



**The Chartered
Institute of Logistics
and Transport**

Freight and Logistics – Responding to Climate Change and the ‘New Normal’

The Route to [Net] Zero - mapping the transition in Freight and Logistics

OVERVIEW

1. Freight and logistics in the UK is a hidden engine of the economy with 2.7 million people employed, turning over £924 billion from 195,000 enterprises and generating £124 billion of GVA or about 10% of the country's non-financial GVA¹.
2. The sector moves 1.6 billion tonnes of freight around the UK, mainly by road (78%). Rail (13%) and water (9%) are also important; together these modes make up the nation's freight transport system with varying degrees of integration. Together and individually the modes offer different pathways for decarbonisation.
3. Imports and exports through our ports are around 500m tonnes with 95% entering or leaving by sea in the various modes from bulk, through container to vehicle or trailer movement².
4. Freight tonne-kilometres are dominated by road freight with 147 billion – about 79% of the total.
5. The intensity of freight has declined in relation to GDP since the mid '90s which appears to reflect the growth in the service economy as well as some degree of product miniaturization and growth of international imports.
6. Freight and logistics is an important contributor to emissions with HGVs and LGVs contributing 31% of carbon and 30% of NOX from just 21% of vehicle mileage.
7. Freight and logistics contribute to congestion making up 25% of motorway traffic (HGV and LGV) and as much as 30% of urban traffic at peak morning periods (mostly LGV).
8. In line with all transport, other perhaps than rail, it is not clear that freight and logistics has been paying the true cost of its environmental footprint: health, emissions and climate change especially.
9. The National Infrastructure Commission completed a study in 2019 on the investment needs of freight in order to comply with air quality and carbon goals. They concluded that, based on the trajectory of other carbon generating segments, without concerted action it could move from just 6% of national emissions to as much as 50% by 2050. The key finding in their interim report is reproduced below:

¹ FTA, 2019, The Logistics Report accessed on-line at <https://www.santandercb.co.uk/factsheet/fta-logistics-report-2019.pdf>

² NIC, 2019, Better Delivery: the challenge for freight

The Commission's central finding is that without action, freight's contribution towards congestion and carbon emissions will remain problematic. Acceleration of technological advancements and clear, firm, long term targets will be key to tackling this. A more coordinated approach within and between different tiers of government, based on better data, will be crucial to getting this right.

10. In its final report to HM Treasury the NIC concluded that there is a technological trajectory by which the sector can decarbonise, but that there are major planning capacity and regulatory dependencies:

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

11. The freight industry consists of thousands of private companies supplying goods and services to thousands of businesses and millions of residents and visitors. As recognised by the NIC, the "freight system already adapts at phenomenal pace to meet customer demands".
12. Goods and services will still be needed in a net zero emissions world. So, supply chains, freight modes, operating networks and the relationship of freight and logistics with society will all be impacted by the transition to net zero. And, customer behaviour will be an unpredictable and central factor on the speed and direction of change in the freight system.
13. The long term implications of the COVID_19 pandemic will also be an influence on the markets being serviced by freight and evolving societal preferences.
14. The goal must be not just zero emissions but also cost efficient and productive logistics operations.
15. This paper explores what the new world of zero emissions freight and logistics might look like and highlights the areas where a combination of technology, industry and public sector change can enable the goals to be met.

DECARBONISING FREIGHT

Overview

16. To meet the obligations of the sector to decarbonise by 2050, the Route to Zero will involve our sector in dramatic changes.
17. The most immediate measure will be the ban on diesel car (and van) sales by 2035. There are around 4 million vans on the UK roads and registrations have been running at c. 350,000 pa; vans are a logistics workhorse of the economy and neglected by researchers for their roles in supply chains.

