus should be on strategic, long term issues – specifically supporting decarbonisation of road and rail freight by 2050. This Council should hold its first meeting before the end of 2020.**

# End notes

[1] The recommendations in this report are consistent with the Commission's long term funding guidance provided by government for its recommendations (the 'fiscal remit'), whereby total public infrastructure expenditure must not exceed 1.2% of GDP in any given year. Where infrastructure is funded by the private sector, and the costs of any recommendations will ultimately be met by consumers, the Commission is also required to provide a transparent assessment of the overall impact on bills. Commentary on the spending impacts of the Commission's recommendations is provided in the technical annex published alongside this report – Freight Study: Impact and costing note. More information on the Commission's fiscal and economic remit can be found in the Commission's remit letter

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# Appendix A: Acknowledgements

The Commission is grateful to everyone who has engaged with the Freight Study. The list that follows sets out organisations that have engaged with the Commission through at least one of the channels below:

- responding to the Commission's Call for Evidence
- participating in meetings, roundtables and panel discussions
- convening working groups, panel sessions and/or site visits with members of the Commission Secretariat.

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Midlands Connect
Mineral Products Association
Ministry for Housing, Communities and Local Government
National Grid
Natural Gas Vehicles Network (NGVN) and Renewable Energy Association (REA)
Network Rail
Newcastle University
Nissan
North East Combined Authority
North East Freight Partnership
North Northamptonshire Joint Planning and Delivery Unit
North Yorkshire County Council
Office of Rail and Road
Ofgem
PD Ports
Peel Group
Port of Dover
Port of London Authority
Port of Tyne
Progessive Energy
RAC Foundation
Rail Delivery Group
Rail Freight Group
Railfuture
Railway Industry Association
Ricardo
Road Haulage Association
Royal Town Planning Institute
Savills
SEGRO
Sheffield University
Smart Freight Centre
Sogaris
Southampton City Council
Steer
Suffolk County Council
Tarmac
Tees Valley Combined Authority
Tesla
Thomas H Zunder, Newcastle University
Dr Tim Marshall, Oxford Brookes University
Timber Transport Forum
Traffic Commissioners for Great Britain
Transport for Greater Manchester
Transport for London
Transport for the North
Transport for West Midlands
Transport Planning Society
Transport Systems Catapult
Turley
UK Major Ports Group
UK Port Advisers
UK Warehousing Association
University of Cambridge
University of Westminster
UPS
Urban Transport Group
Vivid Economics
Warwickshire County Council
West Midlands Combined Authority
West Yorkshire Combined Authority
WSP

NATIONAL
INFRASTRUCTURE
COMMISSION