



National Infrastructure Commission

FUTURE OF FREIGHT MANAGING CONGESTION



FUTURE OF FREIGHT

Evidence Base

This report by WSP was commissioned as part of the evidence base for the National Infrastructure Commission's study on the future of freight.

As with all supporting evidence commissioned by the National Infrastructure Commission, the views expressed and recommendations set out in this report are the authors' own and do not necessarily reflect the position of the Commission.

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EXECUTIVE SUMMARY

THE FUTURE OF FREIGHT INQUIRY

Rising levels of congestion, driven by population growth, urbanisation and new working and living demands, are clogging the UK's cities and its transport and digital systems (National Infrastructure Commission, 2017). This was one of the key observations from the Congestion, Capacity, Carbon: Priorities for national infrastructure report published in 2017. The impact of increased traffic congestion and growing traffic volume needs to be mitigated either by increasing efficiencies supported by, where possible, increasing capacity.

Freight traffic is a significant component of road traffic generally, with HGVs accounting for 11% of miles on motorways and 9% of miles on rural trunk roads. In urban areas, HGV's are a significant component of morning peak traffic. Freight's contribution to congestion is magnified by the physical size of HGVs (impacting capacity), slower speeds, longer braking distances, and a disproportionate involvement in critical highway incidents.

As a key contributor to the UK economy, the needs of the freight and logistics industry together with the impact they have on the UK networks is an important transport and economic issue. Rail and water freight provide an alternative to road freight transport, but, like road freight, must compete for capacity with other users.

In November 2017, the Chancellor of the Exchequer asked the NIC to undertake a study on the Future of Freight, of which this is the strand of work looking at 'Managing Congestion'. The aim of this study is to explore the key issues surrounding managing congestion as it impacts the freight industry with a view to providing insights and analysis to help form an integrated approach for the future.

APPROACH

The purpose of this study is to provide the NIC with advice and analysis on how freight can reduce its impact on congestion and the methods through which freight can minimise its exposure to congestion and how effective those interventions are.

The study focused on developing understanding that met the following six key areas:

- The relative impacts on the freight industry of different interventions to reduce congestion on the national and local transport network, including an examination of the potential for emerging technologies to impact upon congestion on the road and rail networks
- Recent policy interventions for managing congestion generally, and the provision of an evidence-based analysis of their effectiveness
- Other methods of managing congestion, including the potential of larger freight vehicles, better use of existing vehicle capacity, changing operating practices, and the potential impacts of connected and autonomous vehicles
- The potential for modal shift from road to rail, river, or coastal shipping, and the total likely reduction in congestion and vehicle numbers this could have, as well as the potential benefits/impacts on broader transport network capacity of moving freight off rail
- How sharing of haulier data, freight movement data, and the introduction of new data management tools such as distributed ledger technologies such as Blockchain could help inform better decisions as well as speed up key processes such as contract negotiation

- The underlying causes of freight congestion and hotspot areas – identifying the biggest congestion hotspots today (where they have already been identified in existing literature) and what impact congestion has on the operation of the freight system.

The study used a freight decongestion framework to provide a structure for the analysis:

- Shift to modes with less impact on congestion: while there is general acceptance that moving goods by rail or waterways is currently a good thing for the environment and economy, this report focuses on assessing the impact of moving goods by rail on road congestion. Modal shift is tested not as an aim in itself but as the means to reducing congestion
- Freight deintensification: reduce the volume of goods transported or the distance that goods are transported. This doesn't necessarily mean producing less. It could include moving goods in a more compact form, or clustering businesses to reduce distances for goods to travel
- Improve vehicle utilisation: reduce the number of vehicles used/needed to transport a given volume of goods. Increase vehicle payloads through use of larger vehicles and or improved vehicle capacity utilisation
- Using networks more efficiently: reduce the impact of freight movement on congested networks, particularly at peak times
- Increase network capacity: increasing network capacity can be achieved in a variety of ways which, ultimately, could require new roads or railways

In addition, analysis was undertaken for the overarching potential for improved data and technology to reduce freight congestion impacts and improve freight efficiency.

For each intervention a literature review was undertaken to understand the evidence base for the assessment. This created Dashboards for each intervention, which include examples of use, the evidence base, and recommendations for further development of the intervention.

THE IMPACT OF FREIGHT ON CONGESTION

The contribution of freight to congestion is magnified by slower speeds, longer braking distances, and involvement in a disproportionate percentage of critical highway incidents. Over 60% of road freight travels on motorways and trunk roads, however freight tends to travel at all times of day and night, and so makes a relatively smaller contribution to peak hour congestion than cars, vans and other traffic. In urban areas the opposite is often the case, with peak freight deliveries frequently occurring in the morning peak for all road traffic. On railways freight services often have peak hour operational restrictions in urban areas.

Freight also suffers impacts from congestion. Increasing road congestion is estimated to cost the freight industry £3.7 billion annually and without sustained investment and proactive policy, the problem is expected to become more serious for many of the UK's important routes (DfT, 2015).

While routine, predictable, slow traffic can generally be accommodated (albeit at an increased cost), HGV traffic is particularly vulnerable to unplanned serious traffic incidents as alternative routes may not be suitable for HGVs, drivers may exceed their regulated driving time, and missing deliveries to customers can lead to extra costs. Estimates of the economic impact of congestion on freight are based mainly on the additional operating costs of routine delays, and do not take into account any knock-on costs or economic impacts.

From an urban perspective with growing urbanisation and logistics trends reviewed, the issue of urban congestion will continue to get worse. The challenge of managing competing road demands also become ever more prevalent as policies that impact the use of urban road space become a reality.

Rail congestion is different to road congestion as the railway is a timetabled network. Timetables are managed so that services can usually operate efficiently without queues forming at junctions or in reaction to routine

incidents. Because the timetable is strictly controlled, the number of trains operated are kept within the level which can be efficiently handled by the network. Therefore, rail congestion is better considered under the term of 'rail capacity'.

In reviewing national, regional and local policies and strategies for managing congestion it was noted that there is considerable variation between nations, regions, cities, and local authorities. At a national level there is no overarching policy to improve logistics industry efficiency and to reduce logistics impacts.

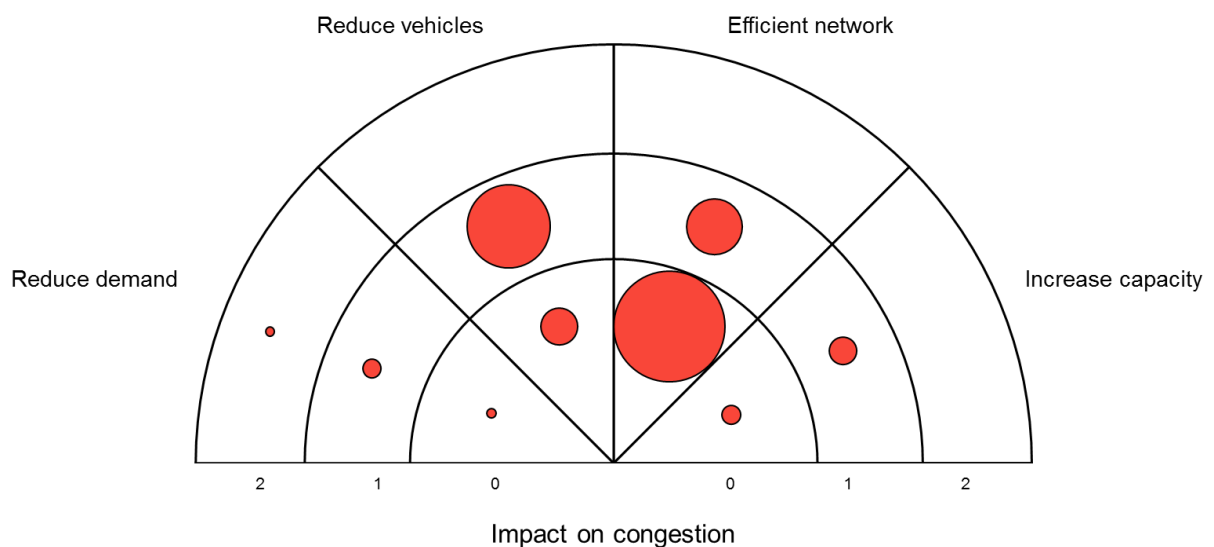
APPRAISAL OF INTERVENTIONS

The term "interventions" is used in the study in a very broad sense to encompass both government interventions, and developments in logistics which may have a beneficial impact on freight contribution to congestion.

The study reviewed 61 interventions. Of those, seven were purely urban congestion focused, 12 were purely strategic, but 30 had an impact on both the SRN and urban roads. There are 21 interventions that relate to rail or multimodal systems.

Some interventions have large benefits but that only affect a limited scope or geographic area. Other interventions have lower congestion benefits, but with impacts spread more widely across the network. The appraisal included a subjective estimate of the overall impact of each intervention on congestion.

The chart below shows that many of the most significant interventions involve improving efficient use of vehicles and transport networks, rather than improving capacity.



Some of the most beneficial interventions were found to be:

- Reduction and simplification of HGV restrictions: which may include timing, size or speed restrictions, customer restrictions or road space restrictions
- Land use planning: to ensure the logistics facilities can be located where needed
- Lorry parking: more parking to avoid excess miles needed to find appropriate parking
- Autonomous Vehicle SAE Level 2: Advanced Driver Assistance Systems (ADAS) fitted to a vehicle that can identify safety-critical situations and act, either automatically or by sending warnings to the driver
- Improved roadworks information: poor quality information on planned roadworks restricts the ability to effectively journey plan (route freight vehicles)

- Back hauling: loading empty vehicles
- Freight exchange: providing an online collaboration service for haulage companies, logistics providers, freight forwarders and transport companies to fill empty space
- Infrastructure investment - road improvements (widening): widening of roads is typically used to increase additional lane capacity but can also provide safety benefits.
- Route planning, navigation and optimisation: to reduce empty running via enabling back and forward hauling, reducing stem mileage and avoiding HGV inappropriate routes
- Smart motorways: using Variable Message Signs (VMS) and signals and enhanced traffic monitoring technology to safely allow drivers to drive on the hard shoulder
- Road freight pinch points: there are various locations on the UK road network where obstacles exist that delay freight and other road users
- Expressways: All-Purpose Trunk Roads (APTR) upgraded to the Expressways standard consist of many common characteristics such as dual carriageway; grade separated junctions
- New strategic highways and link roads: the traditional method of dealing with increasing demand and promoting economic growth involves the construction of roads that link existing or emerging pollution centres and other key areas e.g. ports

For rail capacity, the study identified a number of important interventions, most already being delivered, which can improve rail freight capacity and reduce the impact of rail freight on overall capacity including:

- Running longer trains
- Introducing freight nodes at key locations on the network
- Making incremental timetable improvements based on a better understanding of freight train performance.

KEY FINDINGS

CHANGES IN LOGISTICS

Logistics is going through a period of unprecedented change, driven by customer demands, technological and operational improvements, and an increased focus on emissions, safety, congestion, and liveable cities.

Many of these changes have the potential to improve efficiency and reduce congestion, but some may have the opposite impact, for example resulting in a proliferation of last mile delivery vehicles.

DATA

Throughout the report the lack of comprehensive freight data (particularly for road freight) has been noted as a constraint which ultimately leads to logistics issues and opportunities being downplayed in infrastructure and transport plans. This includes traffic data such as information on origins, destinations, commodities carried, and payload, and economic data on the impact of congestion on freight.

Increased use of delivery management systems and vehicle tracking systems means that better quality data is becoming available, but there are challenges in maintaining confidentiality and linking tracked vehicle movements to commodities and payloads. This area is worthy of further investigation.

TECHNOLOGY

Technological developments will also play a role in reducing freight congestion. An early and significant benefit of increased automation should be an improvement in safety, leading to a reduction in major incidents involving goods vehicles. Ultimately, increasingly autonomous operation of goods vehicles may provide more general capacity benefits, notably through closer running and less variable driving techniques. However, the impact of autonomous vehicles or platoons on congestion has not yet been proved.

MANAGING FREIGHT DEMAND

Freight demand management can be a win win – leading to reduced congestion, reduced emissions, improved safety, and reduced costs for operators and businesses. However, this may not always be the case, and sometimes compromises will be required. It is important that planners and decision makers recognise and balance the essential importance of efficient logistics systems with the need to reduce congestion and emissions.

Recognising that freight demand can be managed is an important factor in the managing of congestion and getting the most out of the infrastructure. Primarily, the normal processes of supply chain management should result in increasingly efficient logistics systems. However, demand management measures can be part of the options available to government at all levels in both transport strategies and infrastructure studies. The public sector can support efficiency improvements by, for example:

- Identifying and encouraging best practice
- Fostering innovation
- Providing and supporting opportunities for businesses to collaborate
- Ensuring that land is available for distribution use where it is needed
- Ensuring that regulations and restrictions are only imposed as a last resort, and are consistently applied across different areas

Freight Quality Partnerships (FQPs) have provided a mechanism for local government to work more closely with businesses on logistics issues. Transport for London's comprehensive approach to managing freight provides a template of how closer working with industry can deliver change. There is a role for collaboration of this type at a sub national and national level.

URBAN FREIGHT MANAGEMENT

The greatest degree of logistics change is happening in towns and cities. The need to address air quality and safety, together with more pedestrianisation, is driving businesses to new models for last mile delivery. There are risks that this could lead to a proliferation of small delivery vehicles. This places even more importance on encouraging businesses to collaborate and providing well located distribution facilities to transfer goods into the smaller vehicles.

There is significant potential to support business efforts to move deliveries out of peak hours.

Best practice needs to be better shared, and restrictions aligned to make managing deliveries more efficient.

MODAL SHIFT

Rail and water freight can provide economic and environmental benefits. Some businesses are dependent on efficient alternatives to road freight to extend their reach and access distant markets.

Generally, freight and passenger trains work well alongside each other in a tightly timetabled environment. Delays are rigorously monitored and causes identified. Rail freight causes less than 3% of all lost minutes on the railway.

There are significant gains to be made to reduce the impact of freight trains on capacity, including longer trains, freight nodes, and electrification. In most cases where passenger trains and freight trains are competing for limited capacity, relatively inexpensive infrastructure improvements can meet the needs of both sectors.

Network Rail has worked with the freight industry to forecast demand and identify capacity constraints. Investment in addressing those constraints has been shown to have a high benefit to cost ratio and will allow passenger and freight rail volumes to continue to grow.

Every lorry removed from roads provides a measurable congestion benefit, recognised in the Mode Shift Values (MSV) used by the DfT. Benefits for congestion are particularly significant on sections of the road network where roads are at or near capacity in peak hours. At these locations rail freight avoids gridlock and, at least, postpones the need for major investment in new capacity.

More work is required to better understand the link between rail infrastructure investment, capacity provided, and congestion relief on specific roads.

PROVIDING MORE CAPACITY

Ultimately, rapidly growing demand for road transport generally may require new capacity to be provided. The impact of new capacity on freight businesses and the benefits of new schemes for freight are not fully understood nor completely included in business cases for new or improved roads.

MONITORING INTERVENTIONS

Promoters of trial operations and government bodies at all levels who implement freight interventions need to consider the careful measurement of freight volumes and other KPIs before and after implementation. This includes “soft measures” such as schemes that encourage best practice through recognition of organisations who demonstrate good practice and delivery and service plans.

CONCLUSION

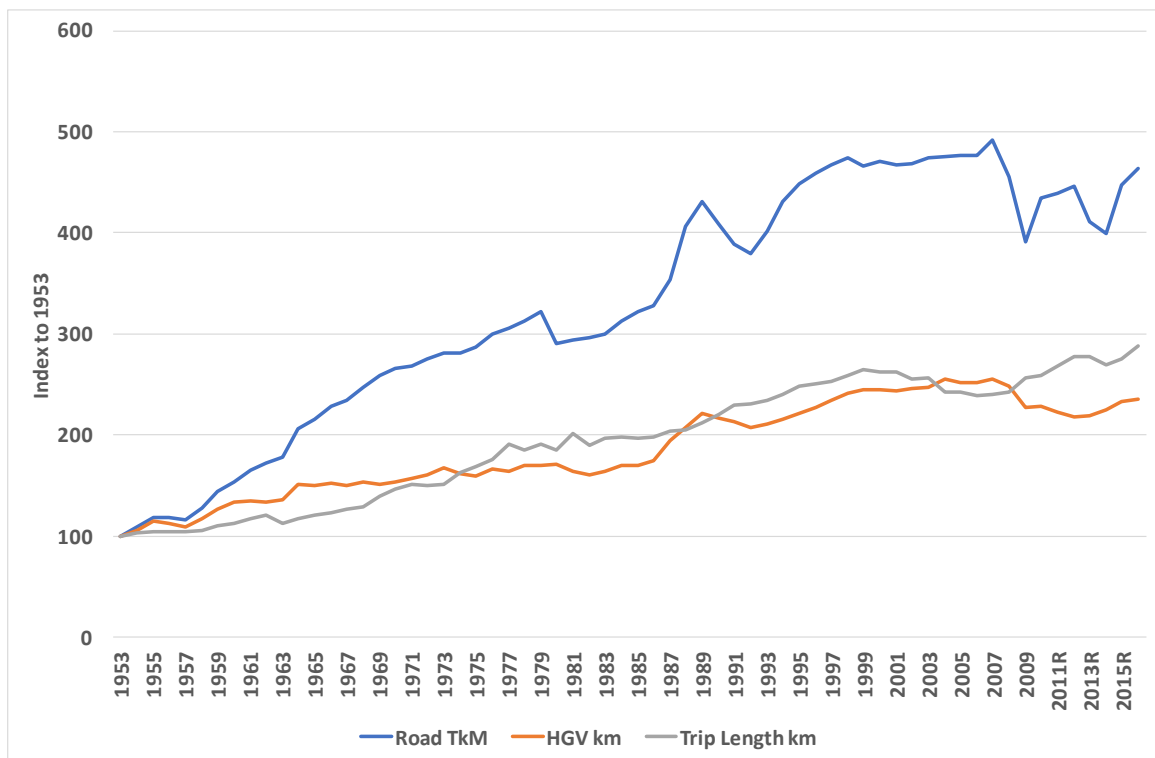
In conclusion there a number of principles for managing congestion which are threaded through all the interventions:

- The need for many parties to work together to achieve successful outcomes
- The need for improved data
- Support from the public sector both on a strategic and regulatory basis
- There is a need for behaviour change by businesses and consumers
- Finding the right operational mix in solution design as otherwise negative trade-offs may result – this will depend on the nature of the congestion and the location

1. INTRODUCTION: REMIT AND APPROACH

- 1.1.1. Rising levels of congestion driven by population growth, urbanisation and new working and living demands, are clogging the UK's cities and its transport systems. This was one of the key observations from the Congestion, Capacity, Carbon: Priorities for national infrastructure report published in 2017 (National Infrastructure Commission, 2017).
- 1.1.2. Freight is both a contributor to and victim of congestion. In the years from 1953 to 2006 the volume of freight moved (in million tonne kilometres) by all modes grew by 120%, whereas road freight volume in tonne kilometres (Tkm) grew by over 350% in the same period. However, because lorries have increased in size, and despite an increase in trip length, the number of HGV vehicle km has only increased by 136% over the same period, while car km has increased more than tenfold since 1953.
- 1.1.3. Even though the freight proportion of road traffic has decreased, its impact is amplified by the slower speeds, longer braking distances, and effect on critical highway incidents of HGVs.

Figure 1 – Road Freight Growth Index (DfT, 2016)



- 1.1.4. The aim of this study is to explore the key issues surrounding managing congestion as it impacts the freight industry, with a view to providing insights and analysis to help form an integrated approach for the future.

1.2. THE NATIONAL INFRASTRUCTURE COMMISSION (NIC) FUTURE OF FREIGHT STUDY

- 1.2.1. In November 2017, the Chancellor of the Exchequer asked the NIC to undertake a study on the future of freight. The Government asked the Commission to:
 - Assess the impact freight currently has on urban congestion and the UK's carbon emissions, and the future of inter-city freight movements

- Make recommendations on the future of freight infrastructure and regulation to reduce the negative effects of congestion on productivity, particularly in urban areas, and ensure wider freight connectivity supports economic growth
- Consider the potential of emerging technologies to improve the efficiency, productivity and environmental impact of UK freight
- Make recommendations on the future of our roads and highways to be able to adapt to new technology, e.g. platooning
- Consider the wider economic role of freight and how its economic benefits are factored into Government infrastructure investment
- Consider the increase in non-fossil fuel propelled road vehicles and possible options for decarbonising the freight sector including the infrastructure and regulation needed for low emission haulage.

1.2.2. The Commission will publish an interim report in Autumn 2018 that will outline the importance of freight, the future of freight demand, the impacts of congestion both on freight and caused by freight, as well as the impact of the carbon agenda on freight vehicles and the key barriers to improvement and change.

1.2.3. The study will conclude with a final report in Spring 2019 that provides recommendations on the changes required to infrastructure, regulation, industry practices, and the Government's investment priorities in the freight sector, in order to deliver an efficient and low-carbon freight system over the next 30 years.

1.2.4. This study is one of several parallel workstreams being undertaken to feed in to the NIC's final study.

1.3. OBJECTIVES

1.3.1. The purpose of this report is to provide the NIC with advice and analysis on:

- How freight can reduce its impact on congestion and the methods through which freight can minimise its exposure to congestion
- The relative effectiveness of different interventions for managing the impacts of congestion on the freight system, including the potential for existing and emerging technologies (including, but not restricted to, smart motorways, lorry platooning, digital railway signalling, and longer, heavier vehicles) to manage congestion on the UK road and rail networks
- The barriers to introducing or the scaling of existing and emerging technologies that seek to manage the impacts of congestion on freight or maximise the existing transport network capacity
- The potential for modal shift of freight from road to rail or waterborne forms of transport, as well as the potential benefits/impacts of moving freight off rail
- The characteristics of congested areas, and a desktop review of pinch points to understand the underlying causes of congestion
- The role that better gathering, sharing and use of data could play in reducing the impact of congestion on freight, and broader decision making on infrastructure investment
- Relevant domestic and international case studies for how the impacts of congestion have been successfully managed in relation to the freight industry.

1.3.2. Most transport strategies and interventions focus on addressing issues related to car and passenger rail transport, where congestion is concentrated into peak hours. While some freight does move in peak hours (and a lot of urban freight is delivered in the morning peak), freight movement on the Strategic Road Network (SRN) is more evenly spread across the day. It is tempting, therefore, to see congestion as a car or passenger rail issue, with freight transport being an uncontrollable and, arguably, poorly understood addition to demand that must be accommodated. However, there are good reasons to look closely at the links between freight transport and network congestion:

- Freight is a significant component of SRN traffic, particularly morning peak hour urban traffic, and is therefore a key contributor to general congestion

- Efficient freight transport is a major driver of the economy, and is recognised as being essential to allow access to supplies and markets. Congestion therefore adversely impacts both local and national economies
- Rail freight competes for limited space on an increasingly crowded rail network
- Rail and water freight play a role in removing traffic from roads, but their significance is not clear.

1.4. SCOPE AND FOCUS

1.4.1. The research has been focused on answering the following key questions:

- What evidence is there that a strategy or intervention has reduced or can reduce the contribution of freight transport to congestion?
- What evidence is there that a strategy or intervention has reduced or can reduce the impact and cost of congestion on freight transport, and through this, the wider economy?

1.4.2. The report covers both strategic roads (defined as the SRN but with reference to other non-urban congestion), and urban roads in Great Britain as well as capacity for rail freight and the contribution that modal shift to rail or water can make to reducing road congestion.

1.4.3. Throughout this report the term “interventions” includes:

- Policies or initiatives undertaken by the public sector such as capacity investment in road and rail transport networks
- Technological advances
- Operational changes for freight operators or other businesses.

1.4.4. The NIC recognises that movement of vans, or light goods vehicles (LGVs)¹, is the fastest growing component of traffic. However, this report does not specifically consider their impact on congestion or their economic significance. This is partly because a large percentage of van transport is associated with servicing or personal transport, and is more appropriately considered as part of car traffic. It is also as a consequence of the fact that there are very limited datasets that can be used to determine LGV movements and hence any associated congestion. It is recognised that some measures to reduce HGV numbers could also increase volumes of vans or light goods vehicles. Where this is a risk it has been identified in the Dashboards and considered in the findings. If any intervention increases van use this is also noted.

1.5. APPROACH

1.5.1. The foundations which support the studies analysis, conclusions and findings was the Evidence Report. This included a thorough and structured review of research and case studies considering various aspects of managing freight congestion. Other activities included discussions and interviews with logistics industry sources, and some desk top research and analysis undertaken by the study team.

1.5.2. The aim of the Evidence Report is to provide a comprehensive background and critical review of existing knowledge. A systematic review of literature and sources was undertaken. The search specification, sources and key words were agreed with the NIC. A bibliography is included within the appendices.

1.5.3. As part of the literature review process, industry representatives were engaged to seek challenge and feedback on the proposed resource methodology, lines of enquiry and findings. Details of who the study involved as part of this are included in Appendix B. The initial assessment was shared with the Challenge Panel and finally the project team peer reviewed each of the interventions to gain a consensus view.

¹ Light Goods Vehicles refers to a commercial vehicle with a gross vehicle weight of no more than 3.5 tonnes.

1.6. CONTEXT: FREIGHT AND LOGISTICS

- 1.6.1. NIC's Future of Freight programme is considering the potential scale of demand for logistics and the economic significance of the industry in separate studies. However, to understand the nature of freight congestion it is worth remembering the breadth and complexity of the logistics sector.

DEFINITION OF LOGISTICS

- 1.6.2. The Chartered Institute of Logistics and Transport (CILT) defines logistics as *"the time-related positioning of resource."* It is also described as the five rights. Essentially, it is the process of ensuring that goods or services are:
- In the right place
 - At the right time
 - In the right quantity
 - At the right quality
 - At the right price
- 1.6.3. The significance of these definitions is that logistics is about much more than transport. The challenge facing logisticians is minimising the cost of the entire supply chain while meeting tough demands from their customers (internal and external) in terms of delivery lead times and other quality factors.
- 1.6.4. As transport is only one part of complex supply chains, decisions may be made which improve the efficiency of a business overall, but result in the increasing of distances that goods are transported or their frequency (potentially leading to lower average payloads and more movements). Prime examples include:
- Centralisation: the long-term trend to centralise manufacturing and distribution nationally or globally, for example building a certain type of engine in one factory to supply car plants globally; or setting up a national distribution centre in the Midlands to serve the whole of the UK
 - Just in time manufacturing: where the emphasis is on supply goods when they are needed and minimising stocks. Transport is required to provide regular deliveries regardless of volume
 - Same day or same hour deliveries: online retailers must meet tight deadlines to meet customer expectations. Deliveries cannot be held until a full load is achieved.
- 1.6.5. Therefore, while this report focuses on the impact of freight on congestion on roads and railways, it is important to remember the wider picture of economic efficiency when considering solutions.

KEY LOGISTICS TRENDS

- 1.6.6. Online research reveals numerous articles describing the key trends in logistics. Looking at the primary causes of change which could impact goods volumes and congestion, four trends stand out:

Customer driven changes

- 1.6.7. The move towards e-commerce is clear, with almost 20% of UK retail sales being recorded online. This is driving other changes such as increased home deliveries, same day and same hour deliveries, and click and collect. Other consumer deviations include changes in the way we use cities, with less shopping, more at-home eating and entertainment, and a shift of purchasing power from material things to virtual things or experiences e.g. declining record sales and growing use of online streaming. The consequences of this on freight are significant for urban areas, with very low load factors for delivery vehicles in cities (e.g. 38% for vans in London) (ALICE / ERTRAC Urban Mobility WG, 2014).
- 1.6.8. To an extent, too, consumers are driving other changes through the supply chain; this includes concerns about waste, preference for locally sourced products, or pressure to reduce greenhouse gas emissions. Some

changes are prompted by wider societal changes such as population growth, urbanisation and new working and living demands.

Government driven changes

- 1.6.9. Goods traffic has always been seen in two ways, both as a concern due to environmental impacts and as a necessary means to sustain the economy and grow businesses. This dichotomy is summarised, for example, in the Minister's introduction to the DfT's Freight Carbon Review (DfT, 2017): *"Road freight's positive contribution to our economy extends beyond its direct employment and financial benefits - the sector is a critical enabler of wider business across the UK - of all sizes, from internet entrepreneurs to large distribution businesses. However, I am also aware that heavy goods vehicles (HGVs) account for a significant portion of the UK's air quality impacts from transport, and am committed to working collaboratively with industry to address these issues."*
- 1.6.10. Two major changes in approach from Government over the last twenty years have been the increased recognition of the impact of freight emissions, particularly greenhouse gases, and appreciation that efficient freight transport is an enabler of economic growth.
- 1.6.11. Response to the challenge of freight emissions has been set out in the Fifth Carbon Budget and the Freight Carbon Review, and there is some common ground between dealing with emissions and dealing with congestion (more efficient use of vehicles; fewer trips). Policy to improve the efficiency of freight is less developed, although there is substantial funding being devoted to innovation and new technology.
- 1.6.12. In cities, local and city Governments have had a much more direct impact on freight movements. While there is a clear understanding of the importance of efficient deliveries to local economies, cities see the urgent need to tackle air quality and congestion. In a positive light, many cities wish to become more pleasant, healthy, and safer places to live and work – this has led to proactive policies such as Low or Zero Emissions Zones and pedestrianisation.
- 1.6.13. The challenge of delivering to cities, with a growing preference for electric or human power for the last mile, means that more and more businesses are seeking to tranship goods from trunking vehicles to delivery vehicles around the city periphery. This disconnect between trunking and delivery has important implications for businesses and transport planners, such as the use of smaller vehicles and the need to provide land for new logistics uses.

Industry driven change

- 1.6.14. At the same time as customer driven changes (market) and Government driven changes (legislative environment), the logistics industry continues to develop and innovate to deliver solutions which meet those competing needs. In the UK in particular, logistics is a low margin activity, with highly competitive businesses ranging from owner operators to major multinational businesses. Technological and operational changes provide opportunities for disruptive entrants and new solutions. There is considerable sharing of experience and expertise across the world.

The impact of technology and better data on freight and congestion

- 1.6.15. Technology can act as a driver and enabler of change in all aspects. The logistics sector is already taking on board technological changes which affect every element of their operations, from automation of warehouses to real time monitoring of haulage fleets. Where available, the industry has been quick to adopt changes in vehicle technology, whether in the form of more fuel efficiency, driver assistance / awareness devices, or safety monitoring devices. In urban areas there has been a rapid uptake of electric vehicles for last mile deliveries.

The way that freight is managed is being changed by delivery management systems (that can plan and monitor every delivery end-to-end), online collaboration tools, and sophisticated fleet management systems. In the future, change is expected to be even more rapid. Connected and automated / autonomous vehicles, low or zero emission vehicles for trunking operations, technology, and better availability of data has the potential to revolutionise the way that supply chains are managed.