18. It has been proposed, but not yet enacted, that diesel powered HGVs (trucks/lorries) will be banned from sale in 2040. There are around 450,000 such vehicles on the roads and registrations run at around 50,000 per year. As noted in paragraph 2, HGVs account for 78% of the tonnage of freight moved in the country.
19. Measures to ban carbon power on vans and trucks together on the timescales will mean that the vehicle parc by 2050 can be alternatively powered within typical replacement and scrappage cycles. Together with the completion of electrification of rail freight, the vast majority of freight and logistics can be zero carbon.
20. So where is the challenge?
21. The challenge comes from how new technology with its different attributes, with the resulting new operating methods and regulation will combine with evolving supply chains and customer preferences in the future. It is an uncertain horizon in many dimensions: operating methods will not just port across cost effectively to new motive power. The new blend will present both business and society with challenges and choices; new regulations will be needed and old ones reviewed, to ensure the industry can be cost efficient the future.
22. While freight has been predominantly a privately invested and operated service (ports, warehouses, trains, trucks, vans), the road and rail infrastructure are in public ownership and control. A radical new model that takes us to a zero-carbon future will require public and private cooperation like never before.
23. The changes across the sector divide into a matrix of directions that cross-relate, as shown in the table following. It is the combination and interactions of the transitions that provides the challenge to business, suppliers and the national and local authorities.
24. This landscape of directions and transitions combines to create a wide range of scenarios and societal choices. And any transition to net zero may involve some intermediate steps with redundancy along the way; such transitions may be difficult for business to accommodate in terms of investment and return.
25. The figure following illustrates the dimensions of potential change under the headings: Technology, Mode, Supply Chains, Control and Regulation. Each of these is then unpacked in an attempt to describe the transition options and the inter-relationships and dependency with other dimensions.

	From	To
Technology	Carbon Intensive	Electric Hydrogen Bio fuels Hybrid LNG Offsetting
	Manned and Planned	Autonomous / digital
Mode	Road freight diesel	Road freight electric / alternative power Rail freight Short sea, river. Canal Long Sea shipping Air Freight
	Vans	Bots and Bikes
	Conventional Rail Freight	Physical Internet
Supply Chains	Extended chains	Local for Local
	High stem distance	Urban last mile
	Independent chains	Consolidation and collaboration
Control / regulation	Roads are 'free	Road User Charging
	Self organising /light touch	Societal Regulation

Figure: Dimensions of transition for freight on the route to zero

Unpacking the detail on the route to zero

26. Fuel / Motive Power Technology

- ☐ Urban freight is serviced by a combination of HGVs and vans, with vans making up c.12% and HGVs c. 5% of urban traffic kilometres . The consensus is that urban freight will go electric for vans and smaller trucks by 2035, but that the motive power solutions for long distance heavy trucks do not yet have a clear technical evolution.
- ☐ The power generation and distribution grid requirement for charging the urban electric freight fleet is a more intensive subset of providing electric power for private cars. The CILT's Roads and Traffic Group have reflected on this in depth and their work is available³. It is sufficient to say here that the investment in infrastructure is much more significant than the tooling and manufacturing set up for the vehicles themselves, and on a longer timescale. How charging EVs at scale will be done is not yet clear.
- ☐ There is likely to be rapid progress on fast battery charging technology including static battery storage and vehicle to grid supply; but in contrast to the time taken to fill a vehicle with carbon based fuel, there will remain a significantly different time profile of re-charging and consequential changes in operating practices; the full nature of these changes is not well understood.
- ☐ The technical electrical options to mitigate the charging 'gap' and increase charging capacity for freight and logistics lie in some combination of off-peak charging, battery power storage and re-feed, induction, catenary and retractable rail methods with significant strengthening of the grid. All of these represent huge infrastructure investment on a tight timescale with an uncertain prioritisation; the timing to meet the 2035 deadline and parc growth to 2050 is tight.

³ CILT Roads and Traffic Forum – <https://ciltuk.org.uk/PolicyandGuidance/PolicyGroups/RoadsTrafficPolicy.aspx>

- ☐ If the country cannot resolve the all-electric van and small truck charging capacity questions, the alternatives include some combination of the continued sale of hybrid, combined with a full range of first and second generation biofuels. These will provide very large improvements in carbon output and emissions and could be transitional technologies.
- ☐ For such intermediate solutions to be viable for manufacturers and customers, there will need to be clarity on timing and usage of these technologies alongside the full electric charging environment for the long term.
- ☐ Range extended hybrids are not necessarily a transitional solution; the use of range extenders allows for EV batteries to be sized appropriately to the vehicle duty cycle, by removing range anxiety associated with the possibility of very occasionally running out of power. Without them, EVs of all sizes will tend to have batteries that are massively oversized, which has a high cost in terms of materials resource use and the inefficiency of a high proportion of vehicles being significantly heavier than they need to be.
- ☐ For **Long Distance – Inter-Urban** – freight, the roadmap to full electric is less certain. The large battery size, and the consequential weight and charging time, for a 44 tonne HGV to travel say 400 miles in a day, will reduce load capacity unless fast intermediate charging is available. The work of the Centre of Sustainable Road Freight (CSRF) at Cambridge and Heriot Watt⁴, suggests that this is very infrastructure dependent, if truck operating economics is to be maintained. Infrastructure may include some or all of charging stations at services, overhead power lines, in road charging and induction charging. The implications for our major road network are huge; 8,000 miles carries 43% of daily movements of all traffic at some point in its journey on just 4% of total road miles. As much as 80% of HGV inter-urban road freight touches the major road network on its journeys.⁵; the investment in an undefined proportion of the charging capacity is clearly a public responsibility, in its planning. .
- ☐ The alternatives to the full electrification of heavy goods vehicles are hydrogen powered or range extender hybrids using biofuels. The Centre for Sustainable Road Freight⁶ has examined these options and shown that the end-to end-efficiency of hydrogen is not competitive with the electrification – so it can only be justified in terms of convenience and storage.
- ☐ However, our policy group have identified the potential to use off-peak power to make the Hydrogen from sustainable sources as an alternative to battery storage or simply having to turn off generation. The team has also identified the potential for hydrogen in rural areas where the costs of providing the electrical charging infrastructure may be prohibitive. The specifics of the rural supply chain requirement is dealt with in more detail in a later report in more detail.
- ☐ Bio-fuels in conjunction with electric range extenders are an option and may need to be on the transition roadmap.
- ☐ The timetable for any transition, taking account of substantial infrastructure investment needs and the risk of redundancy, is a major uncertainty for the long-distance road haulage

⁴ Centre for Sustainable Road Freight - <http://www.csrf.ac.uk/>

⁵ Rees Jeffries Road Fund Major Road Network Study: <https://www.reesjeffreys.co.uk/funding-policy/>

⁶ Centre for Sustainable Road Freight <http://www.csrf.ac.uk/>

sector along with the availability of vehicles. Against the 2050 target and using replacement cycles of 5 years for new vehicles and an average life of 10 years we have only till 2040 to have a clear direction and infrastructure investment.

- ☐ There is a significant opportunity to switch long distance freight to rail to reduce the need for Heavy Goods Vehicles and the infrastructure investment, as well as relieve congestion; this is developed later. In contrast to road freight, rail has proven technology for moving to zero carbon, using renewable electricity fed through overhead equipment. There are well-established methods of electrifying rail infrastructure and the cost of so doing has reduced substantially in recent years.

27. Digital and autonomous technology

- ☐ There are two key dimensions to the opportunity digital technology offers to freight and logistics: autonomous freight and real time 'Uber style' network management. These technologies do not in themselves contribute directly to the route to zero in terms of carbon and emissions generation, but they may enable or require different enabling actions in the areas of Mode, Supply Chain and Control that follow in this paper.
- ☐ At present the near-term prospect on autonomy is confined to 'assist' functions and HGV platooning; both still require a 'driver' present and in any event a person is needed for loading and unloading.
- ☐ But if (or rather when) driverless autonomy were to be achieved and secure regulatory approval, it would transform the economics of heavy goods movement and enable major network changes. Driverless, long distance, HGVs would mitigate the charging capacity issue raised earlier, as the vehicle could stand for charging without cost or implications from the working time directive.
- ☐ Autonomous urban logistics would lead some operators to put more smaller vehicles on the roads as the saving on the driver would enable improved service schedules. That increase in traffic will be offset by some operators increasing vehicle size and reducing fleet size as working time restrictions no longer apply.
- ☐ The introduction of 'Uber' style digital freight demand matching is already more than a dream. The prospect of freight on demand to reduce empty running and improve service is an exciting one.
- ☐ Combining 'Uber' style capabilities for freight with autonomous vehicles in the 2035 to 2050 timeframe may mitigate the charging requirements and the supply chain networks that operators will require. But there must be a note of caution here that there is emerging commentary on the energy demands of full autonomy and the risk of that being a further drain on the grid and eroding vehicle range.
- ☐ The timeframe of these technologies being available and their effectiveness in the context of changes in motive power become a key dependency, on which further detailed research is needed.