CONCLUSION

- 1.6.16. Combined, the changes outlined above may have unpredictable consequences for congestion. While many developments may improve efficiency and alleviate congestion, others have the potential to worsen traffic and reduce payloads further.
- 1.6.17. This report reviews measures to reduce congestion fully in the context of industry changes, supported by further research undertaken for the NIC.

1.7. STRUCTURE OF THIS REPORT

- 1.7.1. Chapter 2: congestion and freight. This chapter defines congestion generally and the scale of the challenge in the UK. It addresses congestion measurement and the impact of freight on congestion.
- 1.7.2. Chapter 3: congestion policies and strategies. Looks at key congestion management policies and the approach to managing freight congestion at all levels of Government.
- 1.7.3. Chapter 4: potential for modal shift to reduce congestion. Looks at how growing rail freight can be accommodated on the rail network, and the impact of rail freight on road congestion as well as the potential for freight to move by waterways.
- 1.7.4. Chapter 5: managing freight congestion. Introduces the approach used in the remainder of the report, including the freight congestion framework used and the roles of data and technology in managing freight congestion.
- 1.7.5. Chapters 6-9: the study has categorised interventions and developments by how they impact congestion and Chapters 6-9 considers each category in turn, reviewing the interventions and considers which are likely to have the greatest impact and reviews the evidence supporting this and their barriers to introduction. The Chapters are:
 - Chapter 6: Freight Deintensification
 - Chapter 7: Improve Vehicle Utilisation
 - Chapter 8: Using Roads more efficiently
 - Chapter 9: Increase network capacity
- 1.7.6. Chapter 10 reviews the opportunities presented by technology and data and Chapter 11, analyses the interventions, Chapter **Error! Reference source not found.** presents summarises the key observations and findings.
- 1.7.7. The report is supported by a number of appendices, including a glossary of the terms commonly found in this report.
- 1.7.8. The report is supported by an Evidence Report which documents evidence related to the conclusions drawn in this report.

2. CONGESTION AND FREIGHT

2.1.1. This Chapter looks at the context surrounding congestion and freight, describing the structure of the industry and highlighting some of the challenges in understanding the nature of freight, as well as how it congestion and freight impact each other. The Chapter also considers how other modes, including rail and water, are also related to the congestion agenda.

2.2. CONGESTION AND CAUSES

2.2.1. Traffic congestion occurs when vehicles travel at slower speeds because there are more vehicles than the available capacity allows at that time. On motorways, capacity is linked to the number of lanes, but on most other roads capacity is more often constrained by the capacity of junctions. Increasing vehicle numbers on any road typically makes trip times longer, and leads to delays and queueing traffic. Traffic congestion impacts journey time reliability such that journey times become more variable. This is because not all traffic congestion follows a routine pattern i.e. occurring at the same time and location each day. For example, abnormal traffic congestion due to accidents, breakdowns and other obstructions worsen journey time reliability.

2.2.2. Traffic congestion can be measured in numerous ways, however the DfT typically identifies traffic congestion using 'journey time reliability', 'average delay' and 'average speed' measures on a network-wide basis. These measures of traffic congestion are defined below (DfT, Travel time measures for the Strategic Road Network and local "A" roads, England: January to Decemember 2017, 2018).

2.2.3. Congestion can be defined using numerous measures and this is detailed in the table below.

Table 1 – Congestion definitions

Measure	Definition
Journey time reliability	<p>On-time journeys</p> <p>The percentage of 'journeys' that are 'on-time'. Here, the journey represents the travel time between adjacent major junctions on the network. An 'on-time journey' is defined as the one which is completed within a set reference time. DfT stopped reporting this measure in 2015.</p> <p>Planning Time Index</p> <p>This presents a percentage of additional time needed compared to free flow, on average, on individual road sections (typically junction to junction) to ensure on-time arrival. It is a road user focused measure that the DfT started reporting from 2015.</p>
Average Delay	The difference between free flow travel times and average journey times. Free flow speed is the estimated speed of traffic if there was no congestion on the road.
Average speed	An estimate of the level of congestion that occurs regularly on a stretch of road.

2.2.4. The causes of road congestion can broadly be categorised as lack of supply (capacity), excess or variable demand, or the way that vehicles are driven, including the impact of incidents and accidents.

DEMAND

2.2.5. In its broadest sense, excess demand is caused when too many vehicles want to travel down the same road at the same time because of a travel need. Examples of demand factors which tend to increase congestion include general population increases, fuel prices reduction, increasing demand for goods as well as more localised aspects such as new housing and warehouse developments.

- 2.2.6. Demand management is any action or set of actions intended to influence the intensity, timing, and spatial distribution of transportation demand to reduce the impact on traffic flow (Kumarage, 2004).
- 2.2.7. The relationship between volume, capacity, and average speed is described in Speed Flow Curves. While the flow in the speed flow curve is defined as the number of vehicles, it is usual for transport planners and modellers to convert pure vehicle numbers into passenger car units (PCUs). PCUs reflect the fact that a single HGV has more impact on congestion than a single car. WebTAG² suggests that a value of 2.5 PCUs should be used for HGVs on dual carriageways and motorways, with 2.0 PCUs recommended for other roads.

SUPPLY (CAPACITY)

- 2.2.8. There are many factors impacting road capacity, these include:
- **Dynamic operational aspects** such as driver behaviour, car parking availability, road traffic collisions, roadworks, obstructions and weather conditions
 - **Infrastructure design aspects** for example, junction design, grade separation, and the number of lanes.
- 2.2.9. Frequently, and particularly on urban roads, capacity is dictated by the capacity of junctions, but even on grade separated multi carriageway roads, traffic slows down as the maximum capacity is reached. This is linked to the speed flow curve as the failure point in the speed flow curve is reached.
- 2.2.10. The limits of capacity constrain the free flow of all travel demand (for all vehicle types), however there are specific causes of capacity restriction that have a greater impact upon freight or where freight has a greater impact upon other road users. This includes Road Traffic Collisions (RTC) and roadworks.
- 2.2.11. **RTC (Road Traffic Collision) incidents** temporarily reduce the capacity of transport networks by restricting the free movement of vehicles. When freight vehicles are involved in incidents, the duration required to return the transport networks back to free flow speed are generally longer, as the removal of spilled freight goods and resulting infrastructure damage is typically much greater. Furthermore, the longer the incident the greater the cost to society / the economy by causing delay and idling.
- 2.2.12. When incidents result in road closures, appropriate local off SRN diversion routes are not always available for freight vehicles due to weight, width and low bridge restrictions or nuisance issues, causing longer journeys and further delays to freight traffic – adversely affecting driver hours too. This was a conclusion drawn by Transport Focus in their ‘road user needs and experiences’ report in 2015 (Transport Focus, 2015) and was reported in several of the Highways England Route Strategies such as that for the East of England (Highways England, 2017).
- 1.1.1. **Roadworks** provide another temporary but longer restriction on transport capacity. Long term roadworks typically aim to maintain capacity at pre-works levels. However, there are occasional closures which can result in diversions onto less suitable routes for freight.
- 1.1.2. **Short term works** are more likely to inhibit capacity and as a result some road operators attempt to minimise disruption by undertaking works overnight when traffic flows are lowest. While this limits the impact to most road users, in some locations HGV freight makes up the highest percentage of vehicle type on the road overnight, so they can be disproportionately impacted by overnight works.
- 2.2.13. **Utility works** have similar impacts to short term maintenance works however they are more prevalent in urban areas and hence can restrict access, impacting upon delivery schedules. While local authorities do require utility companies to plan works and receive a work permit, this does not always occur and planning schedules

² WebTAG provides information on the role of transport modelling and appraisal and its methodology is expected in the appraisal of and Government transport projects.

and layouts can change close to the start date of works, meaning the information communicated cannot be relied upon for freight delivery scheduling. An analysis by Ecorys supports this view of the inconsistent application of permitting systems open to authorities (Ecorys, 2018).

- 2.2.14. The communication and use of this information in real-time logistics planning tools is limited. In addition, the issues of diversions for HGVs as a consequence of roadworks are the same as discussed in RTC.

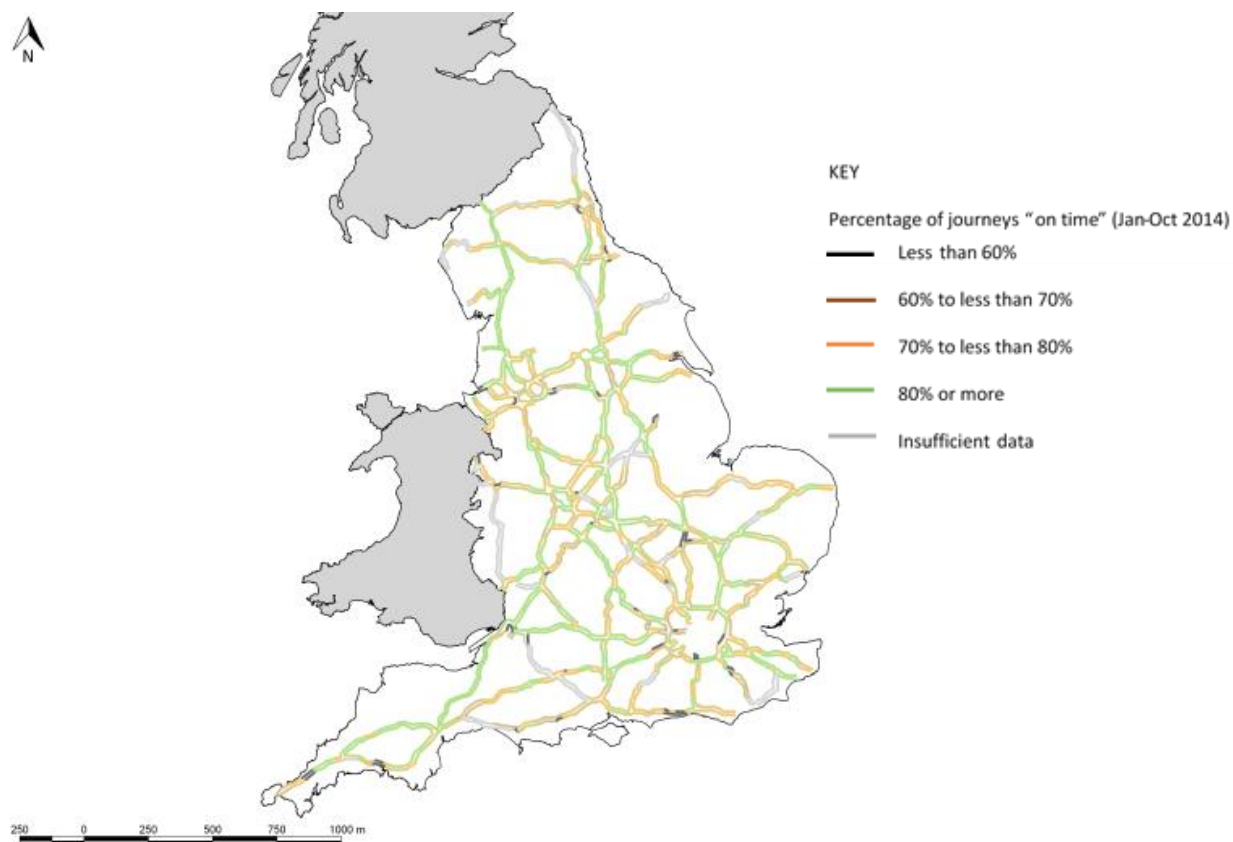
2.3. THE EXTENT OF INTER URBAN CONGESTION

- 2.3.1. Congestion on roads between urban areas tends to be focused on the SRN as this network handles over a third of traffic in England. 46% of lorry miles are on motorways and a further 37% are on “rural A roads” (DfT, 2017).
- 2.3.2. HGV network usage tends to stay relatively constant across the 24hr period of the day, so they make a relatively small contribution to the proportion of traffic in peak hours but a much more significant contribution overnight.

JOURNEY TIME RELIABILITY

- 2.3.3. From 2010 to 2015 Highways England published a journey on-time reliability statistic table which provided travel time measurements on a junction-to-junction basis. This statistical publication was framed as an experimental approach and was subsequently discontinued and replaced with a change in methodology for calculating the journey time reliability statistics (planning time index). The benefit of this approach was that it provided information on a junction-to-junction basis and allowed for a more granular understanding of network performance. The disadvantage was that it was difficult to interpret and then use to engage with the road user community who could not easily relate to it. The ‘on-time journeys’ information can still be obtained from the DfT website allowing junction-to-junction analysis, see table CGN0106 on the DfT website (DfT, 2017).
- 2.3.4. This source provides the percentage of journeys on the SRN in England that were deemed on-time from April 2010 to March 2015. From this dataset a summary table has been produced identifying the top 10 worst congested Motorways and A roads areas on the UK’s SRN. These are reproduced in the Evidence Report but show that, with up to 45% of journeys on the worst section of the M25 being delayed and around 40% being delayed across the other busiest sections of the network, the impact of congestion on car and lorry journey time is significant.
- 2.3.5. Similar data in the Evidence Report shows that the impact of congestion on journey times on A roads is even worse, with only around half or less of journeys on the busiest sections being on time.
- 2.3.6. A congestion hotspot map showing congestion on the UK’s SRN by individual road section is shown in Figure 2. This was developed using the percentage on-time journey data for the year ending 2014 (DfT, 2014). It visualises these traffic congestion hotspots on a junction to junction basis.

Figure 2 – 2014 Congestion hotspots (Journey Time Reliability)

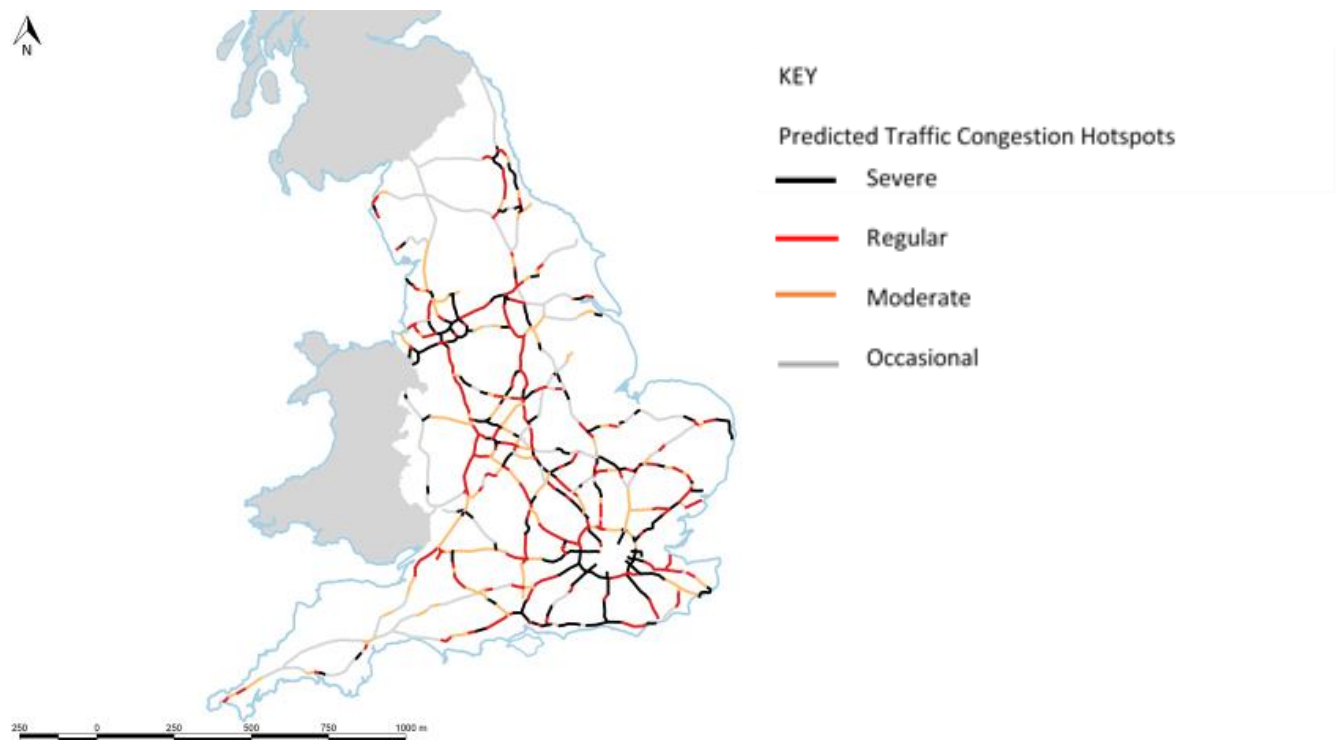


- 2.3.7. The map shows that increased journey times are experienced across a wide range of the SRN, not only the busiest locations, reflecting lower capacity provided at some less busy locations. Motorways around the main urban areas are the worst affected, but also strategically important locations such as roads around Cambridge and Huntingdon and ports such as Hull and Southampton.
- 2.3.8. There is no published disaggregated average delay information for the SRN from the DfT. DfT Data suggests that the average delay per vehicle mile is around 9 seconds, with this number being fairly constant across the year. However, there will of course be huge variation across different sections of the network.

2040 FORECAST TRIP GROWTH

- 2.3.9. The extent of traffic growth depends on how other strategic trends evolve, and their impact on how, and how much, people travel. To account for this uncertainty, the DfT has forecast road traffic trip levels – using the National Transport Model – under several scenarios. The National Transport Model is a multi-modal behavioural model that forecasts travel demand from the bottom up using highly disaggregated input data. The output is the number of billion vehicle miles travelled which is expected to be 43% higher than 2017 levels on the SRN. This is an increase from approximately 75 billion vehicle miles to over 110 billion vehicle miles. The range estimate for forecast trips on the SRN in 2040 was between 27% and 57% higher in 2040 than it was in 2013 (DfT, 2015).

Figure 3 – Predicted congestion hot spots



2.3.10. The graphic above shows that if predicted traffic growth forecasts are realised then significant portions of the SRN are going to suffer regular congestion impacting London and the South East, North West and all North South routes. Note these predictions factor in current Road Investment Strategy (RIS) projects up to 2020.

2.4. THE EXTENT OF URBAN CONGESTION

- 2.4.1. In urban areas high volumes of freight deliveries frequently occur in the morning peak to service premises during the trading hours, and to construction sites due to night time working restrictions. HGV vehicles present a significant contribution to congestion within urban areas due to their size and lack of manoeuvrability. This is exacerbated by delivery time and space controls which mean that lorries often to have to drive around finding and waiting for a delivery space.
- 2.4.2. Increasingly, general congestion in cities is spread throughout the day, and across a high proportion of road networks.
- 2.4.3. INRIX have published a list of the top 10 urban centres for hours wasted in congestion. It shows some interesting results illustrating that congestion can be about demand in major conurbations (e.g. London and Manchester) but is also due to physical constraints that can be found in older cities such as in Lincoln and Bath.
- 2.4.4. The table below shows the top 10 worst UK cities based on the peak hours spent in congestion (INRIX, 2017). It also highlights the expected cost to each city because of this lost time. The results show that London comfortably harbours the worst congestion in the UK.

Table 2 – Worst performing cities in the UK for peak hours spent in congestion

Rank	City	Peak Hours Spent in Congestion	INRIX Congestion Index	Average Congestion Rate	Total Cost per Driver	Total Cost to the City
1	London	74	14.1	13%	£2,430	£9.5bn
2	Manchester	39	6.8	10%	£1,403	£345m
3	Birmingham	36	6.3	9%	£1,281	£632m
4	Luton	29	5.2	11%	£1,143	£102m
5	Edinburgh	28	5	9%	£1,155	£309m
6=	Bournemouth	27	5.6	11%	£1,225	£121m
6=	Bristol	27	4.7	9%	£1,028	£225m
8	Newcastle	24	4.2	7%	£991	£139m
9	Coventry	23	3.9	7%	£905	£140m
10	Liverpool	20	4.1	9%	£1,101	£273m

- 2.4.5. DfT statistical data (DfT, 2017) shows London boroughs as amongst the worst for average speed, closely followed by Manchester, with Tyneside being the only other city from outside London in the top 10 worst locations for 2017. Average speeds in these locations range from 19mph in Oldham to only 10 mph in Islington. It is worth noting that active efforts to reduce speeds such as 20-mile-an-hour limits or traffic calming will impact this. Given that reducing speeds can be an active decision rather than as a consequence of congestion, average speed alone is not used to measure congestion.
- 2.4.6. Transport for London (TfL) measures congestion in terms of the total number of minutes lost per kilometre. This amounts to 5 million minutes per kilometre in Inner London, falling to under 3 million minutes per kilometre in Outer London. All of these values increased between 2012 and 2015 (INRIX, 2016). There is a common theme of congestion in London being significantly worse than other major urban areas, even with a much greater transport spend per head of GDP than other locations in the UK.
- 2.4.7. With growing urbanisation and logistics trends discussed below, the issue of urban congestion will continue to worsen. The challenge of competing road demands also becomes ever more prevalent as policies impacting the use of urban road space become a reality.

2.5. FREIGHT AND CONGESTION

- 2.5.1. Freight congestion cannot be considered in isolation from general congestion and rising demand for road and rail space for people and goods. Reducing freight movements at a particular time and place may not reduce overall congestion, particularly if other traffic fills this vacated capacity. Supply chains are increasingly dependent on just in time deliveries and reliable, resilient transport networks are crucial for production.
- 2.5.2. Various estimates have been made for the cost of congestion, which constrains the economy. For example, research has indicated a cost of £37.7bn for the direct and indirect cost of road congestion to the UK in 2017 with the average cost to UK drivers calculated at £1,168 (INRIX, 2017). This has increased from figures quoted in a 2006 Eddington study which highlighted a per annum cost of road congestion of £23-24bn (UK Parliament, 2011). The Centre for Economics and Business Research (CEBR) suggests the cost of road congestion to the British Economy between 2013 and 2030 will be £307bn (CEBR, 2017).

- 2.5.3. For all businesses, congestion adds to costs if journey times are extended. While the costs incurred by regular congestion, such as additional fuel and time, can frequently be treated as an inevitable additional cost of doing business, the consequences from major unplanned disruptions can have much more significant impacts on businesses.

HISTORIC ROAD FREIGHT GROWTH

- 2.5.4. Historically, the volume of goods lifted (tonnes) increased in line with increased GDP but this relationship broke down early in the 21st Century, and for several years volume has increased at a slower rate than GDP (DfT, 2016). This was regarded as a significant decoupling of freight growth from economic growth. Since the recession, the volume of goods lifted has fluctuated more dramatically but in 2017 volumes were still significantly down on pre-recession volumes, despite GDP remaining fairly constant.
- 2.5.5. The DfT's Domestic Road Freight Statistics United Kingdom 2016 has summarised historic road freight growth:
- “The amount of goods lifted and goods moved by GB-registered heavy goods vehicles (HGVs) operating in the UK has shown a broadly upward trend since 1990 - with notable exceptions during recession periods. The amount of goods lifted (1.89 billion tonnes) and goods moved (170 billion tonne kilometres) in 2016 both reached record highs since recording began in 1990. However, over the same period HGV vehicle kilometres have shown a declining trend, with the 2016 value (19.2 billion vehicle kilometres) 18% lower than 1998's historic peak of 23.3 billion vehicle kilometres. These opposing trends suggest that the road freight sector has become more efficient over time” (DfT, 2017).*
- 2.5.6. Between 2016 and 2017, the amount of goods lifted decreased by 3% to 1.40 billion tonnes. Over the same period, the amount of goods moved by GB-registered HGVs within the UK decreased by 1% to 147 billion tonne kilometres. As with goods lifted, the distance travelled by HGVs, vehicle kilometres, decreased by 3% to 18.6 billion kilometres (DfT, 2018).
- 2.5.7. These statistics illustrate the complexity of analysing road freight data, because they exhibit different trends in tonnes lifted, journey length (leading to tonnes moved), and vehicle loads (leading to vehicle kilometres – the key number for congestion).
- 2.5.8. Generally speaking, since 2010, the volume of goods lifted has changed little (although it has fluctuated), the volume of goods moved (tonnes x distance) has increased, and the number of vehicle kilometres has not increased. This suggests longer journeys but heavier average loads.
- 2.5.9. Vehicle kilometres for LGVs and vans have increased more rapidly, growing by 23% between 2006 and 2016 compared to 2% for cars and -7% for HGVs. Much of the growth is not freight movement but the use of vans for servicing or personal transport (RAC Foundation, 2017), nonetheless, growth of LGV traffic is a significant component of overall traffic growth, particularly in urban areas.

HGVs ON STRATEGIC ROADS

- 2.5.10. HGVs accounted for 5% of all vehicle miles in Great Britain in 2017 (DfT, 2018), but HGVs accounted for 11% of miles on motorways and 9% of miles on rural trunk roads. If using PCU as a measure, in terms of capacity impact, HGVs could be considered to account for 12% of traffic across all roads in Great Britain, 25% of traffic on motorways, and 19% of traffic on rural highways. The following charts illustrate the contribution of HGVs in terms of vehicle miles and then PCU miles, illustrating the impact HGVs can have on the use of road space (DfT, 2017)

Figure 4 – All road vehicle miles

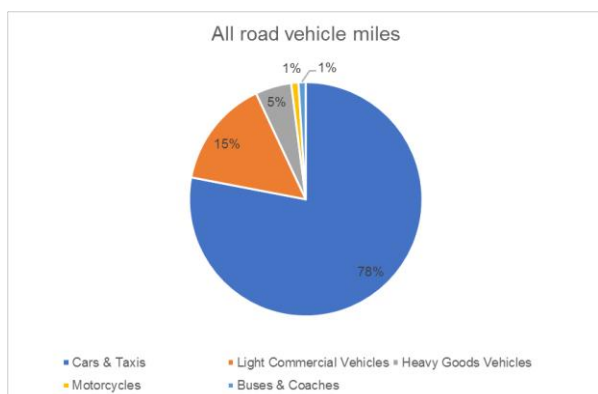


Figure 5 – All road PCU miles

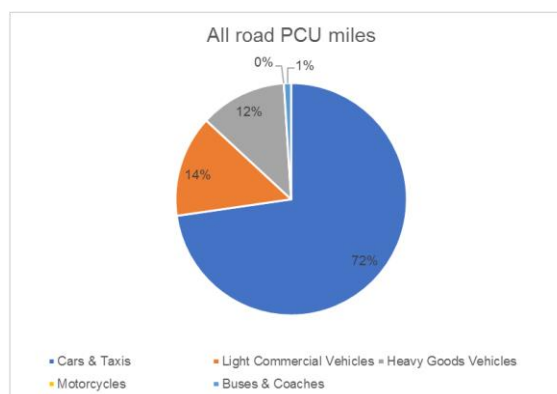


Figure 6 – Motorway vehicle miles

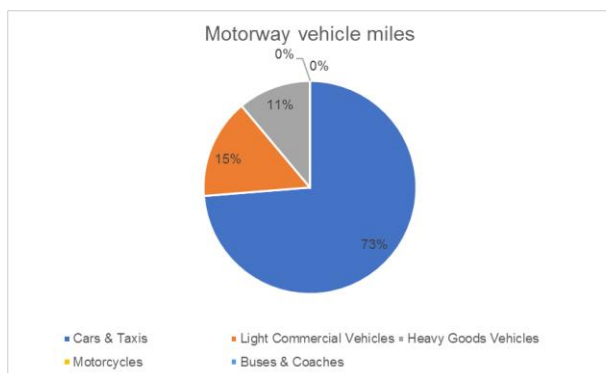
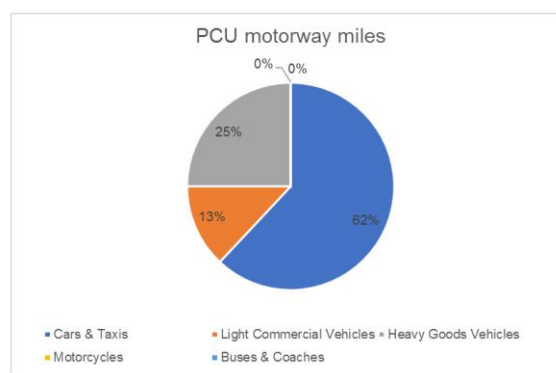


Figure 7 – PCU motorway miles



- 2.5.11. Demand forecasts produced for the Freight Transport Association (FTA) predict that by 2020 HGV traffic will increase by 9%. DfT forecasts that by 2035, HGV traffic will have grown 20% and LGV traffic will have doubled.
- 2.5.12. There is little evidence that the proportion of HGVs on a road impacts the average speed – it is simply a matter of numbers. Research by TRL (TRL, 2009) found that the average speed on motorways, whether congested or not, was not correlated with the percentage of HGVs.

HGVs BY LOCATION ON THE STRATEGIC ROAD NETWORK

- 2.5.13. The maps on the following two pages show the daily number of HGVs what percentage of all traffic is HGVs on the UK motorway network.
- 2.5.14. By and large, the HGV volume maps shows that there are large numbers of HGVs on the motorway network where they might be expected: on the main corridors between the city regions in the North, Midlands, and South East. However, it is also possible to see significant volumes of freight on links to ports and across the Pennines on the M62.
- 2.5.15. To a large extent the pattern of freight movement mirrors patterns of car movement. The HGV percentage map is useful in that it shows motorways where HGVs make up an unusually high percentage of total traffic. Notable among these are the M6 between the Midlands and the North West and between the North West and Scotland, and many of the motorways in Yorkshire. In these areas HGVs make up over 20% of vehicles. In terms of passenger car units (PCUs), HGVs make up over 40% of the traffic on these sections.