28. Mode

- ☐ As observed earlier, in referencing the NIC, road freight is the dominant freight mode with 78% of tonnes lifted going by road. The question is whether this can be substituted in the future with more environmentally and cost-effective modes – not just in terms of CO₂ but other emissions and congestion.

- **Rail freight** is already important in certain sectors of the economy, such as construction materials and the movement of Deep Sea containers from ports. It is no longer bound to heavy industrial users and consumer goods now account for over 40% of rail freight, using intermodal units (containers or swap bodies) in almost all cases⁷. Rail is much more environmentally efficient than HGV road freight, even with the use of diesel power; the benefits are not just in savings in CO2 but also in particulates and NOX as well as easing road congestion. With more extended use of electric traction, the benefits of rail freight are overwhelming as electric road freight will continue to generate particulates based on tyre wear and congestion will remain a challenge. Increased levels rail freight will reduce the need for charging capacity, a particular challenge in the route to zero as noted earlier.
- An electrification programme of around 320 route miles would permit up to 75% of rail freight to be electrically hauled. Another c. 150 miles would increase coverage to around 90% and a further 150 miles to over 90%. Current Network Rail TDNS electrification proposals would leave only a very small number of freight trains not 'wired'. Against the plan to phase out the sale of new diesel trucks by 2040, the replacement cycle for current diesel locos fits well; the comprehensive electrification of freight by rail will take trucks off the road and relieve the pressure on the road network and charging system.
- The first critical dependency for the rapid growth in zero carbon rail freight is having a national intermodal terminal network, together with direct links to major sources of freight, notably NDCs, RDCs, major manufacturing plants and ports. Intermodal terminals need to be able to support efficient and cost-effective transfer for the 'last mile' delivery, most likely to electric vehicles. This requires planning and land use priorities to be reset to favour this modal shift, a recommendation that was recorded by the NIC.
- The second critical dependency is the appropriate prioritisation of rail freight in the national rail network planning. Freight has played second best to passenger travel and this needs to change; perhaps a sustained loss of passengers following the COVID pandemic will facilitate this change.
- The third critical dependency for deep penetration of rail freight into its target market is the adoption of modular handling units – sometimes called the 'Physical Internet' concept.
- The CILT Rail Freight Forum has prepared a multimodal strategy for the role of rail freight on the Route to Zero in a separate paper showing that the long-term potential for rail freight is as much as 40% of long distance (inter-urban) tonne kilometres. . Given the measures outlined above, modal shift to rail for longer distance freight flows, plus medium distance hauls of bulk materials such as aggregates, can form a major component of achieving zero carbon in freight and logistics by 2050. The proven nature of rail systems for decarbonisation means rail can be considered a low risk route to achieving the 2050 objectives for freight and logistics.
- **Air Freight** is hugely important for the UK economy. It carries less than 1% of the tonnes but as much as 45% of the UK trade by value. The majority of this freight is carried in the holds of passenger aircraft and is co-dependent on the carbon reduction trajectory of aviation. Of all the technical evolutions this is the most problematic and the CILT's Aviation Policy Group has prepared a full consideration of the options⁸. The likely direction is electric power for flights of up to 400 miles and for long distance: offsetting and biofuels

⁷ <https://ciltuk.org.uk/About-Us/Professional-Sectors-Forums/Forums/Rail-Freight>

⁸ CILT Aviation Policy Group <https://ciltuk.org.uk/PolicyandGuidance/PolicyGroups/Aviation.aspx>

The timescale for these developments is far from certain to be inside the 2050 net zero horizon.