Figure 8 – Motorway vehicle miles

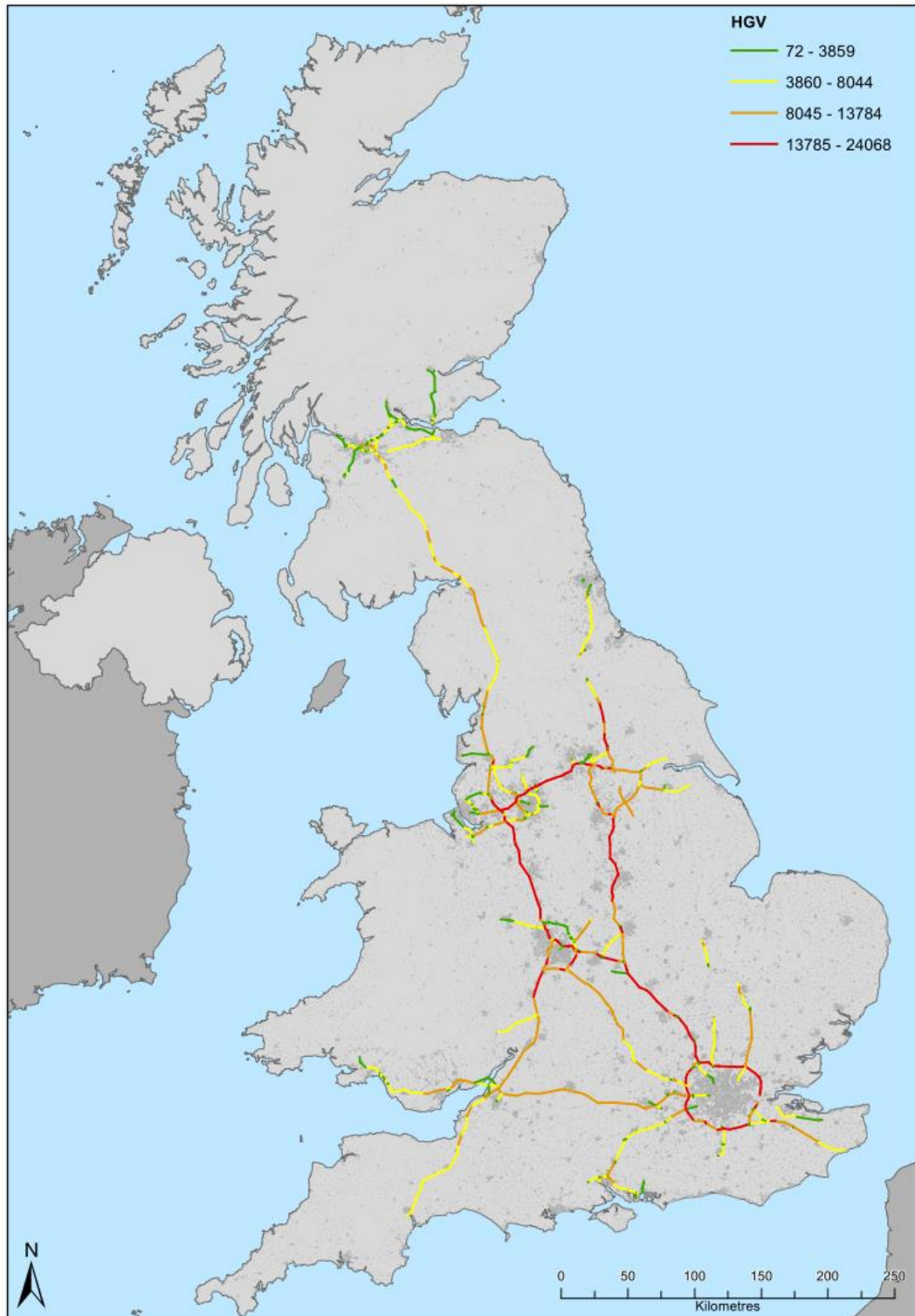
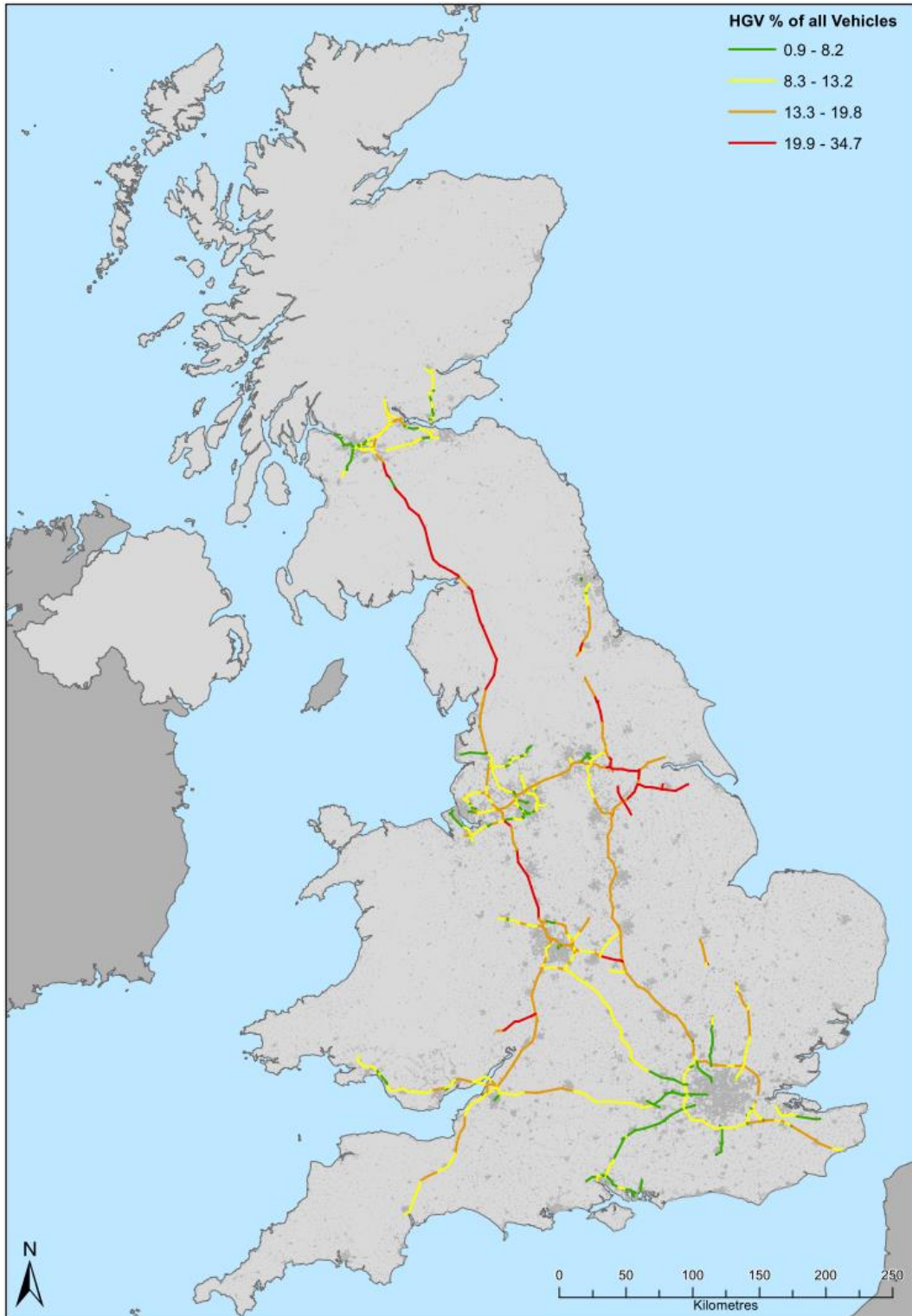


Figure 9 – Motorway vehicle miles



2.5.16. Separately, a 2014 report for Highways England (Highways England, 2016) found “The highest proportions of goods traffic are on:

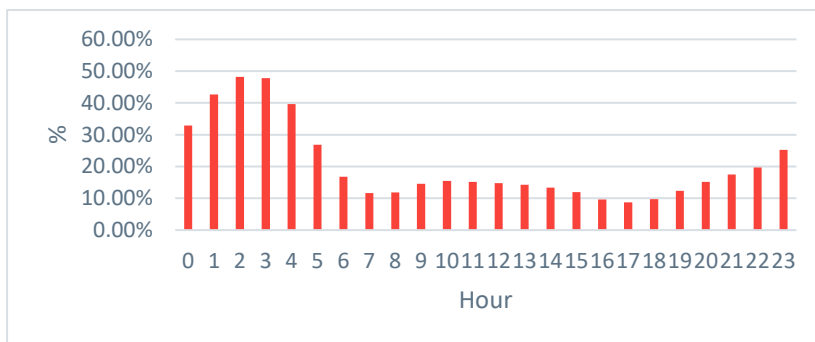
- M25 Junctions 17-21 (near Heathrow)
- M25 Junctions 28-29 (connecting to London ports)
- M50 Junctions 2-3 (connecting South Wales to the Midlands)
- M62 Junctions 21-24 (connecting Manchester to Leeds)”

2.5.17. Comparing these maps to the map of congestion hot spots in Figure 2, suggests that the key determinant of congestion on motorways is the volume of traffic (including cars and HGVS), rather than the percentage of HGVs. For example, the Yorkshire motorways are less congested than the M6, and the M50 stands out as a motorway with a very high percentage of HGVs but which carries low volumes of car traffic and so doesn’t suffer from routine congestion.

HGVs BY TIME OF DAY

2.5.18. The spread of vehicles across the day is different between HGVs and car traffic. The graph below shows the proportion of motorway traffic accounted for by HGVs, averaged across 13 locations on the M6 (sourced for this report from Highways England traffic count data).

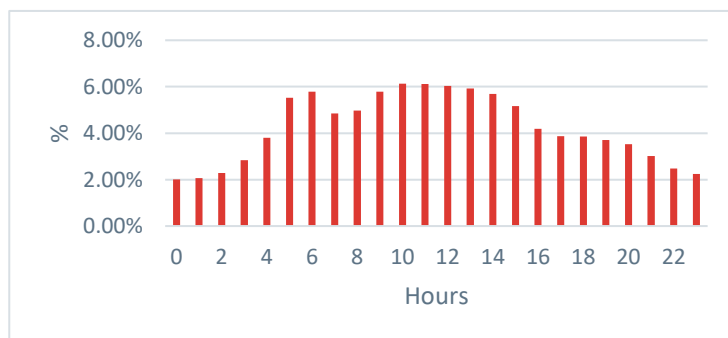
Figure 10 – Proportion of M6 motorway traffic which is HGV



2.5.19. This shows that at night 20% to 40% of vehicles are HGVs. This reduces to 11% to 12% during the morning peak, and lower still during the evening peak.

2.5.20. The same dataset suggests that, for this location, 42% of HGV traffic travels between 1900 and 0630. Widening the analysis to include more locations on the SRN, including the A34 and the A14, still shows 36% of HGV traffic travelling at night.

Figure 11 – Proportion of HGV vehicles per hour



HGVs ON URBAN ROADS

- 2.5.21. While HGVs account for 9% to 11% of vehicle miles on trunk roads, they make up only 2% of vehicle miles on urban roads. In PCU terms that amounts to 4% of PCU miles in urban areas. However, the impact of HGVs in urban areas is much higher in terms of emissions, road safety, and congestion. HGVs are more difficult to manoeuvre in city centres, and cause delays when making deliveries. This is amplified by the large number of HGV trips in urban areas that take place during the morning peak.
- 2.5.22. The London Mayor's Transport Strategy (Mayor of London, May 2018) states that about a fifth of London traffic is freight vehicles, rising to a third in Central London during the morning peak (this includes LGVs and vans as well as HGVs). The same strategy also cites that a third of peak hour HGV movements are associated with the construction sector. TfL's own analysis of 8 construction sites found that 25% of deliveries were made during the morning peak hour for construction industry reasons, enlarging the impact of freight traffic at the time when roads are busiest and there are high numbers of vulnerable road users (cyclists and pedestrians).
- 2.5.23. The charts which follow have been extracted from data published in the Mayor's Transport Strategy (Mayor of London, May 2018). They show the types of vehicles crossing into the congestion charging zone (CCZ) by hour of day.

Figure 12 – Congestion Charging Zone entries per hour by vehicle type

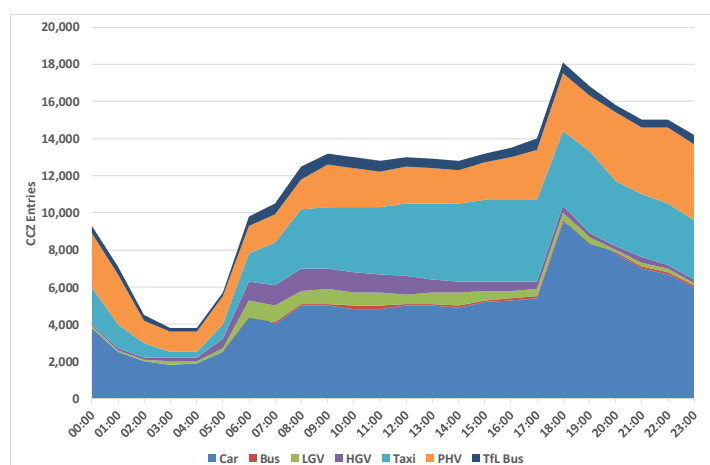
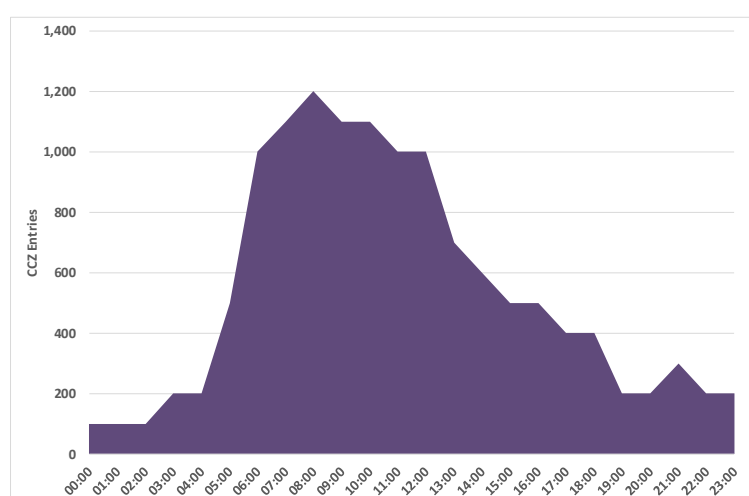


Figure 13 – HGV Congestion Charging Zone entries per hour



- 2.5.24. The London data shows HGV entries peaking at 08:00 when the streets are at their busiest. Between 06:00 and 09:00 HGVs make up 10% of traffic entering the CCZ. In part this could be due to the London Lorry Control Scheme (which restricts night time HGV traffic away from trunk roads), where 49% of operators have been discouraged from delivering within the controlled time (51% said they had not been discouraged) (London Councils, 2017). In terms of PCUs this is about 24% of entries, for HGVs alone. It is likely that this is similar for other urban areas, but this has not been evidenced. While the evidence cited relates to London, other areas are likely to have similar issues.

HGVs AND ACCIDENTS / CRITICAL INCIDENTS

- 2.5.25. The impact of freight traffic on congestion is not limited to their numbers. HGVs are disproportionately involved in incidents which cause significant delays to all road users and an economic disbenefit to society. Even a broken-down HGV can cause hundreds of lost minutes in associated delays.
- 2.5.26. In the 20 months up to August 2018 HGVs were involved in 36% of all critical incidents on the SRN, including 43% of those incidents lasting between 5 and 10 hours, and 56% of those lasting over 10 hours. This proportion varies monthly with 86% of incidents involving HGVs in July 2018 (Highways England, 2018). In terms of numbers, this represents an average of 14 incidents between 5 and 10 hours and 7 over 10 hours per month throughout the period. While there is no data on the delay minutes attributed to each delay, in 2015 the DfT estimated that the cost of closing two lanes for four hours would be up to £645,000 on a busy road, increasing to £1.7m for closing three lanes for four hours.
- 2.5.27. It is also worth noting that, of the eight fatal collisions that have occurred following nearside lane vehicle stops on smart motorways since 2014, six have involved HGVs colliding with the stopped vehicle. This is despite HGVs making up only 11% of traffic on motorways (Road Traffic Estimates Great Britain 2017).
- 2.5.28. In an urban environment, the impact of HGVs on incidents is equally significant. There were 957 reported accidents involving HGVs on urban roads in 2015, compared to 378 rural and 172 motorways. This equates to nearly 64% of accidents with HGV's happening in urban areas. This resulted in 66 killed or seriously injured. There is no specific data that identifies the length of delay caused by HGV incidents in urban areas, but the high percentage of HGV accidents which happen in urban areas suggests that lorry traffic is a major contributor to urban congestion. (DfT, 2015).

HGVs AND ROADWORKS

- 2.5.29. There was no evidence to suggest that HGVs impact delays through roadworks on the SRN to a further degree than any other traffic, other traffic down to HGV speeds.
- 2.5.30. However, there is strong evidence that HGVs have a disproportionate impact on road maintenance, leading to increased frequency of roadworks.

2.6. IMPACT OF CONGESTION ON FREIGHT

- 2.6.1. Section 2.5.2 reported various estimates that have been made for the cost of congestion on the economy. However, these highly publicised costs, and, indeed, the way that congestion costs are quantified for transport appraisal in the UK, are generally based on the hourly cost of a driver plus the vehicle, amounting to little more than £20 per hour (DfT, 2014). This may be appropriate for routine, predictable, delays, but may ignore wider economic impacts from freight congestion.
- 2.6.2. Businesses suffer serious consequences from major unplanned disruptions; for example, Jaguar Land Rover's recent Brexit press release notes that it costs £1.25 million for every hour that production doesn't happen and with a stock holding of less than 3 hours the impact of congestion is significant for the company (Jaguar Land Rover, 2018). Other than such anecdotal evidence, there is no comprehensive research into the wider economic and business costs of congestion for the freight industry and its customers.

- 2.6.3. Freight suffers more than general traffic in the event of major disruption. HGV drivers must adhere to strict driving hours regulations. A delay can lead to a driver running out of hours and having to take a mandatory break – leading to numbers of HGVs parked on the hard shoulder after particularly bad disruptions. Also, HGVs cannot always easily take diversionary routes, and certainly can't make use of rural short cuts that car drivers might use when a road is closed.
- 2.6.4. The extent to which congestion and unreliability drive changes in the structure and management of supply chains needs to be considered. An example of this is forcing businesses to move towards a more localised rather than centralised network of distribution centres. Some research has been completed into this area, notably by the Logistics Research Centre (Alan McKinnon et al, 2009) who concluded:

“The interview survey, across nine sectors, found little evidence of traffic congestion causing companies to restructure their logistical systems or modify key aspects of their transport and warehousing operations. Fleet sizes, tractor-trailer articulation ratios, the speed calibration of vehicle routeing software, inventory levels and internal warehouse design, for example, were largely unaffected. There had however, been a growth of evening / night-time delivery and greater use of regional depots and out-based vehicles / drivers. Overall, companies have been able to adapt their logistics operations to traffic congestion gradually over a long period and minimising its impact on reliability and efficiency has become a core management skill.”

2.7. CONCLUSION FOR CONGESTION AND FREIGHT

- 2.7.1. Road freight movements are a significant component of road traffic. It has an impact on general congestion which is magnified by the characteristics of HGVs. However, when congestion is worst, in morning peak hours, the freight percentage of road traffic is generally at its lowest. Infrastructure capacity investment is often required to provide more capacity at peak times, and so infrastructure investment is rarely justified by the impact on freight. In cities there is, however, a significant peak of HGV movements during the morning peak, placing extra pressure on roads when they are at their busiest.
- 2.7.2. HGVs are involved in a large proportion of ‘significant’ incidents, each of which leads to hours of delays to other motorists and goods.
- 2.7.3. Like all traffic, freight operators suffer increased costs due to congestion. The impact of unreliability on freight businesses and their customers goes beyond direct costs, potentially leading to substantial costs such as halting production lines. There is little data available on the true cost of congestion to businesses, for example through missed deliveries.

3. CONGESTION POLICY AND STRATEGIES

- 3.1.1. In Chapter 2 this report considered the extent of congestion and the significance of freight as a component of congestion. This Chapter summarises policies and strategies for managing congestion at national, regional, and local levels, with an emphasis on freight-related policies; it also researches evidence of these policies' impact on road congestion. More detail on policies at each level is provided in the Evidence Report.

3.2. NATIONAL POLICY

- 3.2.1. The following section illustrates that congestion policy at Department for Transport and Highways England levels is focused on addressing general congestion. There is no national strategy for logistics (despite recognition of its importance), and no clear link between the needs of freight and policy or investment decisions.

UK GOVERNMENT STRATEGY – THE LOGISTICS INDUSTRY

- 3.2.2. The importance of efficient logistics is recognised at Government level. For example, the 2017 Industrial Strategy for Britain sets out a programme which includes several actions to improve supply chains and supports a focus on supply chains when planning infrastructure.
- 3.2.3. The DfT Logistics Growth Review of 2011, reviewed annually, identified five core areas in which Government can play a significant part in increasing the productivity of the UK logistics industry and strengthening its role in the UK economy. The second of these core areas was *“improving the longer-term capacity, performance and resilience of our congested road and rail networks, and in doing so, also improving connectivity to ports.”*
- 3.2.4. However, there is no national industrial or transport strategy for logistics.

DfT: GENERAL CONGESTION POLICY

- 3.2.5. In 2013, the Government announced a series of *“Roads Reform”* measures, which were designed to improve the management and operation of the SRN (DfT, 2013). The RIS was established as one of the main aspects of the *“Roads Reform”* and committed the Government to £11.4 billion of funding to road enhancement works. One of the long-term aspirations was to encourage economic growth through working to minimise delays on the network, stating that *“to ensure the SRN positively impacts growth, we must tackle congestion and delay on the network, particularly on the main freight arteries that connect cities and international gateways”* (DfT, 2018). The types of road enhancement projects included:

- Smart motorways
- Expressways
- Junction improvements
- Technology upgrades.

- 3.2.6. The DfT outlined its ongoing commitment to creating *“a more reliable, less congested and better-connected transport network that works for the users who rely on it”* in the objectives of the 2017 Transport Investment Strategy and reports that Roads Reform projects are making good progress *“in tackling some of the most notorious bottlenecks on the network, like the A14 and A303 and adding 1,300 miles of new lane capacity to cut congestion and smooth journeys on the most heavily trafficked sections”* (DfT, 2017).

DfT: FREIGHT CONGESTION MANAGEMENT

- 3.2.7. Increasing road congestion is estimated to cost the freight industry £3.7 billion annually and without sustained investment and proactive policy, the problem is expected to become more serious for many of the UK's important routes (DfT, 2015). Although congestion in general is a recurring theme in national Government

policies due to its increasing prevalence, interventions targeting congestion caused by freight specifically are less commonplace. Three specific interventions that DfT is investigating are:

- HGV Platooning
- Longer semi-trailers (LST)
- HGV single-carriageway roads speed limit increase (since delivered).

3.3. HIGHWAYS ENGLAND

3.3.1. Highways England is responsible for motorways and major (trunk) roads in England, otherwise known as the SRN (Highways England, 2018). The SRN totals around 4,300 miles. While this represents only 2 per cent of all roads in England by length, these roads carry a third of traffic by mileage and two thirds of all freight traffic.

Highways England's stated priorities (Highways England, 2015) are to maintain an SRN which:

- is free flowing – where routine delays are infrequent, and journeys are reliable
- is safe and serviceable – where no-one should be harmed when travelling or working
- is accessible and integrated – so people are free to choose their mode of transport and can move safely across and alongside our roads
- supports economic growth with a modern and reliable road network that reduces delays, creates jobs, helps business and opens new areas for development
- ensures Highways England activities result in a long term and sustainable benefit to the environment

3.3.2. Highways England emphasises the importance of freight traffic to the British economy, and the SRN to freight traffic; however, it currently specifies few tangible responsibilities towards the freight industry. Freight does not appear in the Operational Metrics Manual (Highways England, 2018), while the list of Key Performance Indicators in the Highways England Delivery Plan (Highways England, 2015) only states that: *“a suite of Performance Indicators (is required) to help demonstrate and evaluate what activities have been taken to support the economy. These should, at a minimum include metrics on: supporting the business, and freight and logistics sectors”*.

3.3.3. In Spring 2018 Highways England commissioned multi-year support to improve their understanding of freight businesses and the required data capture that is able to better inform freight related issues. This will allow Highways England *“to collate benchmark data and develop initiatives for further improvements, lessening the impact of freight related incidents”* (Highways England, 2018). It is further understood that an element of this support will focus on freight incident prevention and tailoring incident response where freight vehicles are involved.

HIGHWAYS ENGLAND STRATEGY: FREIGHT TRAFFIC

3.3.4. Highways England Strategic Business Plan emphasises the importance of collaboration and consultation without committing to specific actions.

- *“Work with the freight and logistics sectors and other frequent and extensive users of the network to better understand their needs and help them achieve their business objectives.*
- *Consult with representatives of the freight and road haulage sectors to assist future network planning”*.

3.3.5. Highways England Strategic Economic Growth Plan discusses in more detail specific potential problem areas and solutions for the freight industry (Highways England, 2017):

“Supporting business productivity and competitiveness, and enabling the performance of SRN reliant sectors:

- *We are also investing in innovation research and development to make journeys more reliable and efficient, and to improve communications with our customers to enable them to plan their journeys more effectively.*

These include working with the DfT and the freight industry on trials for freight platooning (lorry convoys) that should reduce journey times and could bring other savings for the logistics sector” – enabled/enhanced by Highways England investment in connected vehicle technology.

- *There are also large potential benefits from embracing the potential for modal shift onto the rail network for both people and businesses and for greater use of rail freight”.*

3.3.6. A particular example of where Highways England has identified freight congestion issues is in the provision of efficient routes to global markets through international gateways: e.g. improving access to Liverpool port (Highways England, 2017).

3.3.7. Highways England has identified the significant contribution of goods vehicles to major incidents, and has developed an Incident Management Team which is planned to include a freight function.

HIGHWAYS ENGLAND: GENERAL ROAD CONGESTION

3.3.8. By 2040, Highways England forecasts that congestion will cost £10 billion a year in lost time unless action is taken (Highways England, 2015) and therefore the Highways England Delivery Plan developed the anti-congestion objectives and delivery methods laid out in the Strategic Business Plan. These are summarised below:

- **“Supporting Economic Growth”**: To relieve congestion and minimise delay, Highways England intends to deliver 112 individual schemes generating £4 in long term economic benefit for every £1 invested. (Highways England, 2015)
- **“A More Free-Flowing Network”**: Highways England is focused on meeting a lane availability target which does not fall below 97% in any one rolling year, and clear at least 85% of all motorway incidents within one hour, in line with Government requirements (Highways England, 2015).

HIGHWAYS ENGLAND: FREIGHT RELATED CONGESTION

3.3.9. Highways England schemes will improve capacity on critical freight routes (reducing congestion), such as the £1.5 billion A14 scheme (serving Felixstowe in particular) and improvements to the M6 in Cheshire.

3.3.10. Key economic gateways are a particular focus for Highways England: *“Ports are highly reliant on effective road connections. They support manufacturing sectors and are key cross-modal points for the logistics and distribution sectors. Ports handle 95% of UK trade by volume and 75% by value, although the concentrations of value and volume vary; proportionally the value to volume of cargo is greater in southern ports such as Dover, Felixstowe and Southampton. Delays increase freight costs, which have an impact on the competitive advantage of parts of the UK. The pressures that port traffic puts on the SRN vary greatly between the different locations. Ports that are in the heart of a city such as Liverpool, Hull and Southampton encounter local congestion, while traffic from ports that are not close to large centres of population such as Immingham and Felixstowe can sometimes suffer delays further afield”* (Highways England, 2017).

3.3.11. The impact of port congestion can have a knock-on effect to the SRN. Operation Stack is the procedure used to park lorries on the M20 in Kent when cross-Channel services via Dover are disrupted. This has been implemented 74 times in the past 20 years. Due to increasing traffic (car and freight), this has the potential to cause increasingly severe disruption to Kent’s traffic network. A solution that is being implemented is to provide lorry holding areas and lorry parking areas and minimise the need to implement Operation Stack, to a) better cope with cross-Channel disruption and b) lessen incentives for lorries to park illegally/inappropriately.

HIGHWAYS ENGLAND: REGIONAL STRATEGIES

3.3.12. Freight traffic and certainly freight congestion are largely unmentioned by Highways England’s regional route strategies beyond generalities: *“by 2040, we want to have transformed the busiest sections of the SRN to deliver the safer, more stress-free journeys that our customers desire, and the enhanced reliability and*

predictability that is so important to business users and freight. We see the SRN working more harmoniously with its surroundings, impacting less on local communities and the environment” (Highways England, 2015). Sub National Transport bodies (SNTB) such as Midlands Connect arguably provide a better source for freight strategy at a regional level.

3.4. TRANSPORT SCOTLAND

- 3.4.1. The primary role for the public sector in Scotland is outlined in the National Transport Strategy as *“to influence and encourage the industry to develop services that support [Scotland’s] ambitions, share good practice and facilitate legitimate collaboration”* (Transport Scotland, 2016). Transport Scotland in turn was established as an executive agency in 2005.
- 3.4.2. The first Scottish freight action plan was published in 2006 to complement the Transport Strategy at the time. The 2016 Scottish Transport Strategy outlines a refreshed freight policy that is in line with the goals of increasing competitiveness and tackling inequality that are outlined in Scotland’s Economic Strategy (Scottish Government, 2015). The Scottish Government aims to make the movement of freight around Scotland efficient and sustainable and states that *“by adopting a mode neutral approach”* the freight sector can continue to operate in a competitive commercial market (Transport Scotland, 2016).
- 3.4.3. The strategy does not explicitly state interventions to reduce freight congestion, however some measures to achieve the key strategic outcomes are relevant to road freight congestion. Measures put in place to increase the resilience of road freight to extreme winter weather, for example, can help reduce freight congestion induced by network conditions. The development of Road Haulier Winter Advice guidance, documenting vulnerable locations on the network for gritting and winter maintenance, and setting up the Traffic Scotland Freight Hotline for reporting traction problems, all aids information flows in real-time to hauliers and drivers to enable them to prepare and avoid hazardous areas in extreme weather.
- 3.4.4. The Scottish Transport Strategy also outlines that the Scottish Government is responsible for the promotion of a freight modal shift in Scotland through grants encouraging businesses to take the lead in developing flexible and innovative freight operations.
- 3.4.5. In addition to the measures outlined in the Scottish Transport Strategy, the 2005 ‘Improving the Efficiency of the Road Freight Sector’ report recommends more specific measures to improve the efficiency of the freight sector in Scotland.
- 3.4.6. The Scottish Government has also highlighted the importance of planning deliveries to improve vehicle utilisation, reduce lost time and better manage drivers’ hours, all of which can help to reduce freight congestion. The publication of the guide to ‘Planning and Managing Effective Customer Deliveries’ provides information on how deliveries can be planned and executed more efficiently (Scottish Government, 2010).

3.5. WELSH GOVERNMENT

- 3.5.1. Wales also has a range of devolved transport powers in the UK, with the most recent round of devolution occurring through the 2017 Wales Act. Unlike Scotland, however, it is the UK Government that is responsible for developing and applying transport policies. Transport for Wales, which was established in 2015, instead acts in a professional advisory and consultancy capacity with no ability to initiate or engage with policy work.
- 3.5.2. ‘Outcome 9’ of the 17 long term objectives outlined in the 2008 Wales Transport Strategy aims to improve *“the efficient, reliable and sustainable movement of freight”* in Wales and highlights the importance of reliable journey times to Welsh businesses. The strategy states that the outcome will be measured using two indicators: the number of goods vehicles kilometres saved through the transfer of operations from road to rail in Wales, and the travel time variance on key sections of the road network serving freight.

- 3.5.3. The last Wales Freight Strategy was published in 2008 as a companion to the Wales Transport Strategy (Wales Assembly Government, 2008). The strategy highlights that a key weakness of road freight in Wales is the significant traffic congestion in key locations on the strategic and local road networks. Many of the ‘steps towards delivery’ relate to improving the efficiency of freight on the network to reduce congestion.
- 3.5.4. The Wales Freight “*Task and Finish*” group was convened in 2013 to advise the Minister for Economy, Science and Transport on key freight issues and to identify appropriate interventions needed to support the development of business centres in Wales.

3.6. SUB NATIONAL POLICY

- 3.6.1. Central Government decision making has more recently been opened to Sub National Transport Bodies (SNTB) to ensure that “*infrastructure investment takes account of regional transport strategies and contributes towards rebalancing the country’s economy*” (DfT, 2017). Transport for the North (TfN) only became a statutory body in early 2018 and three new SNTBs – Midlands Connect, England’s Economic Heartland and Transport for the South East – are being developed at present, with support from the DfT (French, 2018). The rationale behind the establishment of these new transport bodies is to bridge the gap between national and local projects and therefore SNTBs tend to have more specific congestion intervention policies.
- 3.6.2. England’s Economic Heartland and Transport for the South East are relatively new and are currently developing policies to address freight congestion in their regions, they therefore have been omitted from this review.

TRANSPORT FOR THE NORTH

- 3.6.3. In March 2015, The Northern Powerhouse: A Report on the Northern Transport Strategy outlined the region’s ambitions to rebalance the UK’s economy, identifying logistics as one of the three enabling capabilities that has a key role in supporting the North’s economic vision (Transport for the North, 2015).
- 3.6.4. Congestion is highlighted in the 2018 Enhanced Freight and Logistics Report as a challenge facing the road freight sector in the north of England due to forecasted significant increases in freight movements (Transport for the North, 2018). The report highlights that new infrastructure provision is inevitable however that “*it may be possible to temper this against increased initiatives though the implementation of new policies designed to produce modal shift or cause reduction in the number of vehicles on the region’s congested road network or the development and use of new technology*” (Transport for the North, 2018).
- 3.6.5. New policy ideas designed to produce modal shift include providing more road network capacity made available for freight through initiatives to reduce the number of private cars on the region’s congested road network” (Transport for the North, 2018).

MIDLANDS CONNECT

- 3.6.6. The 2018 report entitled ‘Our Routes to Growth’ outlines recommendations for building a congestion resilient Midlands Motorway Hub (Midlands Connect, 2018). Although not specifically targeting freight congestion, several of the recommendations could address the growing impact of freight traffic on travel costs and delays by 2020.
- 3.6.7. Freight congestion on the road network is considered in more detail in the 2017 Midlands Connect ‘Freight Strategy’ which outlines the organisation’s aim to “provide congestion-free motorways/expressways radiating in all directions... [which is] likely to require more capacity or smart use of it” (Midlands Connect, 2017). Previous strategies that have failed to solve the problem of congestion are briefly mentioned, such as the M6 smart motorway treatment which was unsuccessful in relieving congestion at the M6/M5 junction, however no in-depth analysis is undertaken.

3.7. CITY REGIONS (AND PASSENGER TRANSPORT EXECUTIVES)

3.7.1. There is significant variation between the city regions in their approach to managing freight congestion. To date, only Transport for London has dedicated significant resources to freight issues, driven largely by safety and air quality concerns.

GREATER LONDON AUTHORITY & TFL

3.7.2. The 2007 London Freight Plan outlines initiatives to identify and address the challenge of reducing freight congestion and encouraging modal shift: (Transport for London, 2007):

- Fleet Operator Recognition Scheme (FORS): Voluntary scheme encouraging sustainable best practice for fleet operators
- Delivery and Servicing Plans: Help to proactively manage deliveries to reduce the number of delivery and servicing trips, particularly in the AM peak
- Construction Logistics Plans: Applied to the design and construction phases to improve construction freight efficiency and minimise congestion caused directly and indirectly by construction-related trips
- Retiming: Changing the times businesses make or receive deliveries, collections or servicing.

3.7.3. TfL's Retiming Deliveries guidance highlights that more efficient and safe deliveries can be achieved through retiming, and reports that over 500 sites across London have retimed their deliveries since the programme started in 2015. This in turn has *"helped to reduce congestion pressures in the city by removing 166,000 deliveries annually from roads during peak times"* (Transport for London, 2018).

3.7.4. The Rethinking Deliveries Report from TfL aimed to advise on delivery consolidation and promoted the full utilisation of freight vehicles.

3.7.5. More recently in 2018, the Mayors Transport Strategy outlined the *"aims to reduce freight traffic in the central London morning peak by 10 percent on current levels by 2026"* in Proposal 15.

OTHER CITY REGIONS

3.7.6. Although not all the city regions have specific 'Freight Strategy' policy documents and instead encompass freight policies within their wider Transport Strategy, they all aim to manage their networks to provide safe and efficient freight flows and promote congestion reducing interventions. The freight congestion interventions outlined by Transport for West Midlands (which contains Birmingham, the UK's second largest city by population), Strathclyde Partnership for Transport (the only Passenger Transport Executive in Scotland) and Merseytravel (a port city region) have been summarised in the Evidence Report.

3.8. LOCAL POLICY

3.8.1. Local authorities have taken a wide range of approaches to managing freight congestion which would be expected given their diverse geographical, demographic, economic and social differences. However, most authorities still do not have specific freight management policies beyond objectives to manage the negative impacts of freight. This section reviews an urban and rural example of freight congestion management at a local level. The City of London was chosen at the urban example as it has the highest workday population density in the England and Wales and therefore faces significant challenges with regards to managing delivery and servicing (Department of the Built Environment, 2013). Wiltshire is used as the rural example, as their freight strategy provides good examples of measures to deal with freight through trips.

3.8.2. Local Authorities are best placed to deliver key elements of transport decision making as they are closest to the people and businesses affected. They therefore have responsibility for transport and highways in their areas, either as County Councils or Unitary Authorities, as outlined in the Traffic Management Act. The DfT Transport Investment Strategy states that a "significant share of Government funding is allocated by formula"

in England to Local Authorities to deliver transport decision making which endeavours to reduce congestion and strengthen connectivity to create places in which people want to reside and work (DfT, 2017).

- 3.8.3. County Councils and Local Authorities highlight congestion caused by freight vehicles as a concern and outline interventions to address the problem in their policies. Local policy plays a crucial role in reducing localised freight congestion and collaborative efforts are enabling local policy to increasingly feed into Highways England strategies for reducing congestion on the SRN.
- 3.8.4. The characteristics of Local Authorities vary significantly across the United Kingdom and so do the circumstances and extent to which they are affected by freight congestion. The types of freight congestion interventions outlined in local policy, however, typically echo those stated in national policy. Examples of local authority freight policies are provided in the Evidence Report.

3.9. CONCLUSIONS ON CONGESTION POLICY

STRATEGIC ROADS

- 3.9.1. Congestion on strategic highways is particularly evident in morning and evening peak hours, when the percentage of freight traffic is relatively low in congested areas. Again, this increases reliance on car and passenger focused data.
- 3.9.2. Highways England has good links with the freight sector at an operational level, and is implementing policies intended to reduce the number of incidents involving HGVs and to reduce the time it takes to clear major incidents – this is a key factor in the better management of freight congestion.
- 3.9.3. At a national level, there appears to be no national coordination or alignment of policy to reduce demand or improve logistics efficiency. To an extent, this is regarded as an issue for businesses to manage themselves, but it also reflects difficulties for Government to measure the direct benefits of interventions to reduce demand.
- 3.9.4. At a sub national level, the new SNTBs are taking a more considered view of managing freight congestion. These bodies can see the strong links between maximising freight efficiency and promoting economic growth. Nonetheless, sub-national policy is still highly focused on modelled solutions which are focussed on providing more capacity, particularly for peak hour car traffic. Freight considerations need to be woven into policy from top to bottom to ensure a coordination and consistent approach.
- 3.9.5. At both national and sub national level, the needs of the freight industry are poorly understood, the impacts of congestion on freight are hard to quantify, and transport strategy is more focussed on providing capacity than working with industry to manage demand.

URBAN ROADS

- 3.9.6. Policy towards urban freight is more dynamic. Urban planners are faced with the same issue of a lack of freight data, but freight vehicles are a higher proportion of peak traffic in cities than on strategic roads. City authorities are, perhaps, also more aware of the importance of efficient deliveries to maintain competitiveness.
- 3.9.7. Pressures on road capacity cannot easily be met by increasing capacity, which encourages planners to consider demand management solutions.
- 3.9.8. A huge variety of interventions addressing freight in cities are being implemented and planned. Inevitably the initial actions often centre on goods restrictions, night time bans, ultra-low or low emission zones, delivery restrictions and so on. However, city planners recognise the difficulties that these restrictions impose on businesses, and so there are more positive initiatives such as the development of consolidation centres or support for electric delivery vehicles.

- 3.9.9. London, in particular, has a well-developed group of policies which are taken forward in partnership with businesses. Some authorities such as the City of London are going even further and thinking through the full implications of zero emission liveable cities on businesses and freight. There is opportunity for these good practices to evolve in other areas of the UK.

4. POTENTIAL FOR MODAL SHIFT TO REDUCE CONGESTION

4.1.1. This Chapter considers the following questions:

- How is capacity provided for growing rail freight demand, and how does this impact passenger services?
- What is the potential to move more goods by rail or waterway?
- What is the impact of current and forecast rail freight on road congestion?

4.1.2. This addresses an important objective for this study, which is to understand the contribution that moving goods by rail or water make to relieving congestion on our roads. This inevitably means considering what the impact on road congestion would be if there was no freight transported by other modes – however unlikely that scenario might be.

4.2. RAIL FREIGHT CAPACITY AND RELIABILITY

4.2.1. The railway is a timetabled network. Timetables are managed so that services can usually operate efficiently without queues forming at junctions. Because the timetable is strictly controlled (by Network Rail), the number of trains operated is kept within the level which can be efficiently handled by the network. When services run as planned, there is no congestion. However, as the number of planned services gets closer to the theoretical capacity of each section of the line or junction, any delay or disruption becomes magnified as extra paths for late running trains cannot be found without disrupting more trains.

4.2.2. The rail network is owned and managed by Network Rail, a Government body responsible to the DfT. Services on the network are operated by licensed train passenger (TOC) or Freight Operating Companies (FOC). The relationship between train operators and Network Rail and management and allocation of capacity is tightly regulated by the Office for Road and Rail (ORR). The DfT has policies to support rail freight, but its major rail responsibility is for passenger services as the Great Britain rail franchising authority.

RAIL FREIGHT CAPACITY

4.2.3. Operators bid for capacity for new services, and capacity is allocated by Network Rail according to strict rules which, to a large extent, protect incumbent services.

4.2.4. The determinants of rail capacity are:

- The number of tracks (single track, double track, etc.)
- The signalling system, particularly headways (the time gap between trains)
- Train characteristics such as speed, acceleration, length and braking (capacity is maximised if all trains have the same operating characteristics)
- The layout of junctions
- The layout and capability of terminals / depots.

4.2.5. The differential speed between trains has a major impact on capacity. For example, if most trains on a line run at 75mph, each 75mph train could be said to utilise 1 75mph path. A 60mph train on this route would soon be caught by the faster trains, which would then either have to slow down or pass the slower train at a passing loop. So, the 60mph train consumes more capacity than the standard 75mph trains. Similarly, a 100mph train on this route would catch up with 75mph trains, and so would consume more capacity.

4.2.6. In practice, many modern freight trains, particularly those carrying containers, operate at a maximum speed of 75mph. In some cases, this means a non-stop freight train can more-or-less keep pace with a nominally faster passenger train which has station stops.

IMPACT OF RAIL PASSENGER VOLUME GROWTH

- 4.2.7. Due to unprecedented growth in demand for passenger services, many locations on the rail network are at or near their maximum capacity in terms of the numbers of passengers on peak trains (crowding), the length of passenger trains on busy routes, and the number of trains that can be accommodated during peak hours. This extreme squeeze on passenger capacity in the morning peak and sometimes in the evening peak means that peak hours are extending, and high demand for passengers has spread across much of the day. A long-standing reaction to this has been to avoid timetabling freight trains during the morning or evening peak hours in dense passenger areas such as around London and Birmingham.
- 4.2.8. On key sections of the network, meeting aspirations for passenger and freight growth will be increasingly difficult without infrastructure interventions, including much of the West Coast Main Line and key junctions such as Water Orton near Birmingham.

GROWING RAIL FREIGHT DEMAND

- 4.2.9. Construction traffic and intermodal rail freight volume is forecast to continue to grow strongly. There are three sets of forecasts to consider:
- Network Rail Freight Market Study (FMS) 2013 (Network Rail, October 2013)
 - DfT Rail Freight Strategy (RFS) 2016 (DfT, September 2016)
 - MDS Transmodal Freight Growth Final Report 2018 (MDS Transmodal, 2018).
- 4.2.10. The FMS provided forecasts to 2043 and suggested strong growth of intermodal traffic, with some growth for construction traffic and limited growth or decline for other commodities. The FMS is a non-constrained forecast – it assumes that the railway will have both the capacity and the capability (loading gauge in particular) to carry forecast demand.
- 4.2.11. The DfT RFS, in contrast, is a constrained forecast, taking into account network capacity and other constraints. The RFS forecast uses a different time base for its forecasts (2030 as opposed to 2033 used in the FMS). It does not provide a simple total rail freight forecast, but it does provide forecasts by commodity group.
- 4.2.12. The MDS Transmodal Rail Freight Growth report revisits the 2013 FMS and considers the causes of actual rail freight growth which has been lower than forecast between 2013 and 2017. The report then produces a scenario-based revised forecast to reflect future uncertainty.
- 4.2.13. The main conclusion that can be drawn from these three approaches to forecasting is the broad agreement that there will be continued strong growth in the rail movement of containers to and from ports and construction traffic, but that there is divergence between the forecasts about the future potential for domestic container movements (between non port terminals).
- 4.2.14. The change in the mix of commodities carried by rail has had a major impact on requirements for freight capacity. While declining coal traffic did not release many useful paths for passenger services, many of the fast-growing flows of rail freight are along routes which are already used by large, and growing, numbers of passenger trains. For example, container trains from Southampton use the busy South West Main Line and Reading to Oxford corridors, while construction materials from the Peak District and Leicestershire use the Midland Main Line.

IMPACT OF RAIL CAPACITY CONSTRAINTS

- 4.2.15. It is rarely the case that a proposed new rail freight service is prevented from operating due to capacity constraints. Sometimes rail freight services must compromise to find an available path from origin to destination. This might include retiming or rerouting the train to avoid urban areas in peak hours, neither of which is desirable.

- 4.2.16. A particular issue for freight services is that they nearly always cross the grain of passenger services. This means that typical freight trains use several different passenger routes during its journey. Finding a gap in services in one passenger route that matches a gap in the next route can be challenging.
- 4.2.17. Network Rail uses its long-term Planning Process and its investment programme to plan to provide capacity for forecast levels of passenger and freight services. For example, the Felixstowe Branch is currently being upgraded to increase capacity from 37 trains per day to 45 trains per day to meet growing demand for container trains.
- 4.2.18. In the longer term, there are some locations on the rail network where additional infrastructure investment may be required to provide capacity for forecast growth in passenger and freight services. Network Rail monitors such locations and proposes enhancements through the long-term planning process. The DfT then decides which projects to fund. Network Rail's Freight Network Study (Network Rail, 2017) identifies capacity constraints on a route by route basis.
- 4.2.19. Neither the Network Rail Freight Network Study, nor the DfT Rail Freight Strategy quantify the impact of not providing the capacity required at these major pinch points.
- 4.2.20. The MDS revised 2023/4 rail freight forecasts (MDS Transmodal, 2018) do attempt to estimate the impact of constrained capacity. Their report acknowledges that the approach is crude, and currently only forecasts up to 2023/4. It is understood that similar forecasts for 2033 and 2043 are being prepared with Network Rail.
- 4.2.21. The MDS study estimates that capacity constraints at key locations could constrain growth in their highest growth scenario to 120 million tonnes from 128 million tonnes, a reduction of 6.6%. In tonne kilometre terms the reduction would be 9%. In future years, as potential demand grows, the impact of these pinch points would be even greater.

RAIL FREIGHT RELIABILITY

- 4.2.22. Rail freight trains are quite reliable. Their performance is measured by the Freight Delivery Metric (FDM), which is the percentage of operated trains that arrived on time or within 15 minutes after their scheduled arrival time. The metric is published regularly by the ORR (ORR, n.d.) which shows that the FDM has been consistently between 93% and 94% over the last five years.
- 4.2.23. However, when delays to freight trains do occur the length of the delay can be significant, in part because the train might have to wait a long time for another suitable path without causing too much delay to other services (passenger and freight). As each freight train carries a large volume of goods, the impact on freight customers of a delayed freight train can be significant, ultimately potentially halting the production line of a car plant or leading to empty supermarket shelves.
- 4.2.24. Data on delays that freight operators cause to passenger operators is not routinely published. However, data for 2017 suggests that freight trains caused 3.3% of total railway delay minutes in 2017 (Tableau, 2018). While the overall impact of freight train incidents on passenger train operations is low, individual incidents can cause significant delays to other trains, particularly when freight trains break down.

CONCLUSIONS ON RAIL FREIGHT CAPACITY

- 4.2.25. There is adequate capacity on the network for growth in rail freight, but this will become increasingly constrained by corridor and junction constraints on some routes.
- 4.2.26. Rail freight trains caused only 3.3% of all train delay minutes in 2017, although individual incidents can have significant impacts.

- 4.2.27. Network Rail has a process for agreeing demand forecasts with the rail freight industry and planning to provide capacity to meet forecast demand. NR estimates that potentially £2 billion would be required to accommodate all forecast rail freight growth.

4.3. RAIL FREIGHT CAPACITY POLICY AND STRATEGY

- 4.3.1. A very large element of the DfT's rail workload is to manage the passenger franchising process and to ensure that Network Rail delivers the outputs that the Government requires. However, the DfT does employ a rail freight team, and in 2016 the DfT published its Rail Freight Strategy (RFS) (DfT, September 2016).
- 4.3.2. Providing more capacity is one of four action areas identified in the strategy where further action by Government and others could empower rail freight to achieve its potential. The strategy states that investment in infrastructure through the Strategic Freight Network Fund has already funded new enhancements on the rail network to support the growth of rail freight, with £235 million allocated to the fund during Control Period 5 (i.e. the funding period covering 2014-2019).
- 4.3.3. The need for future investment in the network after 2019 to support freight growth is being considered by DfT as part of the long-term planning process for the rail network, and will be informed by Network Rail's Freight Network Study (FNS) and the initial industry advice submitted to the Department around the end of 2016.
- 4.3.4. The Rail Freight Strategy does not set out proposals for new enhancements to the network or specify the freight paths that will be needed in future.
- 4.3.5. The strategy emphasises that, alongside new infrastructure, Government and industry will also need to make the most of capacity on the existing network. This will mean working closely with Network Rail and the rail freight industry to ensure that the allocation of capacity on the network balances the needs of all users, including freight.
- 4.3.6. As part of work to develop the Rail Freight Strategy, a Strategic Capacity Working Group (including Network Rail, DfT and freight industry representatives) has been exploring options for strengthening processes to identify and protect capacity, and will be taking forward work to assess whether current mechanisms in the Network Code (which sets out policies for the allocation of capacity) should be modified to reflect this work. In addition, the Department is investigating the impact of freight dwell times – time spent in loops or sidings to allow passenger services to pass – which could provide a basis for assessing potential trade-offs between passenger and freight train pathing decisions.

BALANCING RAIL FREIGHT AND PASSENGER NEEDS

- 4.3.7. In addition to Network Rail's role in the efficient allocation of capacity, the Government has an influence over how the network is used in the way it specifies passenger franchises. Freight operators are already consulted as part of the development of passenger franchise proposals, but the development of a Government strategy for rail freight now provides an opportunity to review the current process to identify where there is scope for the current and future requirements of rail freight to be more systematically considered. In the light of the initial industry advice from the Rail Delivery Group (RDG), the DfT is working with the industry to establish how to ensure that the franchising process is informed by a realistic view of likely future demand for rail freight.
- 4.3.8. The issue of balancing freight and passenger needs was considered in a report for the ORR (SKM Colin Buchanan, 2012) which concluded: *"The other change we tested was reallocating paths from passenger to freight in the off-peak. In the examples we tested there was a clear economic benefit from this re-allocation of capacity although we did not test whether other passenger services would be impacted by the additional freight paths outside the corridor we studied."*

NETWORK RAIL'S LONG-TERM PLANNING PROCESS

- 4.3.9. Network Rail's Long-Term Planning Process (LTPP) strategy looks forward over a 30-year period, and fulfils their licence obligations to plan the future capability of the network. The LTPP has been designed to consider the role of the railway in supporting the UK economy over the next 30 years.
- 4.3.10. Plans are developed on a business by business basis, including the Freight Market Strategy of 2013, and the Freight Market Strategy of 2017. The ORR approved the LTPP to inform planning for Control Period 6 (2019-2024) (CP6) and for the longer term.

FREIGHT AND NATIONAL OPERATORS ROUTE

- 4.3.11. Network Rail management and delivery is devolved to routes. Each of these covers a geographic area or corridor. However, the **Freight and National Passenger Operators (FNPO) Route** is a nationwide virtual route focused on meeting the needs of freight operators and non-franchised passenger operators.
- 4.3.12. FNPO produced a Route Strategic Plan (Network Rail, 2018) in February 2018 covering CP6 (April 2019 to March 2024). The FNPO Route Strategic Plan (RSP) includes objectives to achieve and accommodate rail freight growth and quotes a potential cost of £2 billion over 15 years to provide additional capacity in addition to plans to maintain and improve reliability and capability.
- 4.3.13. On maintaining and improving capacity the FNPO RSP notes: *“Given the freight growth forecast in CP6 we will work with the System Operator (the Network Rail business that manages the timetable) to plan how capacity can be made available to accommodate this. A proportion will be through the continued drive to optimise use of the existing network. However, on certain routes in order to deliver a step-change in growth, enhancements to network infrastructure will be required. We will work with both the UK and Scottish Governments to make the case for continued funding to develop the Strategic Freight Network to build on the successes (and tangible benefits) of the CP4 and CP5 Strategic Freight Network funds. In the longer term, the freight capacity and capability requirements necessary to achieve continued freight growth will form a key element of the 15-year Freight Plan with the anticipated focus being on five key strategic corridors:*
- *Felixstowe to the Midlands/North/Scotland*
 - *Solent to the Midlands/North/Scotland*
 - *Cross London*
 - *Northern Ports and Trans Pennine capacity*
 - *Development of additional Nodal Yards (to support train regulation and capacity management)”*
- 4.3.14. While the Freight Route Strategic Plan is required to produce proposals and plans for CP6, it takes a longer-term view of infrastructure investments and demand over 30 years, up to 2034. Core to the RSP's strategy is the development of a Strategic Freight Network, focusing on key corridors with a consistent set of benchmarks.

4.1. MANAGING RAIL FREIGHT CONGESTION / CAPACITY

- 4.1.1. The following pages identify developments and interventions which can improve capacity for rail freight, whether by carrying more goods on each train, or improving the efficient operation of rail freight trains. These interventions are similar to those identified in following Chapters, which are more focussed on road freight congestion.

4.2. IMPROVING RAIL FREIGHT PAYLOADS

- 4.2.1. There is a strong economic incentive for freight operators to maximise the number of loaded wagons in each train. Adding a loaded wagon costs no more in terms of the major fixed costs of locomotive provision and train crew, and the additional cost for fuel, wagon provision, and track access is a small percentage of total cost.

Huge progress has been made by the industry to increase average train lengths. The average tonnage per train increased by 63% between 2003 and 2017 (DfT, 2018), although the peak year was 2012/13 since when there has been a major loss of heavy coal trains.

- 4.2.2. According to the 2018 MDS freight forecast report (MDS Transmodal, 2018): *“the tonnes per train depends on a number of factors. High volumes of high density cargos to and from terminals able to handle large trains are likely to result in high tonnes per train. Small volumes mean insufficient traffic will be available to fill a full-length train. Similarly, it may not be worth waiting for a full trainload for high value or time-sensitive cargo. If a backload is impractical (typically possible for intermodal containers and swap bodies, but normally not practical for bulk commodities), the returning train will be empty thus halving the average tonnes of cargo per train in that market sector.”*
- 4.2.3. The number of loaded wagons on a train may also vary due to seasonal factors, by day of the week, or according to economic variables impacting demand.
- 4.2.4. Finally, tonnes per train is also dependent on the number of wagons that can be carried within the length limit, the maximum trailing load permitted for the type of locomotive and route, and the payload capacity of each wagon. Modern wagons for heavy products such as aggregates have low tare weight, achieved using materials such as aluminium, which maximises payload.
- 4.2.5. The MDS 2018 report calculated that the average payload per train across all commodities was 577 tonnes. This continues a trend of increasing payloads up from 440 tonnes in 2005 (Network Rail, October 2013). These figures include empty and loaded trains. Typically, most bulk trains (such as liquids, aggregates and coal) run out loaded and return empty, so the payload per loaded train is much higher on average than 577 tonnes.

LONGER TRAINS

- 4.2.6. Generally, commercial pressures are considered adequate to encourage freight operators to maximise the utilisation of available wagon space on trains. The growing trend of payload per train may slow, however, unless longer or heavier trains can be accommodated.
- 4.2.7. Network Rail is committed to increasing length capability on the Strategic Freight Network to at least 775m from the current 600m and the standard maximum length for aggregates trains to 450m with a 2,000T payload and ultimately to 600m with a 2,700T payload. This is expected to lead to a 20% improvement in average payloads, resulting in fewer trains being required.
- 4.2.8. Currently the West Coast Main Line (WCML) is cleared for 775m from London to Crewe, and the connecting routes from Felixstowe (via London only), and Southampton are also 775m capable. Priority routes for upgrade are the direct route from Felixstowe to the Midlands, and links from the WCML to Liverpool and Scotland.
- 4.2.9. Not all rail terminals can accommodate longer trains although most new rail terminals, and all new SRFIs, are designed to accommodate 775m trains. Nodal Yards could be used to join shorter trains before congested sections of track and divide them at the end. This approach could be used for very long trains of >1,000m in selected locations.

IMPROVING RAIL FREIGHT WAGON PAYLOADS

- 4.2.10. As with filling trains, there is a very strong incentive for freight operators and customers to maximise the fill on each wagon on a train. Most of the costs involved are fixed (or long-term variable), with only fuel and track access charge depending on the weight hauled, and these costs are a small proportion of total costs.

- 4.2.11. Recent development have included using aluminium and innovative frame designs to minimise the empty weight of wagons and maximise the payload. New approaches to wagon design are being considered which could further improve tonnage payloads.
- 4.2.12. However, for many commodities weight is not the constraint, it is cubic capacity. Rail freight is constrained by the small dimensions of structures on most of the network (the loading gauge). The core freight network is being improved to W10 (for containers), and some routes will be cleared to W12 (for swap bodies, which are a different type of container). Such gauge clearance enables rail to carry containers that otherwise had to move by road, but it also allows existing traffic to potentially transfer to larger wagons to improve payload.
- 4.2.13. In the bulk sector, most wagons efficiently maximise their loads, and freight shippers and wagon owners have invested in low tare wagons to further maximise payloads. Despite this strong economic incentive, almost all bulk rail freight wagons are loaded in one direction only. It is simply not practicable or efficient to find a return load. For example, there are huge movements of aggregates from the Mendips and East Midlands to London. There is no opportunity to move material in the reverse direction in aggregate wagons.
- 4.2.14. While this applies to bulk movements, intermodal movements are more complicated. Rail operators transport containers, and there is little difference to them whether the container is loaded or empty – the price charged generally doesn't vary, and it is up to the customer to ensure that the container is filled as far as possible. Given that most containers have been transported in ships from the far east, there is a clear incentive to maximise payload to minimise shipping costs per tonne or cubic metre.
- 4.2.15. With empty containers, there is an imbalance between imports and exports to the UK, and this leads to many containers being exported empty. These empty containers need to be transported to ports, generally from the locations where inbound loaded containers have been delivered. This means that there are sometimes "triangulation movements" where an empty container is moved to another location to be filled for a return journey.

4.3. USING THE RAIL NETWORK MORE EFFICIENTLY

- 4.3.1. This section provides some examples of ways in which rail freight services could make better use of existing capacity.

TIMETABLE REVIEW PROCESS

- 4.3.2. Network Rail's freight business is undertaking a review of freight timetables to ensure that paths are used efficiently. This covers several areas:
- Reviewing path usage to remove unused paths and agree strategic capacity. This was particularly important following the dramatic decline in the movement of coal, which left a lot of booked paths which were no longer needed. The rail freight industry has been criticised in the past for retaining paths in the timetable which were rarely or never used. To date Network Rail have removed over 5,000 unused freight paths
 - Work with the Route, System Operator and FOC's/TOCs where in upcoming major timetable re-casts the available capacity may be less than contracted rights
 - Review with System Operator and customers suitability of current systems to capture network constraints and traction capability (Loads Book, Timing Loads, Lengths). This could be important as the operating details of freight trains (particularly braking curves) used for timetabling are not up to date, potentially losing capacity.
- 4.3.3. This is already providing more clarity on the availability of freight paths. The process of reviewing freight train operating characteristics is expected to lead to changes in the timetable specification process that may result in freight paths consuming less capacity.

STRATEGIC CAPACITY - FREIGHT NODES

- 4.3.4. Network Rail's FNS (Network Rail, 2017) introduced the concept of Nodal Yards to improve freight capacity and service quality. The study described nodal yards as follows:
- 4.3.5. *“Historically, freight services have often suffered from paths which required them to wait in loops whilst faster trains passed them, increasing the overall journey time, impairing the operational efficiency for operators and delaying end customers. The creation of nodal yards can create the capability for freight to operate in paths that are more appropriate and deliver benefits such as improved timetable capacity and network performance”.*
- 4.3.6. Developed at strategic geographic locations, nodal yards act as freight traffic staging and regulation points at the confluence of adjacent route sections, enabling effective management of freight traffic flows and better exploitation of end-to-end freight path components. Occupancy of the yard is subject to a Yard Plan – essentially a timetable for the yard to ensure optimum freight operations.
- 4.3.7. Development of nodal yards is backed in the FNPO Route Strategic Plan (Network Rail, 2018), which proposes incremental development of at least six such yards.

FASTER TURNOUTS

- 4.3.8. Turnouts are the junctions which join main lines to freight passing loops or rail freight terminals. Many of these are designed for slow speeds, assuming that freight trains need time and space to brake within the loop or terminal.
- 4.3.9. Slowing down before the turnout, and slowly accelerating away when leaving a loop or terminal obviously increase track occupation time, reducing capacity for other trains.
- 4.3.10. Given the length of some new loops and terminals, and greatly improved train braking ability, new turn outs could be designed for 25mph or even 40mph compared to the slower speeds currently used. Existing turnouts could be upgraded.