- ☐ **Long sea shipping** is another problematic area for motive power in terms of meeting net zero goals. The choice of power source will likely be either biofuels or hydrogen with LNG as a transition with offsetting. The life cycle of existing shipping assets is already an issue as vessels have extended lives and their financial accounting reflects this. **Sue T to add here.**
- ☐ Modal shift for long sea shipping from Asia to Europe may mitigate the challenge since the Silk Road overland rail route from China to Europe is already a reality and is proving a success with shorter transit times.
- ☐ **Short Sea, river, canal and waterway** all offer environmentally beneficial alternatives to road freight. While the UK scope is constrained the potential for electric or biofuel powered vessels should be part of the national planning mix. In common with the need for rail freight terminals, there needs to be formal planning designation of land suitable for loading and offloading freight between barges and road/rail.
- ☐ **Urban freight** is serviced by vans as well as HGVs with the van traffic carrying a fraction of the tonnage but creating between 3 and 5 times the number of movements. Vans can be expected to be electric powered well before 2050, as observed earlier. But in addition, there are a range of emerging urban modes to replace vans including delivery robots and electric cargo bikes. These have the potential to take vans off the road, reduce the charging problem and are completely carbon and emissions free. Academic research from the Netherlands suggest that these methods could take 10-15% of vans off the roads which is a useful benefit for congestion as well. These modes may require some changes in regulation, especially in the context of streetscape changes emerging post COVID_19.

29. Supply Chains

- ☐ Freight currently moves millions of different products across global supply chains. The transport mode used is influenced by the distance travelled, commodity, and speed of movement required; effectively a combination of 'cost' verses 'service levels'.
- ☐ These factors are all impacted by the locations and sites on that journey; urban/rural, port/airport, warehouse, delivery address, etc. The structures of individual supply chains are designed to connect the origins of the goods and the points of demand at appropriate service and lowest cost.
- ☐ Urban chains are about the last mile collection or delivery, to and from the points of supply/production to consumption/use in cities and urban areas. Charging and range constraints following the transition to electric vehicles, will increase the requirement for inner city 'local logistics hubs' and edge of conurbation 'urban logistics centres', to breakdown and re-consolidate some traffic for onward delivery. These facilities will enable zero-emission vehicles to operate and provide more city friendly services, for example on-demand and out of hours delivery with reduced street impacts.
- ☐ The facilities provided at these centres may be mechanised and highly cost efficient. Combined with rail freight such facilities could be the platform for the introduction of 'physical internet' modular handling methods that would obviate intermediate handing of goods between long distance and local delivery vehicles.
- ☐ When city traffic is electrified, freight will be green; but with a proliferation of vehicles in most 'autonomy' scenarios, congestion and livability could deteriorate. Combining vehicle

proliferation with reduced road and kerbside space has the flavour of an unintended consequence. Since that is an outcome that Government, local authorities and people generally do not want, we need to continue to see freight as 'key' and plan for it as a priority.

- ☐ The main dependency for these changes is the availability of industrial land in optimal locations and a planning system that prioritises freight and logistics. The current national planning use class for Logistics is B8 Storage or distribution, including open air storage. This is a very wide use category, with traditional planning connotations of low value land and low skill employment. The need for the planning system to prioritise freight and logistics was identified by the NIC as a key recommendation and it also required in the context of rail freight.
- ☐ Localising of supply chains could be accelerated as a consequence of experience in the pandemic. There was already limited evidence of re-shoring and near-shoring of manufacturing supply and the increased use of automation. These measures may change optimum network structures and alter the tonne-kilometre trajectory. At present the scale of this change is very unpredictable and the baseline carbon intensity may increase or decrease; the carbon impacts of manufacturing may also increase for the nation through re-shoring.
- ☐ In any event, the demand for industrial property and distribution sites will change and planning at the national level, and development funding models, will need to provide an integrated framework.