EXPRESS RAIL FREIGHT

- 4.3.11. Express Rail Freight includes several technologies:
- Operating faster conventional freight trains
 - Carry post and parcels on passenger trains or converted passenger trains
 - High speed freight trains on high speed lines
- 4.3.12. While some of these systems offer opportunities for increased modal shift to rail, they are considered here in terms of their potential to provide more capacity for rail freight. In this context, the main benefit would be to reduce the speed differential between passenger and freight trains, which would provide a higher system capacity.
- 4.3.13. Carrying post or other freight on passenger trains may return as a service opportunity, but the impact in terms of capacity would be small.
- 4.3.14. On high speed routes, high speed freight services could be operated alongside high speed passenger services – providing capacity where freight could not otherwise operate and during the daytime. Currently, for example, HS1 (the high speed route between London and the Channel Tunnel) accommodates rail freight but only for a handful of paths in the middle of the night.
- 4.3.15. Network Rail's Freight Network Study (Network Rail, 2017) carried out a “Benefits Study” into increased speed for intermodal flows on the West Coast Main which examined the route between Milton Keynes and Mossend, near Glasgow. *“Increasing the maximum speed of these services from 75mph to 90mph provides journey time improvement only if freight trains can be routed on the fast lines. Substantial benefits could be gained from*

running electric freight trains rather than diesel traction, particularly for the section north of Preston, where there are significant gradients. Initial indications suggest there are identified potential benefits in a timetable context.”

- 4.3.16. *“It must be noted, however, that increasing the maximum line speed for freight services may not always lead to notable benefits where the average speed of a service is still constrained by slow sections elsewhere. For this reason, short-term capability options are focused on increasing the average speed and therefore end-to-end journey times. It is recognised that existing constraints may limit some of these aspirations. For example, running 90mph services on the WCML may lead to increased wear on wagons, air turbulence at stations, increased emissions, and the geographical nature and topography of the line north of Preston could present additional challenges”*
- 4.3.17. French operations of 100mph conventional freight trains in the 1980s and 1990s were discontinued due to high costs. The TGV La Poste operation offering converted TGV trains carrying letters and parcels, lasted longer, but ceased operation in 2008 (Wikipedia, 2018).
- 4.3.18. The biggest opportunity would seem to be for faster freight trains, particularly domestic intermodal services, but technical issues need to be solved.
- 4.3.19. High speed freight services on high speed lines are more of a niche opportunity in terms of impact on rail capacity or road congestion.

4.4. IMPACT OF MODAL SHIFT

- 4.4.1. Preceding sections in this Chapter looked at how capacity to carry rail freight is managed and can be maximised. on the railways can be maximised. This section considers the impact of modal shift to rail or water on road congestion.
- 4.4.2. Modal shift is recognised as an objective at Government level, for example in the 5th Carbon Budget, the National Policy Statement for National Networks (DfT, 2014), and the Logistics Growth Review (DfT, 2011) and in most regional and local transport plans. Moving more freight by rail or waterway is recognised as having numerous benefits:
- Reduced emissions
 - Productivity and other economic benefits (A report for the RDG (Rail Delivery Group, 2018) estimated the productivity benefits of rail freight to be £1.17bn per year, plus an additional £556m for reducing externalities such as environmental benefits)
 - By offering a lower priced solution, non-road modes allow businesses to reach new markets, including international markets, more cost effectively
 - Railways and shipping are much safer than moving goods by road (The Rail Freight Group estimates that moving goods by rail reduces casualties by 600 per year (RFG, 2018).
- 4.4.3. Rail freight's share of inland transport measured in tonne kilometres grew by 72% between 1996 and 2014, but since then has declined largely due to the dramatic loss of coal traffic. While rail freight carried 14.8% of non-waterborne inland freight (tkm) in 2014, this reduced to 10.4% by 2016.
- 4.4.4. As previously noted, Network Rail and the DfT forecast continued strong growth in rail freight for the next 25 to 30 years. The 2013 FMS saw rail freight growing from 11% of tkm in 2011 to 19% by 2023.

MODE SHIFT TO WATERWAYS

- 4.4.5. Movement of goods by inland waterways consists of the following groups:
- Coastwise shipping of containers and other commodities between maritime ports
 - Transport inland to or from ports using rivers or canals

- Transport between locations on rivers or canals.

4.4.6. In combination, water freight transport accounted for 15% of total freight tonne kilometres moved.

4.4.7. The biggest opportunity to reduce road freight volume through modal shift to waterways is likely to be through changes to the market for UK ports, with potentially transferring container calls from ports such as Felixstowe, Southampton, or London to regional ports such as Liverpool, Teesport, or ports in Scotland. This could be through more direct calls, or more feeder operations from continental ports such as Rotterdam.

4.5. RAIL FREIGHT CONGESTION BENEFITS

4.5.1. Various industry reports and strategies emphasise the importance of rail freight in reducing road traffic and hence reducing congestion. The RDG pamphlet 'Rail freight – working for Britain' (Rail Delivery Group, 2018) provides a high level estimate that the 1.66 billion vehicle kilometres of lorry traffic avoided by rail freight is worth £1.7 billion. This includes approximately £1.2 billion of cost savings for rail freight users and approximately £500m of external benefits including decongestion.

4.5.2. Measuring the impact of rail freight on congestion is not straightforward. Several questions need to be addressed:

- How would the goods be transported if not by rail freight?
- What routes would goods use if transported by road?
- What would the impact be on congestion on those routes?

4.5.3. The impact on congestion depends on the time of day goods are moved and the conditions on the roads used.

4.5.4. Published estimates of the benefit of modal shift to rail freight are derived at a very high level based on an average benefit per lorry kilometre saved. In practice, the benefit will vary greatly between, say, a busy urban motorway or a quieter rural dual carriageway.

4.5.5. The Evidence Report illustrates three possible ways of measuring the impact of rail freight on road congestion:

- Reports by Metropolitan Transport Research Unit (MTRU) for the rail freight industry
- Using the DfT's Mode Shift Benefit (MSB) measure
- A new approach for this study focusing on the busiest rail freight corridors and road congestion hot spots.

MTRU CONGESTION STUDY

4.5.6. In March 2017 Freight on Rail published a report by MTRU titled 'Impact on congestion of transfer of freight from road to rail on key strategic corridors' (MTRU, 2018). The objective of the MTRU study was to establish the feasibility of a realistic modal shift from HGVs to rail which could reduce road congestion in key strategic corridors.

4.5.7. The overall approach to this research was to identify four busy sections of trunk road and estimate the proportion of HGV trips along those sections that could realistically be transferred to rail freight services. The four road sections were: Felixstowe A14, Southampton M3/A34, M6 Junctions 12 to 13, M62 Junctions 21 to 22. Two of these represent ports and the other two are busy sections of motorway.

4.5.8. The main conclusion of this study was that there is potential, and that rail capacity exists on the corridors studied, to transfer significant volumes of freight from road to rail. However, the study did not produce any estimate of the congestion benefits of such a transfer.

MODE SHIFT BENEFIT (MSB) APPROACH

4.5.9. Mode Shift Benefit (MSB) values are estimates of the benefit of removing a lorry mile from the road network in Great Britain, by transferring the goods to rail or water freight instead. MSB values form the basis for modal-

shift grants awarded by the DfT. MSB was previously referred to as the Sensitive Lorry Mile value (SLM). (DfT, n.d.)

- 4.5.10. The Evidence Report provides detail on an estimate of the MSB value of freight currently moved by rail. Two values are used: the average MSB value for all goods transported by road in Great Britain, and a lower value which would be used if all lorry miles saved were on uncongested motorways. The actual value would be somewhere between the two.

Mode Shift Benefit Value at Great Britain average = 1.11 billion X £0.57 = **£630,443,212**

Mode Shift Benefit Value for Motorway, Low = 1.11 billion X £0.24 = **£265,449,773**

- 4.5.11. These estimates are for one year, 2015/6, and suggest that use of rail freight in that year produced savings of between £265 million and £630 million in congestion.
- 4.5.12. Note these values only cover the **congestion** benefit. MSB monetises other benefits such as improved emissions and reduced accidents, but is also takes into account tax differences between road and rail and the negative impacts of rail freight emissions.

COMMODITY AND CORRIDOR APPROACH

- 4.5.13. The Evidence Report also describes a new approach intended to illustrate the impact that transferring all rail freight onto the road network would have on 5 key locations on the road network. The 5 locations were chosen because they benefit from major flows of container freight to and from Felixstowe and Southampton. The number of vehicles that rail freight currently removes from the selected roads is significant on all routes, ranging from 500 vehicles per day to 1,500 (both directions combined).
- 4.5.14. Analysis of traffic flows for most of the impacted routes shows that through most of the daytime around 50% of capacity is still available. This would suggest that adding the additional rail freight traffic to the volumes of road traffic seen in 2017/18 would not cause significant congestion, but any increase in traffic volume tends to slightly slow average traffic speeds.
- 4.5.15. However, the profile for locations along the M6 corridor is significantly different. Through much of the day existing traffic volumes leave little spare capacity, resulting in a decrease in average speed for all traffic at those times. Adding a significant number of additional lorries at any time in daylight hours would likely worsen congestion further and / or cause traffic to divert onto alternative routes.

CONSTRUCTION MATERIALS TO LONDON

- 4.5.16. It would not be correct to assume that every tonne of construction materials transported to London by rail would otherwise have been transported by road. Construction materials have a low intrinsic value, and are very sensitive to the cost of transport. Moving materials to London is a close fought competition between rail and water, with, generally, wharves on the Thames serving Central and East London, and rail terminals serving West, North, and South London.
- 4.5.17. If the rail terminals were to close, most movements would transfer to water for the main haul from distant quarries or sea dredged aggregate wharves. This would lead to longer road final delivery journeys in London from Thames wharves to West London and other areas previously served by rail. Currently the average journey from a rail head or wharf to a construction site is very short – possibly 5km-10km. Removing the option for rail would see the average journey for the transferred traffic increase to perhaps 15km-20km.
- 4.5.18. Using this data, it can be calculated that without rail over 3,200 lorry journeys in London would be extended by around 10km each day, leading to 8.2 million additional lorry kilometres across London each year. As construction traffic is increasing, this could grow to 14.6 million additional HGV km in London by 2033 (based on 3% volume compound annual growth rate).

4.5.19. This additional HGV traffic would be concentrated around the Thames wharves, which are often in the most congested areas of the city.

4.6. POTENTIAL BENEFIT OF INCREASED MODAL SHIFT TO RAIL

4.6.1. Neither the Network Rail Freight Network Study, nor the DfT Rail Freight Strategy quantify the impact of not providing the capacity required at major pinch points. The MDS revised 2023/24 rail freight forecasts (MDS Transmodal, 2018) estimate that capacity constraints at key locations could constrain growth in their highest growth scenario to 120 million tonnes from 128 million tonnes, a reduction of 6%. In tonne kilometre terms the reduction would be 9%. This would suggest that potential to expand beyond 120 million tonnes is likely to be limited to traffic which does not pass through key pinch points.

4.6.2. This section considers the potential future impact of modal shift to rail from road under two scenarios. The first scenario is to consider the potential for rail freight volume to grow over the next 26 years, unconstrained by infrastructure; the second scenario is to look at the potential impact of a theoretical new freight rail route, to provide an indication of a possible “maximum rail freight” scenario.

UNCONSTRAINED GROWTH

4.6.3. In considering how much rail freight could grow over the coming years, there are two industry forecasts that could be considered:

- The FMS forecast of 2013 (Network Rail, October 2013) which resulted in a forecast compound annual growth rate (CAGR) of 3% in tkm terms between 2011 and 2033
- The MDS/National Rail 2018 (MDS Transmodal, 2018) rebased forecast, which has a CAGR of 3.1% for tkm between 2016/7 and 2023/4. This is more up to date but only covers 7 years.

4.6.4. Assuming that average payloads on lorries remain the same, using the Mode Shift Benefit approach to estimate the congestion value of saved lorry miles would produce the following annual benefit (2020 values in 2015 prices) based on an unconstrained network:

Table 3 – Forecast congestion value of rail freight based on 3.1% CAGR

MSB Value	2016/7	2023/4	2033/4	2043/5
Unconstrained Rail Freight Growth				
Average	£630,443,212	£757,177,961	£1,027,506,593	£1,394,348,296
Low Motorway	£265,449,773	£318,811,773	£432,634,355	£587,094,019
Estimated Constrained Rail Freight Growth				
Average	£630,443,212	£711,747,283.34	~£800,000	~£800,000
Low Motorway	£265,449,773	£299,683,066	~£338,000	~£338,000

4.6.5. If the network were essentially constrained to current levels of capacity, the MDS research for NR would suggest that 2023/24 freight volumes would be approximately 6% lower than the unconstrained scenario. It

can also be assumed that from 2023/24 onwards rail volumes would be increasingly constrained. By 2043 constraints to rail capacity could reduce congestion benefits by between £250m and £500m per annum.

- 4.6.6. Using the corridor approach, focused mainly on deep sea containers, the tonnage CAGR for ports' intermodal traffic in the MDS study is 3.7% (this value has also been used for the DIRFT to Scotland flow). Using this figure suggests that much greater numbers of lorries would be removed from the selected corridors. For instance, the number of lorries transferred to rail on the A14 would increase from 1,100 per day to 3,000 per day by 2043, and for the M6 the number removed would increase from 1,500 per day to 3,900 per day.
- 4.6.7. Regarding overall traffic growth, rail freight would reduce traffic on these sections by 2% to 3% in vehicle numbers, equivalent to a 4% to 6% reduction in terms of PCU. Increasing traffic by the equivalent of 4% to 6% may not seem significant, but it equates to 4 or 5 years of general traffic growth, and would mean major capacity improvements might need to be brought forwards by 4 to 5 years if rail freight was not used.

MAXIMUM MODAL SHIFT

- 4.6.8. A more dramatic development would be to create a dedicated rail freight corridor from Kent (for the Channel Tunnel and Dover) to Scotland, able to carry road freight trailers. This could offer several bypass opportunities for hauliers:
- Channel ports to North of London (M25 bypass)
 - London to the Midlands (M1 bypass)
 - Midlands to Scotland (M6 bypass).
- 4.6.9. This is not a proposal or recommendation of this report – although major rail freight infrastructure schemes along this corridor have been proposed in the past – but is being used to illustrate the theoretical maximum benefit of modal shift on congestion.
- 4.6.10. Even operating at half of its full capacity, such an operation could virtually eliminate long and medium distance lorry journeys from the most congested sections of the motorway network. With 100mph capability and no need to stop for drivers' breaks, access to and between markets would be greatly improved.
- 4.6.11. Further work would be required to calculate the impact on congestion, but at the very least such a system could postpone or avoid the need for large scale investment in road improvements.

4.7. CONCLUSIONS ON MODAL SHIFT

- 4.7.1. Movement of goods by rail or water offers significant environmental and safety benefits over movement by road. In addition, using rail and water freight services is a key element of some businesses, which, if an alternative to road freight was not available, would come under significant pressures or even cease operation.
- 4.7.2. In terms of impact on congestion, almost every tonne of rail or water freight lifted means less traffic on roads. Every lorry mile avoided has a value, which is crudely expressed in the congestion element of the Mode Shift Benefit, which has a strong link back to traffic modelled impacts. The value of congestion savings generated by rail freight currently lies somewhere between £265m and £637m per annum. This could increase to £587m to £1,394m per annum by 2045 if rail freight grows in line with industry forecasts.
- 4.7.3. Assessing the actual impact on congestion for sections of road would require more detailed modelling, and would particularly depend on assumptions on the time of day that additional HGVs would use the roads. However, any increase in HGV numbers will slow road, and on some sections this will lead to capacity being exceeded, bringing forward the date when road improvements might be required.
- 4.7.4. Measuring the impact of lorry journeys avoided on specific sections of motorway is complicated, also depending on what other measures are taken to improve road capacity to meet growing demand for car traffic.

However, diverting container traffic from rail to road would have a significant impact on the M6 around Birmingham, and would also accelerate worsening congestion on the A34, M3, and A14.

- 4.7.5. In London, without rail freight, 40% of London's building materials would face a changed, extended, and more costly journey, leading to more lorry traffic in central London, particularly during the morning peak.

5. MANAGING CONGESTION

- 5.1.1. As has been described in earlier Chapters, logistics is undergoing a period of significant change with new demands from customers and Government being matched by new technologies and logistics techniques. The remainder of this report highlights changes and interventions that have emerged from the Evidence Report and show potential to reduce the impact of freight on road congestion.
- 5.1.2. The interventions assessed have been considered under categories which allow interventions to be grouped according to how they affect freight congestion. These categories reflect the common use of sustainability frameworks, notably the Green Logistics Framework developed by Professor Alan McKinnon and others, and set out in the book *Decarbonizing Logistics* (McKinnon A. , 2018). The McKinnon framework suggests the following five ways in which logistics can be decarbonised:
- **Reducing demand for freight movement:** within the bounds of logistics management this involves reducing the freight transport intensity of economic activity
 - **Shifting freight to lower carbon transport modes**
 - **Improving asset utilisation:** using vehicle and warehouse capacity more effectively
 - **Increasing energy efficiency**
 - **Switching to lower carbon energy.**
- 5.1.3. There are clear synergies between the McKinnon decarbonization framework and actions required to manage freight congestion. A modified framework focused on congestion has been used for this report as follows:
- **Freight Deintensification:** reduce the volume of goods transported or the distance that goods are transported. This doesn't mean producing less. It could include moving goods in a more compact form (e.g. concentrated liquids), or co-locating businesses to reduce distances for goods
 - **Improve Vehicle Utilisation:** reduce the number of vehicles (including wagons and trains) used/needed to transport remaining demand. Increase vehicle payloads through use of larger vehicles and/or improved capacity utilisation
 - **Improve Network Efficiency:** reduce the impact of freight movement on congested networks, particularly at peak times
 - **Increase Network Capacity:** increasing network capacity can be achieved in a variety of ways which, ultimately, could require new roads
- 5.1.4. Modal shift has been covered in Chapter 4.
- 5.1.5. Detailed evidence for each intervention identified is provided in the Appendix: Intervention Dashboards. Within the main report, the issues and key interventions are covered.

6. FREIGHT DEINTENSIFICATION

6.1. INTRODUCTION

- 6.1.1. This section discusses the potential to reduce the volume or distance of goods transported. As aforementioned, this doesn't necessarily mean less production / consumption, it could involve the more compact moving of goods, such as concentrated liquids, or collocating businesses to reduce distances for goods to travel.
- 6.1.2. Historically, there was a long-standing link between GDP and the volume of freight moved, but in the UK that link was broken in the 1990s. According to McKinnon (McKinnon A. , 2018): *"Between the 1950s and the 1990s every £1 million of GDP (at constant prices) generated roughly 200,000 tonne kilometres of freight, but over the last 20 years this has approximately halved."* The relationship between GDP and freight volume has become less clear since the 2008 recession.
- 6.1.3. McKinnon identifies trends which have led to a fall in volume including:
- Waste minimisation
 - Recycling
 - Digitisation (products such as books, newspapers, and music being transmitted digitally instead of transported as physical objects)
 - Miniaturisation (e.g. the change from CRT to LCD TVs)
 - Material substitution (using lighter materials)
 - Additive manufacturing, including 3D printing.
- 6.1.4. Freight moved comprises the volume lifted and the distance moved, measured in Tonne Miles or Tonne Kilometres. After many years of increases, the average length of haul has stabilised. McKinnon suggests that this implies that the spatial structure of UK supply chains has recently been very stable after decades when average lengths of haul were increasing, partly in response to the development of the motorway network and reflecting centralisation and globalisation of supply chains.
- 6.1.5. McKinnon refers to these processes (reductions in as reducing freight transport intensity; effectively, breaking the link between economic growth and freight growth. Continued improvements in this area should stabilise or reduce the volume of freight moved, reducing the impact of freight on general congestion.
- 6.1.6. At the level of logistics or transport management many of these macro trends cannot be influenced. However, there are some developments and interventions that are worthy of consideration because of their potential impact on congestion.

6.2. INTERVENTIONS

- 6.2.1. Five types of intervention are listed in the Dashboards:
- Colocation and clustering
 - Circular economy
 - Land use planning
 - Improved route planning and navigation
 - 3D printing.
- 6.2.2. Of these, the following three interventions have been assessed as having the best potential for reducing road congestion:
- Colocation and clustering
 - Land use planning

- Improved route planning and navigation.

6.3. CLUSTERING AND CO-LOCATION

DESCRIPTION

- 6.3.1. Co-location refers to locating businesses that trade goods with each other in close proximity. This would include supplier parks around car factories, food parks and petrochemicals parks. The general clustering of connected businesses occurs naturally (through market forces) as suppliers of goods and services benefit from efficiency and productivity savings associated with lower transport costs, a specialised workforce, and increasing innovation and best practice through knowledge sharing at closer distances. Increased productivity through agglomeration is a Government economic objective (outlined in the Industrial Strategy). These pursuits towards agglomeration and clustering via planned co-location of businesses are an economic objective for many regions and LEPs. While some clustering happens naturally there are opportunities to encourage co-location and clustering through economic and land use planning.

IMPACT

- 6.3.2. Clustering has strong potential to reduce the distances travelled by goods. In some cases, road use can be eliminated completely, for example by conveyors or pipelines between businesses.

EVIDENCE

- 6.3.3. While economists and economic planners encourage clustering due to proven economic efficiencies, there are few mentions of transport benefits in academic papers or strategies promoting clustering, although there is an acceptance that improved transport links may encourage clustering.

BARRIERS

- 6.3.4. Clustering is seen by most planners and businesses as something to be encouraged. The main barriers are identifying the opportunities, providing infrastructure and land, and encouraging businesses to locate or relocate into the cluster. Developing supplier parks or industry clusters is a long-term project, that requires coordination between planners and transport planners and close involvement of industry and real estate businesses.

6.4. LAND USE PLANNING

DESCRIPTION

- 6.4.1. The Clustering intervention specifically focussed on locating similar businesses close together. For a much wider range of businesses, land availability and affordability has an impact on congestion by virtue of the fact it affects location of warehousing and logistics facilities and therefore stem³ distances. Lack of available and affordable land forces businesses to locate to sub optimal locations, increasing journey lengths.

IMPACT

- 6.4.2. If land is available for a distribution centre in the optimum location it will enable businesses to reduce the average number of kilometres per delivery.
- 6.4.3. In urban areas last mile deliveries will increasingly be made in electric or human powered vehicles with limited range and capacity. Businesses are already moving towards cross docking or consolidation around, but close to, city centres. Availability of land in the right place will allow supply chains to be optimised, and significantly reduce distances travelled by the smaller, more numerous last mile delivery vehicles.
- 6.4.4. The lack of strategic rail freight interchanges is a major constraint on rail freight growth (Network Rail, October 2013). Goods to or from a distribution centre are much more likely to use rail if the DC is located at a rail freight interchange, not least due to the much lower cost of using rail when collection and delivery costs are minimised. This can be interpreted that ‘more interchanges will lead to more rail freight’, suggesting that there may not be a fixed demand for terminals in any particular region. There are some major gaps where there are no rail freight interchanges, notably in the South East.

EVIDENCE

- 6.4.5. Evidence of the benefit of optimal location is provided in numerous academic and business reports. Two responses to the NIC “Call for Evidence” for the Future of Freight study cited land use constraints as impacting efficiency.
- 6.4.6. *“Left unaddressed the trend of rapid loss of land for industrial uses is unlikely to abate, worsening choice for the logistics sector and compromising its ability to help London function effectively.”* (SEGRO, 2017)

BARRIERS

- 6.4.7. Increasingly logistics facilities need large areas of land with excellent road (and sometimes rail) access. These sites must compete with increased demand for housing and with the constraints of developing green field sites.
- 6.4.8. In urban areas, logistics uses compete with higher value land uses, and there are often pressures to restrict delivery hours when facilities are near to homes. Protected industrial land may not be in the right location for the new generation of city centre distribution hubs.
- 6.4.9. Land use planning is, arguably, focussed on designating sites for specific activities. New generations of logistics facilities could share land with other uses – for example a micro consolidation centre in an office building, or a distribution centre with other uses above.

³ Stem distances - the distance between depot and customer or supplier

- 6.4.10. The availability of suitable sites for strategic distribution is made more problematic because distribution businesses need access to large numbers of potential employees, ruling out some locations, particularly in areas with very high employment rates.

6.5. IMPROVED ROUTE PLANNING AND NAVIGATION

DESCRIPTION

- 6.5.1. Route planning is an essential tool for logistics to reduce their empty running via enabling back and forward hauling, reducing stem mileage and avoiding HGV inappropriate routes (restricted routes). Effective route planning reduces costs through creating the most efficient route, reducing stem mileage and ensuring the most appropriate route is established (e.g. avoiding restricted areas). Route planning tools can be free of charge, but also include bespoke tools for specific companies. Technology can range from simple 'sat navs' through to live dynamic scheduling and route planning facilitated by connected data.

IMPACT

- 6.5.2. Most haulage businesses already use route planning, optimisation, and sat navs, although there is some evidence that drivers may still revert to using mobile phone based satellite navigation. Take up is lower among the smaller operators. This means that, while there is still a potential mileage savings impact by extending use, the overall impact will be reduced.
- 6.5.3. Appropriate route planning, navigation and optimisation have many impacts on congestion:
- Planning the most direct route to final delivery, if necessary via multiple stops en route
 - Potentially provide in-flight changes to route providing dynamic routing
 - Avoid restricted areas and plan the best alternative route

EVIDENCE

- 6.5.4. There is some evidence of an increasing use of measures to improve routing amongst HGV operators. Between 2003 and 2010 the proportion of vehicles fitted with on-board computer systems, GPS systems and/or telematics in the freight sector grew sharply, increasing year on year for all measures (Greening, 2015).
- 6.5.5. Greening estimates that the use of telematics to optimise vehicles will increase from 8% in 2010 to 68% in 2030. This implies that technology is not only fitted to vehicles but that they are actively used to manage vehicle routes and schedules (Greening, 2015). Beyond this, many companies already use GPS tools linked to live traffic updates with routing increasingly reliant on them. There will be less centralised planning and more dynamic routing, allowing for avoidance of congested areas (IGD, 2015).
- 6.5.6. To make the best and most responsive decisions on routing and sharing of loads requires data to be updated and available live to all parties impacted by or with impact on the situation (see also the intervention on data sharing from telematics) (IGD, 2015)
- 6.5.7. McKinnon suggests that vehicle routing upgrades are a quick win for business that could yield cost savings and suggests a 20% improvement carbon intensity due to improvements in routing efficiency (McKinnon, 2018).

BARRIERS

- 6.5.8. The main barriers to effective and ubiquitous use of routing and navigation systems are availability of relevant freight data (including comprehensive and updated restrictions) and enforcing use by all drivers.

6.6. REDUCED PACKAGING / CONCENTRATED PRODUCTS

DESCRIPTION

- 6.6.1. Certain retail products have appeared in “concentrated” formats, for example washing powder. This has significant environmental benefits and reduces the number of vehicles needed to transport goods.
- 6.6.2. While packaging is often required to protect goods and present them attractively, there is recognition that excess packaging materials are wasteful of resources. Excess packaging also leads to inefficient utilisation of vehicle space. This includes standardised packaging for industrial products (for example automotive stillages) and for home deliveries.

IMPACT

- 6.6.3. There is strong evidence to link excess packaging and larger product formats to extra vehicle trips. For example, a parcels company estimates that their packaging printing solution, which produces bespoke packaging for each product, can reduce vehicle space required by 40%.
- 6.6.4. Businesses should therefore seek to reduce packaging as part of any strategy to reduce logistics costs and impacts.

6.7. ANALYSIS OF INTERVENTIONS

- 6.7.1. Two of the interventions identified are at the level of strategic land use.
- 6.7.2. For land use planning, providing land for industrial and distribution use is recognised as being economically important. Ensuring that the industrial land is well located is also recognised as a way of improving sustainability through reducing transport impacts such as emissions.
- 6.7.3. However, industrial land in cities is under pressure from housing and other land uses. Even where land is protected, businesses may be forced away by restrictions intended to protect neighbouring residential lands. This is at a time when more space will be needed to allow goods to be transferred to smaller, zero emission modes for last mile deliveries. Better understanding of the interaction between inter urban and urban supply chains is essential to more appropriate land use planning.
- 6.7.4. Outside cities, sites which are suitable for distribution use generally need to be large, reasonably level, and with excellent access to the strategic road network. Sometimes this means impinging on green belt land, making finding suitable sites even more difficult.
- 6.7.5. Route optimisation can deliver significant costs savings for haulage businesses, generally through reducing the mileage driven, which in turn reduces freight demand on the road network. While most hauliers do now use route optimisation software, the practice is not ubiquitous, and some hauliers use no route-finding software or use software intended for use by cars (and so not plotting routes to avoid steep hills, low bridges, or weight restrictions). There are proposals to make use of freight specific routeing software compulsory. Typically, hauliers employing route optimisation software can reduce costs by 5% to 10% (Dekker, 2012).
- 6.7.6. However, route optimisation isn't only about navigation software. Multi-drop delivery routes are complex because of the variety of different customer requirements combined with delivery restrictions that vary from street to street. Consistency of lorry and delivery restrictions would also reduce freight mileage driven.

6.8. SUMMARY

- 6.8.1. The opportunity that reducing demand presents is the idea of treating the cause of congestion rather than the symptom. The challenge however, is that many of the issues discussed above are fundamental societal issues that have wide ranging implications outside of congestion alone, which has made understanding the potential



impact on congestion difficult. However, while reducing the demand cannot be tackled from a freight perspective alone, there are a number of specific interventions that can be used to get some of the foundations in place.

- 6.8.2. Evidence suggests that refinements to planning and economic policies which are already acknowledged to have economic and sustainability benefits, can also have significant impacts in strengthening freight deintensification.

7. IMPROVE VEHICLE UTILISATION

7.1. INTRODUCTION

- 7.1.1. Improving vehicle utilisation means moving goods with fewer vehicles (lorries, wagons, trains, vessels), rather than reducing the amount of goods or the distance moved. This can be achieved by using larger vehicles, by reducing empty running, or by reducing empty space on loaded vehicles.
- 7.1.2. Improving vehicle payloads can potentially reduce congestion. This is an issue which is central to supply chain management and a key objective for many supply chain managers. However, payload for the freight journey is only one of many KPIs that managers and planners will be considering, and other objectives sometimes have the opposite impact and reduce payloads.
- 7.1.3. This section discusses reducing the number of vehicles (including wagons and trains for rail freight) used/needed to transport freight, including increasing vehicle payloads through use of larger vehicles and improved capacity utilisation.
- 7.1.4. There are three relevant measures of freight payload to consider:
- **Total payload per vehicle:** this is generally measured in tonnes
 - **Percentage empty running:** vehicle kilometres driven empty, defined as carrying zero tonnes, as a percentage of all vehicle kilometres
 - **Loading factor:** the amount of goods that were moved, as a proportion of the total amount of goods that could have been moved if HGVs were fully loaded. This can be measured as a percentage of the tonnage payload or a percentage of the cubic payload. Tonnage is more commonly used because data on the cubic loading factor is very difficult to record.
- 7.1.5. Over the last 50 years the total weight allowed for heavy goods vehicles has increased, culminating in the maximum weight being increased from 38T to 44T in 2001. Since the increase to 44T payloads, payloads have generally continued to improve, for example due to businesses backloading empty lorries, or better supply chain management. Average payloads in HGVs increased by 28% from 1990 to 2017 (DfT, 2018).
- 7.1.6. From a road perspective, around a 30% of UK registered HGVs on the UK's roads are empty, typically when they return to their depots after having completed a delivery job (DfT, 2016) or onwards to collect another load. Empty running, and part loads, equate to wasted money through excess fuel use and resources and contributes to the congested road network. According to the DfT, HGVs covered 16 billion miles on the Great Britain road network in 2014 and 29% of those miles were empty trucks.
- 7.1.7. In 2018 the FTA published a report showing empty running is at 30.2%, which is an increase from 2006 where it sat at 20.8% (FTA, 2018). This could, in part, be due to the increase in multi-drop, shorter journeys, making backloading more challenging to achieve. Reducing empty running to the 2001 level of 26% would equate to industry savings of around 480 million miles, 270 million litres of fuel costing around £340 million and 720 million tonnes of CO₂ (DfT, 2016).
- 7.1.8. For the 70% of trucks that ran loaded in 2016, the average loading factor was only 68% of the full potential tonnage payload. This had improved over the previous 10 years, with the loading factor in 2006 being only 56%. Filling every vehicle to its maximum tonnage or cubic payload would result in further huge reductions in vehicle miles, fuel used, and emissions. (DfT, 2016)
- 7.1.9. According to a study by the World Economic Forum the average capacity utilisation in Europe is 43%. They claim this means that one out of every four vehicles drives empty and that the average loading factor of the other three is less than 60% (Collaboration Concepts for Co-modality, 2018). As a comparison to the UK, recent figures in the EU show that a fifth of journeys at EU-28 level were performed by empty vehicles (21.1%

in 2015). The share of empty journeys grows to 24.3% for national transport, but is only 12.6% for international transport in 2015. At the total transport level, most Member States fall in the range between 15% and 30% empty journeys. In contrast, for international transport, all Member States reported substantially lower levels of empty running, only three countries being over 20%. This indicates there is a greater economic importance of finding loads for international return journeys as opposed to domestic transport, likely to be due to the distances covered (Greening P. , 2015).

- 7.1.10. European Commission data suggests that empty running of freight transport combined with average weight loading rates of 56% contributed to a total road freight transport inefficiency cost burden of €160bn across Europe in 2010. This accounts for freight movements in all sectors but out of this food has the highest market share in terms of tonne-kilometres at 17.1% in 2013 (European Commission, 2014).
- 7.1.11. There are two key studies which suggest that the size of the opportunity to improve payloads may be limited to just 2% (McKinnon & Ge, 2006) or 7.9% (Palmer and McKinnon, 2011) . This is reviewed in more detail in the Evidence Report, however, while there is debate about the size of the opportunity there is no doubt that there is still more to be gained.

7.2. BARRIERS TO IMPROVING VEHICLE CAPACITY UTILISATION

- 7.2.1. Transport is only one part of a supply chain, and changing the transport element may impact efficiencies elsewhere. As an example, in car manufacturing the cost of holding stock of high value items is significant and just in time manufacturing allows businesses to minimise this, but just in time manufacturing also necessitates a fast and responsive supply chain that needs parts to be transported when needed rather than waiting for a full load. Jaguar Land Rover recently quoted that a delay to their manufacturing site at Solihull costs £1.25 million per hour (Jaguar Land Rover, 2018), so slowing down the manufacturing process to wait for appropriate vehicle fill is not appropriate. Other examples show that initiatives to reduce miles in one area could simply move costs elsewhere, for example, moving manufacturing closer to the customer must consider the potentially increased costs of transporting raw materials to ensure an overall benefit (IGD, 2015).
- 7.2.2. Supermarkets have taken steps to address empty running: for example, where possible delivery lorries pick up goods from suppliers for the journey back to the depot. But this is only possible for some locations. Extending backloading might mean picking up goods for other businesses.
- 7.2.3. Some studies have suggested that empty running can be partially explained by the relatively low costs of road freight transport as a proportion of the total cost of goods, which breeds utilisation inefficiencies. A true (higher) cost of road transport may drive a reduction in miles travelled and encourage alternative modes of freight movement (Campaign for Better Transport, 2018). In contrast, increased haulage costs, such as higher fuel costs, would lead to improved average payloads (McKinnon A. , 2018).

MARKET CHANGES

- 7.2.4. Just In Time manufacturing supply chains focus on regular deliveries of parts to minimise stock, but this leads to lower utilisation of vehicles. Supermarkets require regular frequent deliveries to each store, even when lorries are not full.
- 7.2.5. Changing consumer trends have caused many changes in the logistics sector. Extended opening times and increased consumer expectations has led to an increase in the number of deliveries being made but with fewer goods per drop. This is then combined with potential multi drops making supply chains more complex when considering filling vehicles to capacity.
- 7.2.6. There has also been an increase in the number of deliveries being made as part of multi-drop journeys (several deliveries made as part of one journey) adding complexity to filling vehicles and reducing the financial benefits of doing so as the empty legs are now potentially shorter.

- 7.2.7. Greater customisation could also in part explain why supply chains are becoming more complex with smaller volumes of units leading to supply chain inefficiency.
- 7.2.8. In response, there is evidence that the logistics industry may restructure and adapt to accommodate customer demands while maintaining efficiency. For example, smaller depots, being closer to urban centres may increase shorter multi drops in the urban environment but could mean longer journeys with fuller vehicles from national distribution centres to these smaller depots. This model is used currently by parcel companies but could be extended to other sectors allowing faster but smaller deliveries. This is subject to the availability of land in the right places as highlighted in Section 6.
- 7.2.9. Maintaining customer service, whether for delivery times, turnaround or lead-times, is a key criterion when operators are assessing the potential to work with others to reduce empty running. A survey undertaken as part of the DfT collaboration study suggested that protecting service level agreements (SLAs) was a major barrier for business collaboration (TRL, 2017).

LOGISTICS FACTORS

- 7.2.10. Demand fluctuations also impact the degree to which industries and organisations can share. Being flexible and responsive to demand changes can be critical and so load sharing can be impacted by a lack of consistent and reliable availability of space, making it difficult if not impossible to plan.
- 7.2.11. Understanding the product requirements of those empty vehicles is a key factor when understanding the potential to share loads. Load compatibility because of contamination issues or vehicle requirements such as liquids, dangerous goods or refrigerated products can restrict the ability of some supply chains to work together or reduce their empty running (examples can be found in construction logistics, fuel supply chains, food supply chains etc). This can be exacerbated by different handling equipment needed to load and offload, limiting the load sharing opportunities.
- 7.2.12. Further to this, imbalances on the volumes of regional freight means that there is a steady flow of product in one direction but fewer suitable backloads. This is true for movements between Scotland and England, where there are significant flows of southbound manufactured goods and food but smaller volumes of retail goods in the return direction.
- 7.2.13. Understanding the limitations of the product type is an important factor when considering the ability to load share and reduce empty or under capacity running. A large proportion of loads ‘cube-out’ or ‘floor-out’ before they reach the maximum weight limit, therefore the Continuing Survey of Road Goods Transport (CSRGT) may not be providing the full picture of empty running, give it uses weight as the measure of capacity. This is discussed within Chapter 7 and as part of the Evidence Report.
- 7.2.14. Load security is cited as a concern in the DfT’s collaboration study (TRL, 2017), this may be actual risks such as Ministry of Defence freight movements, or confidential paperwork. Other concerns may be more about perceived risks of sharing loads that are borne out of competitive issues.

SEASONAL FACTORS

- 7.2.15. Increased capacity not yet matched by demand (which results in needing some slack to deal with peaks and troughs) or due to seasonality so that excess capacity is created in off season. This could be combined with poor vehicle choices that mean larger vehicles than needed have been bought causing excess capacity. The issue of anticipated demand is a potential short-term result of empty running, however, poor vehicle choices could have a longer lasting impact, until new vehicles can replace the purchased vehicles.

COLLABORATION

- 7.2.16. Maximising loads requires businesses to collaborate to fill empty space. Building trust between supply chain partners can be a reason why collaborative working for mutual benefit may not be undertaken. Concerns that

the distribution of costs and benefits achieved through collaboration are not fairly apportioned. This idea is supported by the CO3 Project which identified custom and practice is a limiting factor and it may be the introduction of an independent third party could help overcome the issues of trust and management time.

- 7.2.17. Often a lack of collaborative interventions (such as backhaul and consolidation) are due to a lack of common standards of load description, in particular the availability of weight and volume data would enable more collaborative ventures to form. National standards for road freight data could facilitate collaboration and provide a more robust foundation for the calculation of logistics efficiency and more meaningful insights into best practice (Greening P. , 2015). Transparency and timely access to data creates a disconnect between parties within supply chains, preventing an agile supply chain and one that allows for driving efficiencies through for example reducing empty running (Davis, 2011). This was also reflected in the ability to have comparable IT systems, especially when considering the ability of SMEs to share data (TRL, 2017).
- 7.2.18. The DfT collaboration study found that collaboration could be anti-competitive and therefore businesses may avoid collaboration so as not to contravene competition law. The CO3 project investigated this issue and found that the EU law condones collaboration, if it benefits consumers and the wider community (TRL, 2017). Aside from the CO3 project, companies have in the past found it difficult to agree on the fair distribution of costs and benefits of collaboration. Recent discussions on smart contracts which Blockchain technology enables highlights an opportunity where security of information and greater transparency and sharing of data may be on the horizon (Warehousing News, 2018).
- 7.2.19. In conclusion the barriers to empty running are broad, but there are interventions which could facilitate the removal of these barriers. The issues identified above are in line with the Institute of Grocery Distribution's (IGD) Efficient Consumer Response (ECR) White paper (IGD, 2015) into reducing wasted miles. They interviewed IGD members and summarised a number of different barriers to better collaboration and reducing transport miles which reflect the key issues identified here, ranging from trust, concern over customer service, risk, lack of data and legal constraints.
- 7.2.20. The DfT Freight Industry Collaboration Study concluded that whilst there are some examples of how these barriers are being overcome, this tends to happen in silos and driven by specific initiatives (TRL, 2017). It may be that more fundamental changes within the industry need to happen to make the reduction of empty running easier, advantageous to all and more systematic which will in turn have a positive impact on the wider congestion issues.

7.3. INTERVENTIONS

- 7.3.1. As noted previously there are two main ways to reduce the number of vehicles – increasing the size of vehicles (or trains), and making better use of the space on vehicles or trains. In this section the study aims to look at interventions designed to reduce the number of vehicles used to move a given volume of freight. There are a number of interventions that are included under this heading:

Road: Increasing size

- Heavier HGVs
- Longer HGVs
- Higher cube HGVs

Road: Better utilisation of capacity

- Alternatively-fuelled HGVs
- Back and forward hauling
- Consolidation centres
- Construction Logistics Plans (CLP)

- Delivery and Servicing Plans (DPS)
- Distance based HGV charging
- Freight exchange
- Freight Quality Partnerships (FQP)
- Logistics network planning
- Optimising vehicle choice
- Parcel/Personal delivery management
- Wider supply chain solutions

General interventions in capacity utilisation

- Blockchain, smart contracts, payments and tracking
- Digital marketplaces for freight
- Tracking data / Internet of Things

Alternative modes

- Tunnels and pipelines

7.3.2. There are some interventions that the analysis suggests could be more effective than others. The following have been identified as the key interventions for consideration:

7.4. LARGER VEHICLES

7.4.1. The Dashboards include consideration of longer, heavier, and higher cube lorries. Each of these solutions has some common limitations:

- A large percentage of lorries are already not filled to their capacity, so a capacity increase would be of no benefit – and as capacity grows, the proportion not filled to capacity would also grow
- Vehicles which are full may be full in terms of payload, cube, or surface area, and so any one solution would not meet all of the opportunities
- Each solution has significant barriers including the cost of infrastructure investment and safety or public acceptance concerns.

7.4.2. Of the three solutions, Longer Semi Trailers (LST) has been the most researched and evidence suggests that widespread introduction could be beneficial.

LST DESCRIPTION

7.4.3. DfT began a trial of longer semi-trailers (LSTs) for articulated goods vehicles in January 2012. The operational trial aims to see if using longer semi-trailers brings about anticipated environmental and economic benefits. The trial is expected to save over 3,000 tonnes of CO₂ with overall economic benefits estimated at £33 million. The trial involves longer semi-trailers of that are up to 2.05m longer than the current standard semi-trailers on roads (15.65m instead of 13.6m). The trailers must operate within the UK's existing domestic weight limit (44 tonnes for vehicles of six axles).

IMPACT

7.4.4. By allowing for longer vehicles payload would increase, effectively reducing the number of vehicles needed to undertake the same tasks.

EVIDENCE

7.4.5. In the first five years, 1775 LSTs were involved in the trial, operated by 161 operators undertaking 2.6 million journey legs covering 319 million km (Brand, 2017).

7.4.6. The following data is from the 2016 LST Annual Report. The 2017 report is due to be published but at the time of writing was still being drafted. The impact on congestion can be derived from key material gathered by the LST trial:

- The trial estimated that 125-150,000 legs / 15-18 million km were 'saved'.
- 34% of all vehicle km used 100% of the extra length used, and 50% used some of the extra length.
- 18% of km were empty legs vs 29% national average (Brand, 2017).

7.4.7. It is worth noting that the results are not based on a stratified sample of the UK freight industry. The Autumn results which involve even larger numbers of vehicles will reflect that.

7.5. BACK AND FORWARD HAULING

DESCRIPTION

7.5.1. *"Backhauling to reduce empty running - the objectives of this is to minimise the amount of empty running through returning from a delivery with a load. An extension of this may be "forward hauling" where a vehicle is empty whilst 'en-route' to pick up a load and therefore the objective of forward hauling is to reduce the amount of time this leg of the trip is empty"* (TRL, 2017). It can be used to fill completely empty loads or filling under capacity. This can be arranged within the supply chain of one company, between organisations independently, or using a third-party freight exchange. Consolidation represents a natural extension to backhaul operations and can be undertaken with or without out consolidation centres or freight exchanges. Effective route scheduling/planning is an enabler to allow for opportunities for backhauling and consolidation

IMPACT

7.5.2. The DfT Industry Collaboration study estimated that savings of between 1 and 5% in mileage could be achieved using back and forward hauling, implying a reduction in empty running, but potentially having a positive impact on congestion (TRL, 2017).

EVIDENCE

7.5.3. Whilst 29% of vehicles are quoted to run empty, studies have shown the actual potential to reduce this percentage is low due to issues such as load incompatibility, or short journeys making backhauling uneconomic. For a short journey it is usually more efficient to return directly to the origin to collect another load. For a longer journey it is more worthwhile to drive a short distance after unloading to find a return load.

7.5.4. McKinnon and Ge concluded that approximately 2% of empty journeys could be backhauled resulting in a 2% reduction in kilometres driven (McKinnon & Ge, 2006).

7.5.5. In contrast, research by Starfish identified a perceived opportunity to reduce kilometres driven by 7.9% through backhauling (Palmer and McKinnon, 2011). This could be achieved if time constraints were relaxed, permitting a greater coordination of delivery and pickup windows and hence greater exploitation of backloading opportunities.

7.5.6. Outside of grocery, Fast Moving Consumer Goods (FMCG) and construction there is little evidence of the extent to which other industries can back and forward haul. Larger organisations undertake this systematically within their own supply chains often, as do hauliers who need to make money on every leg. However, there are fewer opportunities for Small and Medium Sized Enterprises (SME).

7.5.7. Effectiveness is also impacted by the level of data gathered and sharing. This activity is often undertaken because of and in combination with other interventions such as consolidation centres, freight exchanges, and retiming and could be enhanced by new technologies such as blockchain, route planning and optimisation and data sharing. Respondents of the FTA survey also reported that more efficient deployment of their core fleet on existing flows is the most effective way to reduce empty running, followed by collaboration with suppliers.

There are many examples of where this is being undertaken, together with a vast array of technology available to facilitate this.

- 7.5.8. As part of the back and forward hauling process, 55% of IGD's survey responders said that sharing trucks was in the top three opportunities to reduce miles and 42% of retailers and 32% of suppliers in IGD's survey suggested that sharing transport is the biggest opportunity to reduce costs and improve efficiency (IGD, 2015). This then could mean a reduction in empty running.

BARRIERS

- 7.5.9. This is discussed in detail in section 7.2.

7.6. DISTANCE BASED CHARGING

DESCRIPTION

- 7.6.1. The concept of charging lorries a tax or toll based on distance (potentially among other factors) is intended to address a range of issues including:
- Anticipating a move away from fossil fuels with their associated taxes
 - More accurately reflect the costs imposed by HGVs
 - Creating a level playing field between UK and overseas based vehicles
 - Encouraging modal shift over longer distances
- 7.6.2. Depending on the level of charge, a distance based tax might increase the cost of road freight and so encourage more sharing of loads and improved utilisation. A tax which included higher costs at times of congestion or in areas of high congestion could also move freight journeys, reducing peak congestion.

IMPACT

- 7.6.3. There is evidence to suggest (as well as anecdotal support through discussions with the Challenge Panel) that the introduction of a sophisticated form of HGV distance-based charging (combined with removal of other road based taxation) could change the way in which operators pass on costs of freight to their customers. While distance based charging would meet strong resistance from hauliers, there is evidence that application of charges which are higher in congested areas could encourage a reshaping of supply chains that better reflect the full cost of transport including impacts on congestion.

EVIDENCE

- 7.6.4. There is an argument that HGV's specifically should be targeted because of the disproportional impact of maintenance on road infrastructure. For example, it is argued that, theoretically, the heaviest HGV axle does over 150,000 times more damage than a typical car axle (Campaign for Better Transport, 2014). Freight industry commentary suggests road charging is an effective means to manage the cost of road infrastructure, however, it needs to be combined with offsetting other kinds of HGV tax reduction.
- 7.6.5. This may reduce congestion, but must be balanced against deviance by operators and drivers to avoid charging by partially obscuring number plates etc (Challenge Panel, 2018).
- 7.6.6. McKinnon (McKinnon P. A., 2006) has produced several papers in response to the UK proposal in 2005 to introduce lorry road user charging (LRUS). He questioned the effectiveness of the proposal based on:
- HGVs make up only a low percentage of total traffic on UK motorways
 - Current technology would only allow a uniform distance based charge; congestion levels vary considerably by location and time
 - Opportunities to reschedule freight journeys may be more limited than expected.

BARRIERS

- 7.6.7. Acceptability with all stakeholders would be a significant barrier and cannot be applied in isolation, so it needs to be considered as part of a reform of the HGV tax structure.

7.7. FREIGHT QUALITY PARTNERSHIPS (FQP)

DESCRIPTION

- 7.7.1. FQPs work to develop a shared understanding of freight, delivery and servicing issues between different organisations. The FQPs aim to promote constructive local solutions that reconcile the need for access to goods and services and the economic benefits that brings together with environmental and social concerns. There is no standard format and can take slightly different forms.

IMPACT

- 7.7.2. FQPs have a high level of acceptability and there are examples of where they have been effective to implement other interventions (such as the North East, Newton Abbot Area, Reading, Northants Logistics Forum) and would be a cost-effective means by which to encourage collaboration across industries and in turn reduce congestion. Implemented on a regional basis, FQPs support a regional approach to congestion mitigation, which may be more effective in reducing traffic than applying an FQP to a smaller geography.
- 7.7.3. FQPs can be used to encourage best practice, many of which have the potential to reduce congestion. This can include for example facilitating:
- Route scheduling/planning that allow for more efficient supply chains
 - Backhauling to reduce empty running, through developing collaborative relationships or the promotion of freight exchange
 - Use of HGV specific planning tools or traffic information tools provide real time and short term predictive traffic conditions and incidents allowing diversions that can support HGVs
 - Use of vehicle telematics to improve driving standards, fuel efficiency, safety and potentially reduce insurance premiums
 - Adoption of safety feature improvements such as encourage quicker roll-out Advanced Driver Assistance Systems for HGV
 - Driver training to improve safe standards.

The impact of FQPs centres around a more collaborative approach to local or regional logistics operations, that may not have happened if the FQP were not operational.

EVIDENCE

- 7.7.4. There is little or no published evidence of how FQPs and the adoption of best practice schemes specifically reduce congestion. However, improved vehicle utilisation is a key feature of logistics Best Practice and as such these schemes encourage efforts to reduce congestion. The University of Westminster undertook a survey of the effectiveness of FQPs and concluded:
- FQPs can potentially lead to actions and policy measures that would never have been contemplated if the FQP had not existed such as retiming of deliveries
 - In the case of policy issues, FQPs can potentially result in better policy measures being devised and implemented than would otherwise have been the case for example the timing of roadworks
 - Allen points out that FQP members can (if consulted) also potentially help to identify the unintended consequences of regional or local government action (Allen. J et al , 2010) such as junction changes.

- 7.7.5. Therefore, while the specific effectiveness of FQPs in reducing congestion is unevidenced, they can act as an enabler for other interventions to be implemented within industry.

BARRIERS

- 7.7.6. The main barrier is the effective management of the groups with the provision of resources to make sure they contribute to creating local solutions and ensuring industry buy-in by delivering valued benefits.

7.8. FREIGHT EXCHANGES

DESCRIPTION

- 7.8.1. A freight exchange is an online service for haulage companies, logistics providers, freight forwarders and transport companies. Freight exchanges create platforms where opportunities for backhaul can be shared, complementing more formal and permanent arrangements between companies. Recent developments in freight exchanges is the launch of “Uber Freight” who claim to provide a faster, more accessible and transparent approach to back and forward hauling.
- 7.8.2. Modern freight exchanges use artificial intelligence and big data techniques to anticipate and optimise opportunities to fill vehicles. As such they are a step forward from traditional load sharing platforms, which started as little more than online listings.

IMPACT

- 7.8.3. DfT freight collaboration study estimated that savings of between 1 and 5% in vehicle mileage could be achieved using freight exchanges, implying a reduction in empty running, and potentially having a positive impact on congestion. (TRL, 2017). This low level of impact reflects the difficulty of achieving collaboration given the diversity of commodities, routes, vehicles, and competing businesses.

EVIDENCE

- 7.8.4. Research by TRL reported that improved collaboration through freight exchanges was enabling members to reduce empty running on average to just 9 per cent, compared with an industry average of around 27 per cent (TRL, 2017). TfL’s Freight Operator Recognition Scheme (FORS) suggest that “The benefit of collaboration for FORS members is the chance to reduce their empty running by around 60%, extend their real-time network capacity, and get lower cost access to TEG services, such as Haulage Exchange”. (FORS, 2018). These apparently high numbers reflect that businesses who join freight exchanges are likely to be those actively seeking to fill empty space.
- 7.8.5. Molden, who founded Emissions Analytics, commented in an article in The Pan European Transport and Logistics Magazine: *“Load matching platforms which facilitate consolidation are unambiguously a good thing. Through collaboration, members using them are burning less fuel and emitting fewer greenhouse gases in the atmosphere. Even if maximising the loads carried by each vehicle increases CO₂ emissions, if the empty miles saved more than compensates for the higher laden journeys, then operators using collaborative platforms will continue to do so”* (Pan European Transport and Logistics Magazine, 2017).

BARRIERS

- 7.8.6. Technology is starting to enable the further progression of easy to use platforms for Freight Exchanges which may allow for the benefit of Freight Exchanges to be shared with all parties, including SME’s. One barrier is the cost of setting up a high participation exchange, and so supporting the development of this solution through technology may bring costs down.

- 7.8.7. Another barrier is a lack of common standards to quantify empty space. Different businesses use different measures, such as cages, pallets, tonnes, or cubic metres. For this reason, many freight exchanges still focus on filling empty vehicles with back loads rather than finding part loads.

7.9. ANALYSIS OF INTERVENTIONS

- 7.9.1. There is a clear combination of interventions that can be used to maximise payload and there is an argument that much of this is driven by the economics of the freight industry and a desire to maximise profitability. However, there are areas where external intervention could be undertaken to facilitate further improvements, although this is likely to be incremental improvement rather than a radical overhaul of an industry that already manages its operations to gain efficiency benefits at the same time as meeting customer needs.
- 7.9.2. The Institute of Grocery Distribution (IGD), under the Efficient Consumer Response (ECR) programme have undertaken extensive research into wasted miles and their research is key to this section. They note that there are five areas that *“work together to point to a future with a step change increase in collaboration, spreading of risk and more intelligent and responsive decisions leading to fewer wasted miles”* (IGD, 2015). These areas include: shared services, flexible flow, data, tailored transport and streamlined stock. The White Paper notes that certain business strategies, such as the move to smaller convenience stores, may increase miles but that the aim of their work is to make delivering these business strategies as efficient as they can be rather than hindering growth by advocating that the move to convenience stores (and smaller, more frequent vehicles) should be in some way reversed.
- 7.9.3. What is clear in reviewing the evidence of effectiveness in dealing with congestion is that take up and cost is very sensitive to individual industries, companies and even regions. What works for one company is no guarantee of success for another. IGD’s research indicated that whilst there are barriers to change, *“reducing road miles is widely recognised by the industry as offering significant opportunities for costs savings with 14% of businesses identifying it as their biggest cost saving opportunity”* (IGD, 2015).
- 7.9.4. Based on the above assessment (full assessment can be found in the Appendix and the Evidence Report), research suggests there is not one single intervention that will have a significant impact and in fact a complex mix of interventions are required to have a material impact on congestion; some interventions also have a dependency on others. The literature review highlighted that one solution will not always work in all circumstances and therefore, decision makers will need to consider the appropriate interventions for the area being considered, both based on the nature of the prominent industry types and the external factors that are causing congestion in the area.
- 7.9.5. Encouraging backhauling / forward hauling appears to have the greatest acceptability, although many of the big wins for organisations may have already been realised. However, in urban environments or for SME’s external support for back / forward hauling could bring further congestion benefits to deal with the more challenging areas of underutilisation of vehicles. A key enabler for this could be consolidation, but this still needs to be explored to understand the limitations of their use in certain areas. This is discussed further in this section. Freight exchanges, again while having been implemented through existing private enterprise, do have the potential for further development, to make further incremental inroads into improving vehicle capacity. This may be through public facilitation for the SME environment or supporting the development of data standards for better sharing of information to allow for greater load sharing.
- 7.9.6. Alongside consolidation centres and back / forward hauling, the most appropriate use of vehicles is shown to be an important consideration in reducing vehicles on the road. Consolidating loads allows for potentially larger vehicles to be better filled inbound and then smaller vehicles that are more suitable to the outbound journeys. Examples may be smaller, quieter vehicles to be used for retail deliveries in residential areas and therefore enabling ‘out of hours’ deliveries at less congested times or that may assist the delivery of other environmental objectives for example, the use of cargo bikes. Cargo bikes may have a limited impact on large

scale urban deliveries, but they could help in city environments to have a positive impact on air quality perhaps more so that the congestion itself.

- 7.9.7. Building on the above, evidence also suggests that the needs of the urban environment may require additional considerations to reduce vehicles on the network. Initiatives such as CLPs and DSPs introduce businesses to a package of measure that could have significant benefits on congestion in specific geographies. Whilst the evidence is limited to the degree to which these impact congestion, this may be more because of a lack of current use rather than not being effective. Two considerations need to be made at this point, in that the DSPs and CLPs in themselves are not a means to reduce congestion, but the implementation of the resulting actions is. Therefore, important to their ongoing effectiveness is the quality of the plans, the degree monitoring of their implementation and the training of those both designing the plans and those monitoring them (such as Local Authorities).

7.10. SUMMARY

- 7.10.1. Some increase in the size of HGVs may have a small impact on congestion. Key to increasing average payloads per lorry is improved collaboration in a number of ways, including through more use of consolidation centres, the use of freight exchanges, standardisation of measures of load and capacity, and extensive use of technology and data to provide transparency.

8. USING ROADS MORE EFFICIENTLY

8.1. INTRODUCTION

- 8.1.1. Using roads more efficiently means minimising any impact of freight on congestion within a fixed road network and moving a fixed number of vehicles.
- 8.1.2. Just as freight operators and their customers will naturally work towards increasing payloads and reducing unnecessary movement of goods, businesses will also try to avoid using roads and railways at peak times. This is a key way of making efficient use of networks. Other ways include, changing operating practices, and using new vehicle technologies which allow vehicles to travel closer together.
- 8.1.3. Market trends such as the increasing demand for same day or just in time delivery can run contrary to delivering efficient use of road space, with deliveries to shops and construction sites forming a significant percentage of morning peak traffic in most cities. Furthermore, as congestion spreads beyond the peaks into longer periods of the day, many businesses now accept congestion as an unavoidable cost and send vehicles onto the roads at all times of the day, potentially maximising vehicle utilisation.
- 8.1.4. Earlier Chapters showed evidence that 42% of HGV traffic moves at night on some sections of the motorway network, with only 11-12% in the morning peak two hours. Conversely, data from London suggests that 24% of deliveries into London by HGVs took place during morning peak hours.
- 8.1.5. A study undertaken by Southampton University and the University of Westminster, 'Understanding urban freight activity – key issues for freight planning' (Cherrett et al, 2012) used information gathered from some 30 UK surveys undertaken over the last 15 years. It aimed to provide planners with an understanding of road-based urban retail freight transport activity.
- 8.1.6. The findings suggested that the 06:00 to 12:00 period generates the most urban delivery activity with 49% of 2178 recorded delivery times relating to a morning delivery before 12:00, often during the morning peak congestion period. In addition, service vehicle activity is a significant contributor to commercial movements and often requires vehicles to be parked close to the premises being served and during peak hours.
- 8.1.7. Another survey for TfL of activity at 12 construction sites in London found that, typically, 25% of construction site deliveries take place during the morning peak. This is partly due to night time restrictions on construction work. (AECOM , 2017)
- 8.1.8. Freight journeys during peak hours are one example of inefficient use of network capacity. Other examples include:
- Poor routing and scheduling, resulting in wasted mileage
 - Driver behaviour adding to road capacity occupied by HGVs (e.g. over defensive driving, or lane switching)
 - Significant involvement of HGVs in accidents and disruption of the road network.