30. Control and regulations

- ☐ Under current control and regulation, the transition to EVs will deprive the Treasury of substantial revenues, reinforcing the message that road space is 'free'. Given the economic impact of congestion estimated at £30 billion (let alone the current health and wellbeing costs estimated by some at £50bn), this is clearly not the case. The CILT has argued for some years that road user charging is an inevitable necessity.
- ☐ We should therefore expect that by 2035 there will be some kind of charging mechanism for urban access, to replace fuel tax, VED and registration. Logically this would be based on a combination of mileage, location and time of day. In line with other parts of the world, we would expect this to influence freight operating practices, feeding back into the supply chain structure comments earlier.
- ☐ Freight on the roads is subject to a range of regulation (type, testing, loading, hours) but, within that, the market is left to self-organize competitively with few constraints on access and only local conditions for parking. As a result, PCNs and chronic congestion abound.
- ☐ The 400+ local authorities in the UK have traditionally controlled local parking and access and there has been a growing demand to tackle air quality at the local level with local clean Air Zones planned from Portsmouth to Dundee. In London, separate regulations exist covering HGV routing, emissions, congestion and vehicle safety. This proliferation of local, unlinked regulations on air quality and safety is unsustainable – being confusing and disruptive to economic operations.
- ☐ Planning authorities are increasing asking for Construction Logistics Plans, specifying the routing and safety requirements for construction vehicles. The Mayor of London has introduced a similar concept of 'Delivery and Servicing Plans' where the receivers of the

goods and services will need to play a role in the freight operations in their localities⁹. This may include electronic booking of parking and access and be part of the road user charging regime. However, the detail of any such schemes and how the actors will interact is, as yet, uncharted.

COVID_19 Impacts

31. The precise impacts of the pandemic have yet to fully unfold, for logistics and society at large. However, we must recognise the short-term impacts and consider the changes that may result in any consideration of the route to de-carbonisation.
32. Freight and Logistics have moved Centre-Stage as an essential service during the COVID_19 pandemic. Drivers of trucks and trains and warehouse staff are being applauded as key workers for food and health supplies; the courier market has also kept some of the economy open. Airfreight of medical supplies is being given priority with pilots and ground handling teams in high demand.
33. This favourable recognition of the sector has been important and the role of the Institute has been central in advice to government and officials.
34. The huge reduction in traffic volumes and improved air quality resulting from the lockdown has been remarkable and authorities are anxious to retain the health and wellbeing benefits. This includes supporting the growth in cycling and walking by increasing the space available for cycle lanes and pavements. However, without proper planning, this could increase the conflict between freight and other road users and increased costs for the economy in terms of congestion and longer delivery times.
35. Commercial vehicle traffic has become a much higher proportion of total traffic (we estimate in some cases it has been as high as 40% of all traffic depending on road). This will, of course, decline as the lockdown eases, but is likely to remain an increased share for the foreseeable future. At the same time rail freight transit times and productivity have improved significantly with fewer passenger trains running.
36. In the context of the concept of 'Delivery and Servicing Plans', piecemeal measures will be regressive. The consequences will be increased conflict between freight and logistics and other road users and increased costs for the economy in terms of congestion and longer delivery times.

IN CONCLUSION

37. The freight and logistics sector has a challenging pathway to a de-carbonised future, based on the structural supply chain shifts, the technology that will emerge, constraints on capacity and the regulations that may be put in place.
38. The potential for a post-COVID_19 response to influence the trajectory, both positively and negatively, is substantial alongside the climate change imperative.
39. The saying goes that the 'devil is in the detail' and that is clearly the case in this challenge. The role of national and local government in defining the future, working with the sector is self-

⁹ Mayor of London, March 2019, Freight and Servicing Action Plan, Transport for London

evident; the public interest in a zero-carbon future requires a collaborative effort to map the transition and protect national productivity.

40. The CILT hopes that this short paper provides a useful framework and a basis for discussion by describing the possible future landscape and the interdependencies on the 'route to zero'.