8.2. BARRIERS USING THE NETWORK MORE EFFICIENTLY

- 8.2.1. Logistics businesses prefer to use roads at night when there is less congestion. This is true of urban areas as well as on strategic roads. However, there are significant barriers to making more use of night time capacity including:
- Strategic and main roads
 - Disruption caused by major night time closures for road works
 - Customer demand and other constraints requiring day time deliveries or collections
 - A desire to keep vehicles utilised, sometimes by using 2 shifts of drivers per vehicle to allow trucking to take place day and night

- Urban roads
 - Customer constraints, notably delivering when staff are present
 - Local restrictions on night time deliveries for certain premises
 - Night time bans such as the London Lorry Control Scheme
 - Restrictions on night time work on construction sites, compounded by construction industry practices.

8.3. INTERVENTIONS

8.3.1. There are number of interventions that relate directly to more efficient use of the network. Some of these can impact both the strategic and urban environments as well some the urban environment. The following lists the interventions considered and set out in the Dashboards to help use the network more efficiently:

Road

- Cargo bikes
- Congestion charging - urban
- Delivery management systems
- Fleet recognition schemes
- HGV road speed increase
- Improved roadworks information
- Incident management – infrastructure
- Lorry parking
- Night time trunking
- Reduction of HGV restrictions

Technology

- Application of Artificial Intelligence (AI)
- Autonomous HGVs
- Autonomous Vehicle Society of Automotive Engineers (SAE) Level 2: Advance Driver Assistance Systems (ADAS)
- Connected vehicles and corridors
- Data sharing from telematics
- Delivery droids / pavement devices
- HGV platooning on the SRN
- Incident Management -eCall

8.3.2. As with the previous analysis on reducing vehicles, research suggests there is not one single intervention that will have a significant impact and in fact a mix of interventions are required to have a material impact on congestion. One solution will not always work in all circumstances and therefore, businesses and government will need to consider the appropriate interventions for their business or area. Whilst developing local solutions for local problems is key to congestion management, research in some areas, such as congestion charging, and fleet recognition schemes suggest that there is a need for central guidance to ensure that there is consistency on methods and application across the UK. That said, there are some interventions that the analysis suggests could be more effective than others. The following have been identified as they key interventions for consideration:

8.4. AUTONOMOUS VEHICLE SAE LEVEL 2: ADAS

DESCRIPTION

8.4.1. Advanced Driver Assistance Systems (ADAS) are used to describe active safety systems on a vehicle that can identify safety-critical situations and act, either automatically or by sending warnings to the driver. ADAS

systems use sensing technologies such as cameras, radar and laser technology referred to as lidar. This technology also supports connected and autonomous vehicle systems and are typically regarded as SAE Level 1 and 2 type systems. ADAS systems can aid freight congestion by reducing the frequency and severity of accidents thereby reducing delays caused by reduced capacity as a result of these situations.

IMPACT

- 8.4.2. Alongside the avoidance, the management of incidents can have a significant impact on congestion. Incidents on the SRN are an unfortunate occurrence and can number up to 350 daily. 85% of these incidents are cleared within 60mins however some can take five or more hours to clear. In 2016 incident related delays cost UK Plc an estimated £9billion. A large proportion of this cost will be attributed to the freight vehicles through missed delivery slots, time sensitive loads and perishable goods. Therefore, improved incident management processes focused on the freight haulage industry could have a significant positive impact to reduce incident related congestion, contributing to a free-flowing network and improving journey time reliability.

EVIDENCE

- 8.4.3. The evidence on the success of ADAS is significant enough to make the fitting of some this technology mandatory for new vehicles since 2014. However, this is predominantly on a safety related benefits case. The main benefit and impact on freight congestion is because of the expected reduction in frequency and severity of accidents therefore freeing up road network capacity that would otherwise have been reduced due to sever accidents including freight vehicles.
- 8.4.4. The evidence is generally strong in terms of the safety benefits of these technologies.
- 8.4.5. In 2018, WSP analysis of Highways England critical incidents, (Wickenden, 2018) identified that 36% of all critical incidents involved HGVs and of these 43% lasted between 5-10 hours. This analysis also noted that of the 8 fatal Road Traffic Collisions (RTC) that have occurred following nearside lane vehicle stops on smart motorways since 2014, 6 have involved HGVs colliding with the stopped vehicle and 1 has involved a PCV doing so. This is despite HGVs making up only 11% of traffic on motorways in Great Britain. (Wickenden, 2018)
- 8.4.6. In 2014, TRL carried out in-depth investigations for Highways England into most of the fatal crashes on England's strategic road network (all England's motorways and most of its A roads), using crash investigation teams. TRL estimated how many deaths in these fatal crashes would have been prevented if certain ADAS systems had been mandated, and as a consequence the resulting congestion. TRL concluded:
- More than a third (34%) of deaths studied could have been prevented if ADAS had been mandatory on all vehicles, and (TRL, 2015)
 - One in seven (14%) could have been prevented if advisory Intelligent Speed Adaption (ISA) had been mandatory (TRL, 2014).
- 8.4.7. Other transport academics have also estimated reductions in deaths through fitment of ISA. It has been estimated that nearly one in three fatal crashes could be prevented by ISA.
- 8.4.8. The role of technology is discussed in more detail in Chapter 10.

BARRIERS

- 8.4.9. The time to increase the penetration rates to levels which will show significant benefit is lengthy. This is primarily due to the cost of upgrading freight vehicles.

8.5. HGV PLATOONING

DESCRIPTION

- 8.5.1. Road trains – where a single tractor unit will pull multiple connected trailers – are a concept widely used in some countries such as the USA, Canada, Australia, and in Scandinavian countries in Europe – i.e. those where vast distances need to be travelled (IGD, 2015).
- 8.5.2. In the UK a study into the opportunities of HGV platooning (the linking of leading and following vehicles through connected vehicle technology) is currently underway.

IMPACT

- 8.5.3. A feasibility study into undertaking a trial was undertaken in 2014 and highlighted that platooning is predicted to bring about significant benefits in terms of safety (casualty reduction), real-world fuel efficiency, emissions (lower CO₂), road capacity and congestion (more efficient use of the road space leading to improved traffic flow), and driver convenience. It also identified risks to other users which included:
- Distraction of other road users
 - Negative influence on driving behaviour of other road users
 - Obscuration of information for other road users (signs, markings, etc.)
 - Difficult to overtake
 - Prevents other road users from exiting the motorway at desired junction
 - Motivation of dangerous driving manoeuvres (e.g. pulling ahead of platoon/in the middle of platoon) which could have associated impacts on capacity and congestion (TRL, 2014).
- 8.5.4. The feasibility study also suggested that if limited to five vehicles, there would not be an impact on infrastructure, but that if platoons were formed on motorways longer platoons could be used without impact on the infrastructure. The issue of slip roads, prevailing road conditions, impact of roadworks, toll booths, tunnels and bridges with specific weight restrictions would need to be considered as part of the future trial. This implies that there could be an impact (TRL, 2014).
- 8.5.5. Industry support within the UK is mixed, with the Road Haulage Association (RHA) (2017) of the belief that the characteristics of the UK Strategic Road Network (defined by character of road network, length of stretches uninterrupted without junctions) and the routings linking to warehouses and delivery destinations (i.e. short usage of SRN) are not particularly suitable for platooning and therefore a trial on the network is essential (Road Haulage Association, 2017).
- 8.5.6. Meanwhile, Ash et al. released a report on the potential for automated freight corridors identifying a strong economic rationale for Highly Automated Vehicle (HAV) deployment with a number of corridors identified, although ironically the best corridors are those already with the lowest congestion and highest throughput (Ash et al., 2018).

EVIDENCE

- 8.5.7. In 2017 the DfT commissioned research to identifying the issues and risks of a UK road based trial of truck platooning technology.
- 8.5.8. In a report by Kotte et al., potential efficiencies to overall traffic flow of platooning are shown, but the need for high penetration and long length platoons is also highlighted (Kotte et al., 2012). Similarly, in 2014, in a study for the Department for Transport, Harwood and Reed showed that for a UK style road, HGV platooning needed 50% of HGVs to be equipped with the technology to gain a 2% increase in capacity.
- 8.5.9. Although it has been deemed possible to measure the effectiveness of platooning, reporting of the impacts of platooning on congestion from trials has been limited. The potential benefits of platooning on traffic flows have

been simulated, however at present actual trials are focused on ensuring the technology is safe and works well on the roads. The Heavy Vehicle Platoons on UK Roads Feasibility Study for the Department for Transport in turn states that “parameters such as ...congestion cannot be realistically measured in a trial”, questioning how reliable reporting of effectiveness of platooning can be (Ricardo, TRL & TTR, 2014).

CONCLUSION

- 8.5.10. Studies of platooning are at a very early stage, and it will be a long time before impacts on congestion and road capacity can be understood. Currently, the evidence available suggests that benefits may be limited by take up, the lack of suitable stretches of road, and potential negative impacts on other road users. However, this technology is developing, and other benefits such as reducing haulage costs may be more significant than congestion benefits.

8.6. REDUCTION OF HGV RESTRICTIONS

DESCRIPTION

- 8.6.1. HGVs face a plethora of restrictions to the roads they can use and the times that they can operate. These include road restrictions and delivery restrictions. Planning a schedule to avoid restrictions, particularly in urban areas, can lead to longer journeys or unintended consequences such as more peak time traffic. The following is list illustrates the type of HGV restriction, and the reasons they are introduced:
- Time/Noise restrictions implemented to protect residential areas – these can be planning restrictions, voluntary restrictions, planning or noise abatement notices.
 - Weight and width restrictions implemented to protect infrastructure or sometimes to deter larger vehicles from residential or other unsuitable streets e.g. Lorry Control Schemes
 - Customer restrictions created by customers limiting operating times, stock requirements, labour restrictions
 - Road space restrictions e.g. bus lanes, kerb space, delivery bay availability
 - Speed restrictions implemented for safety reasons
 - Congestion charging intended to encourage goods vehicles to avoid areas or enter at different times
 - Ultra-Low / Low / Zero Emission Zones – designed to address areas where there is a serious air quality problem.
- 8.6.2. While many of these restrictions are desirable and effective, in combination they can have negative impacts on congestion. Removing, reducing, or coordinating restrictions would allow operators to use the network at times appropriate for their businesses (and avoiding congested times), reducing peaks and troughs and using vehicles sizes and weights suitable to their needs. In addition to helping businesses using the network more efficiently, removing restrictions could be used as a means to encourage collaboration, as an example priority access could be given to high utilisation vehicles or vehicles delivering to or from consolidation centres or rail terminals.

IMPACT

- 8.6.3. In the areas where restrictions on HGV are in place, the reduction of them could have a general positive improvement on congestion, which in turn will help freight congestion. This is particularly the case where deliveries are taken out of peak times thereby reducing congestion for time critical deliveries and vehicle movements. More than 90% of London's freight is transported by road. In the morning peak (07:00-10:00) deliveries and servicing vehicles account for about one-third of all traffic. Avoiding these times can benefit businesses and the local area. This position is reflected in other urban centres as well as logistics centres such as ports or concentrations of distribution centres, rail freight interchanges – anywhere where time restrictions are imposed. Accelerating delivery reception processes at factories, warehouses and shops can reduce these times, increasing the number of drops or collections per delivery and thereby cutting the number

of trips. It has been noted that removing access restrictions on permissible delivery times would make it possible to reduce greenhouse gas emissions by up to 7% (P Greening, 2015).

- 8.6.4. Fewer restrictions would make delivering easier to plan, and would allow for a more flexible approach to when deliveries are made (i.e. could be made at night). Vehicles would have more flexibility on time of day and could plan more direct routes. A particular issue is differing restrictions in neighbouring areas, making efficient planning very difficult (TRL, 2017).

EVIDENCE

- 8.6.5. There is much case study evidence to suggest the impact on congestion, this is discussed in detail in the Dashboard, however, enabling operators to extend delivery times/relaxing just in time pressures and reschedule deliveries to inter-peak periods and evening / night, represent the greatest potential for reducing CO₂ savings according to Greenings modelling (P Greening, 2015). The implication is that a reduction in CO₂ is achieved through smoother and quicker travel during less congested times. From an overall congestion perspective this moves vehicles away from peak times. The impact of relaxing time constraints is difficult to predict as the benefit amplifies the effect of other logistics improvement measures which have already been implemented. However, it was assumed that relaxing time constraints would reduce the kilometres driven by 3% (P Greening, 2015).

BARRIERS

- 8.6.6. There are a complex range of barriers to reducing HGV restrictions, often because restrictions are imposed that try to balance the needs of different stakeholders, for example, overnight delivery restrictions are in place to protect the amenity for local residents, or lorry bans to reduce noise and vibration in certain areas. This means the removal of them can be a long process negotiating between different parties. That said, there are, as detailed in the Dashboard, examples of where this has happened. Other areas which are perhaps more challenging are the cultural barriers, where customers place restrictions because of perceived labour issues or security issues of delivering at night for example.

8.7. LORRY PARKING

DESCRIPTION

- 8.7.1. The lack of lorry parking is one of the challenges facing the freight industry: The impact on congestion is the resultant inappropriate parking on roads which in turn cause access issues. The DfT identified “an immediate need” for more than 1,400 new parking spaces in critical areas of the country (DfT, 2018). In addition, having adequate provision at distribution parks, ports and urban centres can contribute to the congestion on the adjacent roads (SRN or local).

IMPACT

- 8.7.2. In key hotspots the lack of lorry parking impacts congestion through the resulting inappropriate parking which can obstruct the highway, or in extreme cases completely prevent the free flow of all traffic. Searching for suitable parking creates unnecessary HGV mileage, as does driving to parking which is not on the most efficient or direct route and can cause delays and cost.

EVIDENCE

- 8.7.3. 18,670 vehicles were found to be parked overnight across England. The total capacity of on-site spaces was found to be 15,012, hence leaving a theoretical excess of 3,658 vehicles that could not park in an on-site space. The following regions have parking that exceeds or is close to exceeding capacity: East Midlands, East of England, North East, South East, West Midlands and South West. The number of HGVs counted making overnight stops on a typical mid-week night has risen from 13,708 (2010) to 18,670 (2017). This represents a

36% increase (4,962 vehicles). In comparison, the total capacity of on-site spaces available in lorry parks or motorway service areas (MSAs) has increased by just 14% to 15,012 (AECOM, 2017).

- 8.7.4. An extreme example of the impact of inadequate lorry parking is the consequences of disruption at the Port of Dover and Eurotunnel in Kent which can lead to significant congestion in that county and further afield. In the event of such disruption, Operation Stack is deployed which queues lorries on the M20 until they can access their ferry or train, closing parts of the motorway to other traffic. However, it has been accepted that this is not an ideal contingency solution particularly given the impact it has on the M20, the surrounding roads, and on people and businesses in Kent (Grayling, 2017).
- 8.7.5. There is little evidence of the impact of the lack of lorry parking and its impact on congestion and therefore the benefit of adding more parking, except on the M20. There is evidence on the impact on local residents and nuisance, however this doesn't extend to published congestion impacts caused by inappropriate parking.

BARRIERS

- 8.7.6. The availability and affordability of land to designate for use as lorry parks has been limited and competes with other needs for land in areas where land is limited (e.g. urban centres).

8.8. IMPROVED ROADWORK INFORMATION

DESCRIPTION

- 8.8.1. While infrastructure providers now plan strategic roadworks well ahead and provide good advanced information, that information is not always used effectively by logistics businesses and truck drivers. Poor use of information on planned roadworks restricts the ability to effectively journey plan (route freight vehicles) and journey time reliability:
- 8.8.2. Roadwork data quality issues are primarily caused by:
- Lack of common use of standards in recording this type of information (noting that standards are available but inconsistently deployed)
 - Complex and long business processes, with a lack of joined up thinking between parties in the value chain.
- 8.8.3. A key issue is the availability of suitable alternative routes, particularly routes which avoid unsuitable areas where large numbers of HGVs come into conflict with local residents.

IMPACT

- 8.8.4. Roadworks are a feature of UK roads to ensure our roads are more dependable, durable and safe, however their management can have a significant impact on congestion and for freight doubly so if the roadworks happen at times critical to them, for example Christmas or at night. Improving the regularity and management of these are key and there are a number of interventions being considered from an SRN perspective, but it is less clear how this is being done at a local level - with the exception of London where efforts are being taken to minimise roadworks. Poor quality information on planned roadworks and alternative routes restricts the ability to effectively journey plan (route freight vehicles) and journey time reliability and so interventions that focus on improving that will have a significant impact on the freight industry.

EVIDENCE

- 8.8.5. More effective management of roadworks may alleviate freight congestion by:
- Enhancing the incentive/penalty regime for on-road contractors – leading to fewer roadworks on the network at any given time
 - Improved Highways England understanding of the core issues affecting freight users and a commitment to considering these issues when planning roadworks

- Improved communication with freight companies enabling freight to proactively plan journeys better and account for the possibility of delays
- Enhanced monitoring regime to track network performance on roadworks and how this affects freight, facilitating more accurate problem identifications and interventions.

8.8.6. However, many of these interventions are unprecedented for Highways England and as such there is limited evidence for their efficacy in England; evidence has been taken from comparable countries and highways regimes including:

- Design: customer-centric guidelines for design are common overseas; the Rijkswaterstaat in the Netherlands adopts a road user-focused network management regime with outcomes such as “Smart Planning” which prohibits roadworks on diversion and parallel routes
- Scheduling: Transport for London is a leader in scheduling via the use of a single roadworks scheduling system and encouraging contractor collaboration in effective use of roadworks space
- Communications: The Dutch Minder Hinder⁴ model has Effective Customer Communication as a core pillar.

8.8.7. A key observation is about the efficiency of roadworks and reducing the time for road closures or reduced lanes. Permitting schemes may be a route improved co-ordinate utility works, thus reducing impact of roads works on the network. An analysis by Ecorys supports this (Ecorys, 2018).

8.8.8. BARRIERS

8.8.9. The barriers to achieving better management is not primarily a technology problem but rather a process one created out of a lack of application of freight needs together with not having the right level of reward or penalty for finishing work on time.

8.9. ANALYSIS OF INTERVENTIONS

8.9.1. Some of the interventions to improve network efficiency relate to reduction of restrictions imposed on logistics operators that prevent them from being as efficient as they could be. These restrictions are considered above and eliminating or modifying these, research suggests, would release potential for operators to be more efficient and there is evidence that supports this. Removing restrictions could be used as motivator for changing other practices – for example the use of urban consolidations centres could be encouraged if, by using them, it would mean users would gain some advantage of less restricted movements. It has also been observed that there are restrictions that are imposed by customers where, if changed, could improve transport efficiency – for example inappropriate delivery times or lead times that generate inefficiency further up the supply chain from a congestion perspective.

8.9.2. Within the context of urban freight, some believe that managing the consequences of different agendas remain a challenge. “*Urban freight is a big blind spot for policy makers,*” Sophie Punte of the Smart Freight Centre said in a recent article. “*Many cities are still measuring their traffic in terms of total number of vehicles, so the impact of trucks just isn’t on their radar*” (Andrews, 2018).

8.9.3. Even when cities consider the matter of urban freight more seriously, there are often large gaps in information and this is where data becomes an enabler to effective interventions. “*When New York started working on its freight plan, they thought there were maybe a few hundred thousand deliveries happening every day in the city, and that they would be clustered around the industrial neighbourhoods. When they actually did a study,*

⁴ A Dutch approach to roadwork management which includes Smart planning, Smart construction, Mobility Management, Traffic Management, Communication, Public-oriented execution, Regional cooperation

they discovered that daily deliveries were in the millions, and that they were clustered primarily around Manhattan.” Such major gaps in understanding make it difficult for cities to come up with strong and evidence based traffic policies, especially when it comes to freight (Andrews, 2018).

- 8.9.4. Technology plays an enabling role in many of the interventions discussed in this report, AI specifically presents a great opportunity to take many interventions onto a more sophisticated level, such as route planning that intuitively works to take vehicles the best route at the time the vehicle is on its journey, dynamically changing to take the best route. While there is a lot of debate that surrounds autonomous vehicles, as an assessment of the impact it may have on congestion is inconclusive and there is a degree of resistance from stakeholders.
- 8.9.5. That said, degrees of automation, such ADAS show there is clear links between that and congestion. Research into HGV platooning suggests a theoretical potential to improve capacity and reliability, but this is unproven and dependent on a high take up (>60%) which currently seems unlikely. There are also concerns about where this technology could be rolled out given the density of junction spacing on the majority of the motorway network within the UK. The role of technology is discussed in Chapter 10.
- 8.9.6. The potential role of technology is discussed in detail in the accompanying Evidence Report.

8.10. SUMMARY

- 8.10.1. Reducing and rationalising restrictions, particularly night time restrictions on deliveries, can lead directly to reduced freight traffic in peak hours. The research illustrates that a wide range of measures undertaken by businesses and government can have negative impacts on using the road network efficiently. Businesses and government should make themselves aware of these negative impacts and consider changes that can improve efficiency.
- 8.10.2. CAV technology has significant potential to reduce accidents and smooth traffic flows, particularly significant for HGVs, but the case for platooning having a significant impact on congestion has not yet been made.

9. INCREASE NETWORK CAPACITY

9.1. INTRODUCTION

- 9.1.1. Increased network capacity can be achieved in a variety of ways including improving junctions, extra lanes, or, ultimately, new roads. These interventions often require long term planning and significant cost. Road network operators have plans for addressing pinch points or, where required, building new roads

9.2. BARRIERS TO INCREASING CAPACITY

ROAD INVESTMENT

- 9.2.1. For roads, most capacity improvements are designed to alleviate congestion or prevent congestion from becoming worse. Congestion can occur at any time of the day, but most often occurs in morning peak hours or whenever traffic is dominated by cars. Demand forecasting for car traffic is sophisticated, but freight is less well understood, and while models predict goods vehicle route changes due to traffic congestion, they often see freight forecast demand for the network as effectively fixed, with growth in line with national trends unless there is evidence of a clear local change in freight demand.
- 9.2.2. Similar limitations apply to valuing the benefits of schemes for car and freight traffic. For cars benefits include fuel and other costs savings, and time savings for all motorised road users. In addition, business cases also tend to include wider economic impacts, which are benefits to the wider economy predominantly driven by reductions in journey times for cars and freight.
- 9.2.3. For goods vehicles, the calculation of journey time savings / costs include fuel and non-fuel cost savings are also assessed. For car drivers, the value of their time is calculated according to journey purpose, whereas for lorry drivers only the direct cost of their pay is included.
- 9.2.4. When it comes to Wider Economic Benefits, models forecast that shorter journeys lead to economic benefits, but most of these benefits come from assessments of improved accessibility to employment for people, rather than goods.
- 9.2.5. Very few highways investments are justified primarily to benefit freight traffic. Exceptions may include providing improved access to ports, and special investments such as providing parking areas for lorries queuing to access Channel ports.
- 9.2.6. An acknowledged challenge for road improvements is that capacity created quickly gets filled by traffic diverting from more congested routes, people transferring from other modes to car transport, or people making car journeys that they otherwise would not have made.

URBAN CAPACITY

- 9.2.7. For urban freight movement, providing more capacity is rarely an option. In fact, with growing populations and workforces, and with cities planning to become better places to live and work, road capacity is being actively reduced. While the main objective may be to reduce car use and encourage walking and cycling, an important effect is to reduce road space for goods and services. This puts even more emphasis on maximising effective use of remaining road capacity.

9.3. INTERVENTIONS

- 9.3.1. The following interventions are considered as means by which capacity can be increased, thereby increasing flow throughput which delivers improved goods throughput. There are a variety of interventions that can enable increased capacity, these include interventions to build new capacity such as addressing pinch points,

widening roads, or building new roads, and interventions to use technology to improve capacity such as Expressways and Smart Motorways.

9.4. ANALYSIS OF INTERVENTIONS

- 9.4.1. The analysis suggests that many of the infrastructure improvements would have a direct impact on congestion – ranging from Smart motorways through to traditional road widening. New roads are unlikely and controversial and therefore maximising the capacity of the existing infrastructure is likely to be the key intervention. Not surprisingly the impact of new or better infrastructure has the greatest collective impact on congestion of all the interventions assessed, though they also remain some of the most controversial with stakeholder acceptance potentially low for some of these interventions.
- 9.4.2. However, none of the interventions reviewed were assessed as being likely to have a significant impact on freight's contribution to congestion above and beyond their general contribution to providing more capacity. Approaches such as smart motorways and expressways have proven benefits in reducing congestion, but these are general rather than freight specific benefits.

10. TECHNOLOGY AND DATA OPPORTUNITIES

10.1.1. This Chapter looks at three areas of progress which have the potential to improve the way that freight traffic is managed and reduce freight impacts on congestion:

- Connected and autonomous vehicles
- Other technological developments
- Improved data availability.

10.2. CONNECTED AND AUTONOMOUS VEHICLES

10.2.1. As part of the study, the NIC requested a review of the implications of CAVs for the freight industry and its operations (i.e. parking space reductions, driverless vans/HGVs). This Chapter provides a review of this area, with much more detail provided in the Evidence Report.

10.2.2. The primary principles of technology change can be summarised as follows:

- Digital connectivity
- Automation (and ultimately autonomous operation)
- De-carbonisation of transport.

10.2.3. Significant investment is being made in these primary areas of transport technology innovation and in the UK policy supports and encourages this innovation and uptake, i.e. Industrial Strategy and Digital Strategy. It is important to remember though that this innovation extends far beyond just changes to vehicles and their use, the connected, autonomous and de-carbonisation agendas have far reaching implications for and logistic applications.

10.2.4. Fundamental changes to the way in which vehicles meet the needs of customers will have wide ranging implications:

Connectivity

- Connectivity between vehicles, networks and operations could provide for enhancing information to improve operational decision making and associated efficiencies
- The increasing application of IT automation and Artificial Intelligence could automate many existing manual functions. Within integrated end-to-end warehousing and logistics solutions AI will inevitably impact traditional operations moving toward on-demand operational models.

Automation

- The introduction of autonomous technologies into freight and logistics operations could result in a seismic shift in existing operational models. The removal of the driver from the system could result in significant changes to drivers' jobs, but consideration will be needed to solve 'last metre' issues
- Platooning operations could deliver some of the benefits of autonomous operations but will still have human control. Operational challenges will emerge with regards to which flows could be viable for platooning operations
- All forms of automation will potentially impact how depots and terminals are arranged with potential improvements in asset utilisation (because of self-parking).

De-carbonisation

- A move to fuels beyond existing diesel applications will have inevitable implications for existing operational regimes. Duty cycles could change in terms of where vehicles need fuelling, and where supporting infrastructure is, thereby disrupting long established commercial models

- There are also implications in terms of the costs of vehicles, comparative energy costs and the cost of new supporting infrastructure on and off the network. These will all impact ultimately impact uptake
- With a move to non-mechanised drive trains (as provided by electric motors) maintenance needs could be significantly reduced thus delivering cost savings and potentially increasing asset utilisation.

10.2.5. Operational implications are likely to be driven by the commercial realities and potential benefits that technology brings over and above traditional solutions. The transition to change is likely to slow (rather than a big bang) but intervention by Government in terms of policy or financial incentives could accelerate change.

10.3. OTHER TECHNOLOGY IMPROVEMENTS

10.3.1. Technology improvements in the logistics industry and supply chains have an overarching role in potentially helping to manage freight congestion or the impact of congestion on freight. Technology is sometimes the driver of change, and sometimes a key enabler for other changes such as operational changes.

10.3.2. In considering the role that technology plays within the freight and logistics sector it is important to consider how these innovations will integrate with existing business models and operations. New technologies such as the electrification of vehicles and the future role of autonomous transport are likely to have major impacts on the nature of freight and logistics operations, how customers (businesses and individuals) interact with vehicles and services and potentially the cost base in terms of human interactions.

10.3.3. There is much investment in technology from a European perspective with the Alliance for Logistics Innovation through Collaboration in Europe (ALICE). ALICE is the European technology platform for logistics, which develops a comprehensive strategy for research, innovation and market deployment of logistics and supply chain management innovation in Europe. Following its mandate, ALICE is providing recommendations for the next Work Program 2018-2020.

10.3.4. ALICE is addressing freight transport and logistics with an integrated perspective in two ways, namely what to transport and how to transport. It addresses areas such as:

- Synchromodal freight transport
- Urban logistics
- Circular economy & logistics
- Integration of transport and manufacturing to build smart supply chains
- Safety and security issues related to goods trade.

10.3.5. Moreover, logistics is a promising field to leverage the full potential of technologies such as Internet of Things, Big Data, Robotics and Autonomous Systems towards increased efficiency and sustainability of European Industry and contribution to sustainability, minimising environmental impacts of freight transport and congestion (Alliance for Logistics Innovation through Collaboration in Europe, 2018).

10.3.6. ITS is often a generic term which can mean anything, but for logistics management it can be integrated into assist in many areas. The Netherlands is seen to be one of the leading lights for ITS use where they have focused efforts on the use of ITS in many ways:

- Optimising the use of road, traffic and travel data
- Continuity of traffic and freight management ITS systems
- Road safety and safety of freight transport
- Integration of the vehicle into the transport infrastructure
- Data protection and liability (Ministry of Infrastructure and the Environment, 2017).

10.3.7. In summary the application of technology in the freight sector could deliver benefits with regards to managing congestion on the road and rail networks. They could improve just in time deliveries and reduce the impacts of movements with regards to other users and neighbours. However, the application of technology should not be

considered in isolation and must be part of wider policy and strategy considerations and where appropriate be built into future programmes. Consideration on where best practice can be seen allows for the progressive use of technology based on shared learnings.

10.4. DATA IN LOGISTICS

- 10.4.1. Management of data in logistics has always been as important as managing the transport of goods for logisticians. Many flow charts for supply chain management show goods flowing in one direction with data flowing between the main activities on the chart.
- 10.4.2. Effective information flows are not only important for the correct positioning of goods, but also for related processes such as invoicing, handovers between contractors, customs or transport documentation, or dealing with insurance and liability.
- 10.4.3. Modern supply chain management is extremely sophisticated and often fully integrated with all the other activities of a business. Scanning a packet of crisps at a supermarket till initiates a chain of actions that ultimately result in a new carton of crisp packets being delivered to replenish the supermarket shelves.
- 10.4.4. Businesses employ a range of tools to manage this information, including, for example, routing and scheduling systems, delivery management systems, warehouse management systems, and fleet management systems. A major challenge and opportunity for all businesses is to integrate these systems better, and to make their data more transparent and useable across their business.

10.5. IMPROVED PUBLIC SECTOR DATA

- 10.5.1. For the public sector, particularly infrastructure planners and operators, freight is sometimes seen as a difficult area to obtain data. Transport planners have developed complex models of demand and supply to manage infrastructure and plan investments, but principally focus on passenger transport. Typical transport models look at the origin, destination, mode, and journey purpose of people's journeys. From this information models can predict behaviour when various changes are made such as changed costs or changed journey times. Factors impacting mode or route choice are also well understood, including passenger attitudes to crowding, and willingness to change travel time to avoid congestion. Data used for passenger modelling includes census data, traveller surveys, spot traffic counts at junctions, passenger counts, and attitude surveys.
- 10.5.2. In contrast, road freight information available to transport planners is limited to little more than:
 - Traffic count data, generally broken down by hour of day and vehicle type (although different types of count use different definitions for goods vehicles)
 - Crude data on origin, destination, commodity, load, and vehicle type for UK registered goods vehicles (the Continuing Survey of Road Goods Transport (CSRGT) - based on a small sample size, so origin and destination data is published at region to region level, but can be made available county to county)
 - Even higher-level data for the movement of foreign registered goods vehicles
 - Occasionally, ANPR data showing the route vehicles take through an area but is limited to the area in which it recorded and there can be issues of data privacy if this information is not sufficiently anonymised
 - Data on registrations of various vehicle types.

10.6. ROAD FREIGHT MODELLING

- 10.6.1. A key difference between the movement of goods and people is that, over a large population, the movement of people can be observed as responding to changes on cost and time in a predictable way, particularly when their journey purpose is known. Longer term trends in population and employment are also amenable to modelling. On a day to day basis freight movements follow similar patterns, taking the cheapest or fastest route. But longer-term trends in freight patterns do not respond to changes in transport costs in a predictable

way. Decisions over large volumes of goods lie in the hands of a smaller number of businesses, and developments in their business strategy can have a large impact on traffic.

- 10.6.2. Similarly, with the impacts of delay. For people this is based on the value of their time, which depends on journey purpose. For freight, the value of delay is simply the direct cost of the delay. For many businesses this will be true, but for many other businesses, delays can lead to other increased costs, particularly unforeseen disruptions which can lead to significant costs which are not captured by traditional models.
- 10.6.3. In corridor models, HGV forecast origins and destinations are fixed after forecasting i.e. they only respond to a change in travel costs by re-routeing where possible. They do not change destination, reduce frequency, time of travel or mode.
- 10.6.4. At a national level, the Great Britain Freight Model (GBFM), operated by MDS Transmodal, underpins freight forecasts. The GBFM contains geographic data on industry and population, as well as CSRTG data, traffic counts (for calibration), and a detailed database of rail freight flows. It has proven to be a reliable tool for forecasting high level demand and mode share. However, like all models of its type, calibration is essentially based on assuming that future supply chains behave in a similar way to historic supply chains. Much of this study is showing the rate of change in the freight industry is significant which may therefore impinge the value of this model in predicting future freight needs.

10.7. PRIVATE SECTOR DATA

- 10.7.1. In contrast to the poor quality of public sector freight data, there is an abundance of high quality private sector freight data. But making best use of this data is made more difficult by several issues:
 - Even within a company, data is often poorly integrated and not transparent
 - Data is commercially sensitive and so never published and rarely shared
 - Collaboration between companies is difficult unless a third or fourth party logistics operator is responsible for the goods of both companies
 - Data is provided in a wide range of formats, and to differing quality standards.
- 10.7.2. Other sources of data include GPS and mobile phone tracking data. This is now commonly provided to organisations interested in managing road networks, providing real time indications of congestion. Currently this data is not provided separately for HGV, although exercises have been undertaken using anonymised data for large retailers to monitor hundreds of thousands of movements via proprietary route planning and scheduling software (IGD, 2017).
- 10.7.3. Real-time and Historical journey time data from aggregators such as INRIX, TomTom, TrafficMaster, Google, Here and Masternaut provide summarised journey time information in real-time/historical datasets. The Masternaut example does have specific freight data within it (from vehicles fitted with the Masternaut telematics devices). Whilst Masternaut has a large fleet, it is still not significant in terms of the overall freight fleet in the UK, however it could inform origin destination datasets for freight. This dataset does not provide information on the type or volume of goods transported.
- 10.7.4. There is a major opportunity if elements of this wealth of private sector data can be made available for example:
 - Real time data to help highways managers to plan traffic capacity
 - Longer term origin destination data to better plan infrastructure
 - Providing real time load data to encourage and facilitate collaboration.

10.8. BLOCKCHAIN

- 10.8.1. Blockchain is a Distributed Ledger Technology (DLT), which is a special type of distributed database. Each computer ‘node’ or member in a network stores an identical ‘ledger’ or database. This database takes the form of a chronological chain of unique groups of information called ‘blocks’, hence blockchain. They are securely linked together using cryptography (Transport Systems Catapult, 2018).
- 10.8.2. Features of blockchains make them particularly suitable for application to logistics management. The Transport Systems Catapult report asserts that blockchains can enable:
- Traceability and auditability
 - Disintermediation
 - Smart contracts
- 10.8.3. These are all fundamental issues for logistics managers. Again, the Transport Systems Catapult report states that some of the main proposed business benefits of using blockchain are:
- Increased collaboration – sharing information and processes between businesses (B2B) and customers (B2C)
 - Increased sharing of trusted information – enabling consensus-based validation of information, via a distributed, replicated database, to ensure data integrity
 - Increased efficiency – removing duplicated effort by maintaining a common ledger which can be used to manage smart contracts and dramatically streamline processes
 - Reduced costs – removing the need for third-party intermediaries as well as the duplicated effort that is required for maintaining separate databases which contain the same information
 - Reduced risk – minimising errors and the risk of malicious tampering, with traceable transactions that can show who did what and when to both tangible and intangible assets
 - New business models – creating new commercial opportunities and revenue streams, because of decentralisation and disintermediation (cutting out the middlemen).
- 10.8.4. *“Global supply chain networks are very complex. Multiple stakeholders (manufactures, land transportation providers, warehouses, freight forwarders, custom brokers, Governments, ports, ocean carriers and final customers) need to interact in different operative transactions. Such complexity, especially with multiple data exchanges in the processes, can potentially lead to increased cyber insecurity and unclear visibility such as shadow accounts and tampered goods or data. Blockchain technology could bring collaboration, trusted information, consensus, immutability, and provenance to the movement of value, in this case a physical item, across supply chains. The technology could help reduce inefficiency in the system, through removing duplicate effort across different stakeholders in maintaining separate databases and documentation about the same consignment, automating approvals and removing some intermediaries. A single version of the truth could be established in seconds, rather than hours or days, allowing capacity utilisation to be optimised”* (Transport Systems Catapult, 2018).
- 10.8.5. In the marine environment there are plenty of examples of where Blockchain is being trialled including:
- Container Logistics Pilot – Port of Rotterdam, Samsung SDS, and ABN Amro
 - Port Connectivity Pilot – Associated British Ports, Marine Transport International
 - Completion of the world’s first bunker delivery and transaction using blockchain – GoodFuels Marine
 - Supplier Management System – DB Schenker, VeChain
 - Efficient and secure global trade platform – IBM, Maersk
 - Shipment of Almonds from Australia to Germany – Commonwealth Bank of Australia.
- 10.8.6. However, none of these give an estimation of view on the impact of congestion outside of the port.

- 10.8.7. Blockchain is not the only technology which allows data to be shared across complex supply chains, but it has unique features which have the potential to reduce complexity, reduce cost, and foster new forms of collaboration. It is already being applied to maritime transport, and will also prove valuable for logistics systems where goods are transferred between modes or vehicles en-route.
- 10.8.8. While there are benefits to freight and logistics organisations of using DLT such as blockchain, making the case for sharing this anonymised information for the 'greater good' of the network to external organisations such as Road Operators or Transport Planners, is still up for debate. There is evidence the Governments are willing to pay for software-as-a-services that include floating vehicle data to manage the road network performance (Magazine, 2018) but it is not clear on whether there is a market for this data outside of these organisations. Finally, the use of DLT to join up data within organisations could lead to increased decentralisation of control with unintended impacts for transport networks and increased difficulties for network wide real-time network management.

BIG DATA

- 10.8.9. This is data that has large 'Volumes, Variety, Velocity and Veracity'. Over the last ten to fifteen years there has been a huge increase in the number of connected devices and data streams that are collected by logistics and freight organisations. This includes cars, smartphones, Radio Frequency Identification (RFID) readers, webcams, blog entries, e-commerce catalogues, sensor networks and many more anonymous data sources. This data is collected at differing data rates, formats and with varying quality. The benefits are not in the collection and storage of this data but in statistical mining of the data, using data science techniques, for specific use cases to deliver business value. In the freight and logistics industry areas where big data are expected to benefit include strategic planning, operational efficiency (optimise processes and resource planning and route usage), customer experience (optimise customer segmentation, interaction and service use) and new business models (expanding and creating new revenue streams from data).
- 10.8.10. The GPS sample includes data from freight and non-freight sources but the sample size does not currently allow statistical significance in terms of freight movements. The origin destination data and what is being carried tends to be obtained from surveys of Transport Operators that are obliged to provide statistical information to the DfT. This is then extrapolated with the GPS data to provide some freight specific statistics.
- 10.8.11. In this context, blockchain could help as it could provide a platform for sharing anonymised data in a secure way for the benefit of all road users. Linking telematics data with Delivery Management System data could provide a benefit to the UK road users and support short term and longer-term planning use cases and near real-time delivery planning. This could be a voluntary opt in system or potentially mandatory. These datasets could support delivery of freight data portals and exchange services. The difficulty would be building trust with freight operators and getting their buy-in.

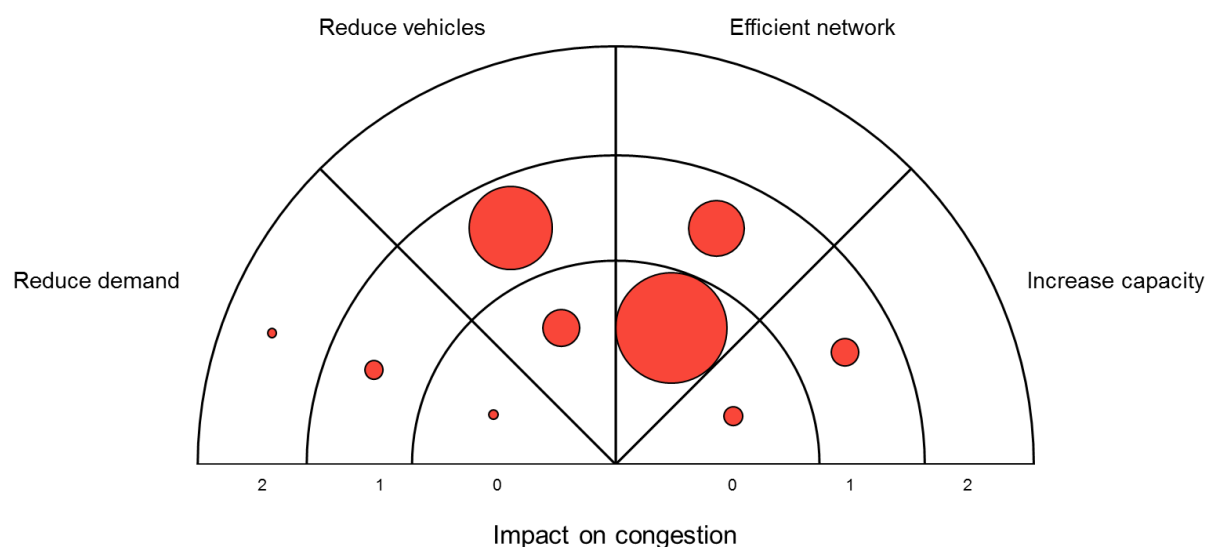
CONCLUSION

- 10.8.12. Accessing, mining and sharing data is key to maximising the potential of many of the interventions discussed in this report, particularly empty running and route optimisation. There is a central role for Government to facilitate the development of data standards that would enable better transparency.
- 10.8.13. Blockchain and Big Data have the potential to become a disruptive trend in the logistics industry. However, the application of Big Data analytics is not immediately obvious in this sector and there are challenges in data privacy, data quality, technical feasibility and skillset. The particularities of the logistics business must be thoroughly examined first to discover valuable use cases. (DHL, Big Data in Logistics, 2013).

11. KEY FINDINGS

11.1. APPRAISAL OF INTERVENTIONS

- 11.1.1. The term “interventions” is used in the study in a very broad sense to encompass both government interventions, and developments in logistics which may have a beneficial impact on freight contribution to congestion.
- 11.1.2. The study reviewed 61 interventions. Of those, seven were purely urban congestion focused, 12 were purely strategic, but 30 had an impact on both the SRN and urban roads. There are 21 interventions that relate to rail or multimodal systems.
- 11.1.3. Some interventions have large benefits but that only affect a limited scope or geographic area. Other interventions have lower congestion benefits, but with impacts spread more widely across the network. The appraisal included a subjective estimate of the overall impact of each intervention on congestion.
- 11.1.4. The chart below shows that many of the most significant interventions involve improving efficient use of vehicles and transport networks, rather than improving capacity.



- 11.1.5. Some of the most beneficial interventions were found to be:
- Reduction and simplification of HGV restrictions: which may include timing, size or speed restrictions, customer restrictions or road space restrictions
 - Land use planning: to ensure the logistics facilities can be located where needed
 - Lorry parking: more parking to avoid excess miles needed to find appropriate parking
 - Autonomous Vehicle SAE Level 2: Advanced Driver Assistance Systems (ADAS) fitted to a vehicle that can identify safety-critical situations and act, either automatically or by sending warnings to the driver
 - Improved roadworks information: poor quality information on planned roadworks restricts the ability to effectively journey plan (route freight vehicles)
 - Back hauling: loading empty vehicles
 - Freight exchange: providing an online collaboration service for haulage companies, logistics providers, freight forwarders and transport companies to fill empty space

- Infrastructure investment - road improvements (widening): widening of roads is typically used to increase additional lane capacity but can also provide safety benefits
- Route planning, navigation and optimisation: to reduce empty running via enabling back and forward hauling, reducing stem mileage and avoiding HGV inappropriate routes
- Smart motorways: using Variable Message Signs (VMS) and signals and enhanced traffic monitoring technology to safely allow drivers to drive on the hard shoulder
- Road freight pinch points: there are various locations on the UK road network where obstacles exist that delay freight and other road users
- Expressways: All-Purpose Trunk Roads (APTR) upgraded to the Expressways standard consist of many common characteristics such as dual carriageway; grade separated junctions
- New strategic highways and link roads: the traditional method of dealing with increasing demand and promoting economic growth involves the construction of roads that link existing or emerging pollution centres and other key areas e.g. ports

11.1.6. For rail capacity, the study identified a number of important interventions, most already being delivered, which can improve rail freight capacity and reduce the impact of rail freight on overall capacity including:

- Running longer trains
- Introducing freight nodes at key locations on the network
- Making incremental timetable improvements based on a better understanding of freight train performance.

11.2. MANAGING FREIGHT DEMAND

11.2.1. Freight demand management can be a win win – leading to reduced congestion, reduced emissions, improved safety, and reduced costs for operators and businesses. However, this may not always be the case, and sometimes compromises will be required. It is important that planners and decision makers recognise and balance the essential importance of efficient logistics systems with the need to reduce congestion and emissions.

11.2.2. Recognising that freight demand can be managed is an important factor in the managing of congestion and getting the most out of the infrastructure. Primarily, the normal processes of supply chain management should result in increasingly efficient logistics systems. However, demand management measures can be part of the options available to government at all levels in both transport strategies and infrastructure studies. The public sector can support efficiency improvements by, for example:

- Identifying and encouraging best practice
- Fostering innovation
- Providing and supporting opportunities for businesses to collaborate
- Ensuring that land is available for distribution use where it is needed
- Ensuring that regulations and restrictions are only imposed as a last resort, and are consistently applied across different areas

11.2.3. FQPs provide a mechanism for local government to work more closely with businesses on logistics issues. Transport for London's comprehensive approach to managing freight provides a template of how closer working with industry can deliver change. There is a role for collaboration of this type at a sub national and national level.

11.3. URBAN FREIGHT MANAGEMENT

11.3.1. The greatest degree of logistics change is happening in towns and cities. The need to address air quality and safety, together with more pedestrianisation, is driving businesses to new models for last mile delivery. There are risks that this could lead to a proliferation of small delivery vehicles. This places even more importance on

encouraging businesses to collaborate and providing well located distribution facilities to transfer goods into the smaller vehicles.

- 11.3.2. There is significant potential to support business efforts to move deliveries out of peak hours.
- 11.3.3. Best practice needs to be better shared, and restrictions aligned to make managing deliveries more efficient.

11.4. MODAL SHIFT

- 11.4.1. Rail and water freight can provide economic and environmental benefits. Some businesses are dependent on efficient alternatives to road freight to extend their reach and access distant markets.
- 11.4.2. Generally, freight and passenger trains work well alongside each other in a tightly timetabled environment. Delays are rigorously monitored and causes identified. Rail freight causes less than 3% of all lost minutes on the railway.
- 11.4.3. There are significant gains to be made to reduce the impact of freight trains on capacity, including longer trains, freight nodes, and electrification. In most cases where passenger trains and freight trains are competing for limited capacity, relatively inexpensive infrastructure improvements can meet the needs of both sectors.
- 11.4.4. Network Rail has worked with the freight industry to forecast demand and identify capacity constraints. Investment in addressing those constraints has been shown to have a high benefit to cost ratio and will allow passenger and freight rail volumes to continue to grow.
- 11.4.5. Every lorry removed from roads provides a measurable congestion benefit, recognised in the Mode Shift Values used by the DfT. Benefits for congestion are particularly significant on sections of the road network where roads are at or near capacity in peak hours. At these locations rail freight avoids gridlock and, at least, postpones the need for major investment in new capacity.
- 11.4.6. More work is required to better understand the link between rail infrastructure investment, capacity provided, and congestion relief on specific roads.

11.5. FREIGHT DEINTENSIFICATION

- 11.5.1. The opportunity that reducing demand presents is the idea of treating the cause of congestion rather than the symptom. The challenge however, is that many of the issues discussed above are fundamental societal issues that have wide ranging implications outside of congestion alone, which has made understanding the potential impact on congestion difficult. However, while reducing the demand cannot be tackled from a freight perspective alone, there are a number of specific interventions that can be used to get some of the foundations in place.
- 11.5.2. Evidence suggests that refinements to planning and economic policies which are already acknowledged to have economic and sustainability benefits, can also have significant impacts in strengthening freight deintensification.

11.6. IMPROVE VEHICLE UTILISATION

- 11.6.1. Some increase in the size of HGVs may have a small impact on congestion. Key to increasing average payloads per lorry is improved collaboration in a number of ways, including through more use of consolidation centres, the use of freight exchanges, standardisation of measures of load and capacity, and extensive use of technology and data to provide transparency.

11.7. USING ROADS MORE EFFICIENCY

- 11.7.1. Just as freight operators and their customers will naturally work towards increasing payloads and reducing unnecessary movement of goods, businesses will also try to avoid using roads and railways at peak times.

This is a key way of making efficient use of networks. Other ways include, changing operating practices, and using new vehicle technologies which allow vehicles to travel closer together.

- 11.7.2. Studies of platooning are at a very early stage, and it will be a long time before impacts on congestion and road capacity can be understood. Currently, the evidence available suggests that benefits may be limited by take up, the lack of suitable stretches of road, and potential negative impacts on other road users. However, this technology is developing, and other benefits such as reducing haulage costs may be more significant than congestion benefits.

11.8. PROVIDING MORE CAPACITY

- 11.8.1. Ultimately, rapidly growing demand for road transport generally may require new capacity to be provided. The impact of new capacity on freight businesses and the benefits of new schemes for freight are not fully understood nor completely included in business cases for new or improved roads.

11.9. CHANGES IN LOGISTICS

- 11.9.1. Logistics is going through a period of unprecedented change, driven by customer demands, technological and operational improvements, and an increased focus on emissions, safety, congestion, and liveable cities.
- 11.9.2. Many of these changes have the potential to improve efficiency and reduce congestion, but some may have the opposite impact, for example resulting in a proliferation of last mile delivery vehicles.

11.10. DATA

- 11.10.1. Throughout the report the lack of comprehensive freight data (particularly for road freight) has been noted as a constraint which ultimately leads to logistics issues and opportunities being downplayed in infrastructure and transport plans. This includes traffic data such as information on origins, destinations, commodities carried, and payload, and economic data on the impact of congestion on freight.
- 11.10.2. Increased use of delivery management systems and vehicle tracking systems means that better quality data is becoming available, but there are challenges in maintaining confidentiality and linking tracked vehicle movements to commodities and payloads. This area is worthy of further investigation.

11.11. TECHNOLOGY

- 11.11.1. Technological developments will also play a role in reducing freight congestion. An early and significant benefit of increased automation should be an improvement in safety, leading to a reduction in major incidents involving goods vehicles. Ultimately, increasingly autonomous operation of goods vehicles may provide more general capacity benefits, notably through closer running and less variable driving techniques. However, the impact of autonomous vehicles or platoons on congestion has not yet been proved.

11.12. MONITORING INTERVENTIONS

- 11.12.1. Promoters of trial operations and government bodies at all levels who implement freight interventions need to consider the careful measurement of freight volumes and other KPIs before and after implementation. This includes “soft measures” such as schemes that encourage best practice through recognition of organisations who demonstrate good practice and delivery and service plans.

11.13. CONCLUSION

- 11.13.1. There a number of principles for managing congestion which are threaded through all the interventions:
- The need for many parties to work together to achieve successful outcomes
 - The need for improved data

- Support from the public sector both on a strategic and regulatory basis
- There is a need for behaviour change by businesses and consumers
- Finding the right operational mix in solution design as otherwise negative trade-offs may result – this will depend on the nature of the congestion and the location.

Appendix A



GLOSSARY

Term	Definition
3PL	Business who provide transport and logistics services
AI	Artificial Intelligence
BIDS	Business Improvement Districts
Bulk goods	In the logistics environment this term is used to describe goods such as coal, grains, oil, or chemicals that are not packaged in any type of container and are stored, transported, and sold in large quantities
CAZ	Clean Air Zone
CLP	Constriction Logistics Plan
CILT	Chartered Institute of Logistics and Transport
CSRGT	Continuing Survey of Road Goods Transport
Cube	Dimensional metric for the measurement of a load – i.e. the amount of space an item takes up on a vehicle. Frequently a load will volume out or cube out before it weights out
DLT	Distributed Ledger Technology
DfT	Department for Transport
DMS	Delivery Management System
DMS	Delivery Management System
DSP	Delivery and Servicing Plan
ETCS	European Traffic Control System
FDM	Freight Delivery Metric
FFG	Freight Facilities Grant
FMCG	Fast Moving Consumer Goods
FMS	Freight Market Study. A regular study undertaken by Network Rail to establish the market forecasts for rail freight
FNPO	Freight and National Passenger Operators
FNS	Freight Network Study
FOC	Freight Operating Company
FORS	Freight Operators Recognition Scheme
FQP	Freight Quality Partnership

FTA	Freight Transport Association
GBFM	Great Britain Freight Model a model, designed by MDS that attempts to forecast freight movements, and is widely used throughout the industry as the best available data source
GDP	Gross Domestic Product
GPS	Global Positioning System
GVW	Gross vehicle weight, means the weight of a vehicle or trailer including the maximum load that can be carried safely when it's being used on the road
ECR	Efficient Consumer Response
Haulage	Businesses that provide freight movement services
HGV	Heavy goods vehicle, a vehicle over 3.5 tonnes up to a maximum of 44 tonnes
IGD	Institute of Grocery Distribution
IoT	Internet of Things
ITS	Intelligent Transport Systems
JIT	Just in Time
JTR	Journey Time Reliability
KPI	Key Performance Indicator
LGV	Light Goods Vehicle
LHV	Longer Heavy Vehicles
MIDAS	Motorway Incident and Automatic Signalling
MoS	Motorway of the Sea
MRN	Major road Network
NIC	National Infrastructure Commission
NTIS	National Traffic Information Service
Own account	Businesses that manage their own freight/goods transport in house
Payload	The part of a vehicle's load, from which revenue is derived, usually measured by weight in the case of road and rail but sometimes by volume
PCU	Passenger Car Unit
RFS	Rail Freight Strategy

RDC	Regional Distribution Centre, a distribution centre that serves a particular area or region, potentially through smaller regional or local distribution centres
RHA	Road Haulage Association
RIS	Road Investment Strategy
RTC	Road Traffic Collision
Semi-trailer	A semi-trailer is a trailer without a front axle. A large proportion of a semi-trailer's weight is supported by a tractor unit, or a detachable front-axle assembly known as a dolly, or the tail of another trailer. A semi-trailer is normally equipped with landing gear to support it when it is uncoupled
SRFI	Strategic rail freight interchanges are purposely designed an area where distribution centres are linked into both the rail and trunk road system to enable the movement of goods by road and rail
SRN	Strategic Road Network
STB	Strategic Transport Body
Stem distances	The distance between depot and customer
TfL	Transport for London
TOC	Train Operating Company
Tonne Kilometres	A tonne-kilometre, abbreviated as tkm, is a unit of measure of freight transport which represents the transport of one tonne of goods by a given transport mode (road, rail, air, sea, inland waterways, pipeline etc.) over a distance of one kilometre.
Trunking	A point to point journey, traditionally on the SRN, from one depot location to another (with no multiple drops)
UCC	Urban Consolidation Centres
ULEZ	Ultra-Low Emission Zone
VMS	Variable Messaging Signs

Appendix B

CHALLENGE PANEL 

The study engaged with industry representatives and key stakeholders to seek challenge and feedback on the proposed resource methodology, lines of enquiry and findings. The Challenge Panel were separate from the project team, and not involved in carrying out the research, providing them with the independence. This is separate to WSP's own internal peer review process.

The following were approached, with feedback provided by those highlighted.

Organisation
Risk Solutions
Newcastle University
FTA
TfL
RHA
TfN
Westminster University
RAC Foundation
CILT Freight and Logistics Interest Group
Rail Freight Interest Group
Rail Development Group
Network Rail
Highways England
Police

Appendix C



ASSESSMENT CRITERIA

The following outlines the assessment criteria used in the intervention assessment that forms the basis of the study.

INTERVENTION TYPE (STRATEGIC, URBAN, RAILWAY)

This should indicate the main area the intervention will impact.

TRL (FOR TECHNOLOGY ONLY)

As per standard TRL definitions – please be realistic, these will be moderated carefully and need strong evidence for high TRLs

COST OF ADOPTION AND APPLICATION

High - Cost over >£100million

Medium - Cost £20million to £100million

Low - Cost <£20million

OPERATING COST

Negative – High (meaning there will be a high operating profit)

Negative – Medium

Negative – Low

Neutral

Positive – Low

Positive – Medium

Positive – High (meaning there will be a high cost)

TRL SCORE

Phase	TRL	Stage	Description
Operations	TRL9	Operations	The technology is being operationally used in an active facility
Deployment	TRL8	Active Commissioning	The technology is undergoing active commissioning

	TRL7	Inactive Commissioning	The technology is undergoing inactive commissioning. This can include works testing and factory trials but it will be on the final designed equipment, which will be tested using inactive simulants comparable to that expected during operations. Testing at or near full throughput will be expected
Development	TRL6	Large Scale	The technology is undergoing testing at or near full-scale size. The design will not have been finalised and the equipment will be in the process of modification. It may use a limited range of simulants and not achieve full throughput
	TRL5	Pilot Scale	The technology is undergoing testing at small to medium scale size in order to demonstrate specific aspects of the design
	TRL4	Bench Scale	The technology is starting to be developed in a laboratory or research facility
Research	TRL3	Proof of Concept	Demonstration, in principle, that the invention has the potential to work
	TRL2	Invention and Research	A practical application is invented or the investigation of phenomena, acquisition of new knowledge, or correction and integration of previous knowledge
	TRL1	Basic Principles	<i>The basic properties have been established</i>

WHO WILL BEAR THE COST? (PUBLIC: PRIVATE)

Criteria (split between Public / Private) as a ratio

POTENTIAL SCALE OF APPLICATION

Market Penetration: indicator of application to total veh-km or tonnes freight transported

High, Medium, Low

RISKS TO APPLICATION (SOCIAL / LEGAL)

High, Medium, Low

CONGESTION IMPACTS

This relates to the congestion on the type of road highlighted in the intervention type column i.e. urban or strategic

Congestion criteria:

- 3 Major decrease in congestion
- 2 Medium decrease in congestion
- 1 Minor decrease in congestion
- 0 N/a or no change
- 1 Minor increase in congestion
- 2 Medium increase in congestion
- 3 Major increase in congestion

Scope of Impact	Limited locations	Corridors and known congestion hot spots	Widespread benefits across the network
Scale of Impact			
Significant reduction in routine peak and off-peak delays for all traffic	2	3	3
Significant reduction in routine peak delays for all traffic	2	2	3
Moderate reduction in routine peak delays for all traffic	1	2	2
Small reduction in routine peak delays for all traffic	1	1	2
No known impact	0	0	0
Small negative impact in routine peak delays for all traffic	-1	-1	-2
Medium negative impact in routine peak delays for all traffic	-2	-2	-3
Significant negative impact in routine peak delays for all traffic	-2	-3	-3



QUALITY OF EVIDENCE

Significant, quality published material	1
Limited quality published material	0
No quality published material or anecdotal	-1

STAKEHOLDER ACCEPTABILITY

Accepted by industry, public and public authorities	2
Likely to be acceptable to the industry, public, and public authorities	1
More evidence required on acceptability	0
Potential concerns in one or more groups	-1
likely to be unacceptable to one or more groups	-2

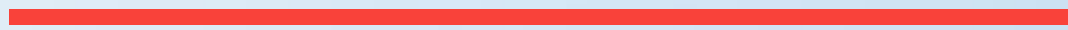
Appendix D

OUT OF SCOPE INTERVENTIONS



Technology/Intervention	Why out of scope
Automation in loading / unloading	No direct impact on congestion
Liquid Natural Gas	No impact on congestion
Biofuel	No impact on congestion
Black box driven insurance technology - insurance industry as policy driver etc	No impact on congestion
Load tracking (rail)	Already takes place - needs updating
Hybrid	No impact on congestion
Hydrogen	No impact on congestion
Liquid Petroleum Gas (LPG)	No impact on congestion
Synthetic fuel	No impact on congestion
Uranium / nuclear	No impact on congestion
Pedestrianisation expansion in urban areas / smaller last mile vehs.	Negative impact on congestion - but not a congestion measure
Driver hour restrictions	Minimal impact on congestion - not a congestion measure
Low emission zones/zero emission zones	Negative impact on congestion - but not a congestion measure
Hyperloop	Limited information on who this could work for freight and impact congestion within the timescales of the study.
Big data	Data sharing is covered within the interventions

Appendix E



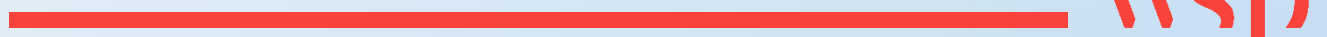
INTERVENTION DASHBOARDS

Appendix F



INTERVENTION ASSESSMENT

Appendix G



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