SRF Roadmap – part 1

Road freight transport in the UK

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1. The importance of logistics and road freight to a national economy

The global ratio of trade to GDP, commonly referred to as a measure of the openness of economies, has increased from 39% in 1990 to 59% in 2011 (World Economic Forum, 2013). The expansion of global trade requires efficient logistics to facilitate the exponential growth in international and national freight movements. ‘Logistics is a critical service without which global supply chains would not be viable. The lower the costs and the greater the quality of services provided by logistics companies, the better off customers and consumers’ (World Economic Forum, 2013, p.6).

Recently, the UK government’s Logistics Growth Review asserted that ‘the logistics sector is a hugely important part of the UK economy’ (Department for Transport, 2011, p.4). There is recognition, therefore, in government circles that the business of distributing goods, so often taken for granted by the public, is vital to our economic well-being. The main way in which economists have measured this importance is by estimating total national expenditure on logistics and expressing this figure as a percentage of gross domestic product (GDP) or gross value added (GVA). The freight transport, warehousing and cargo handling sectors (excluding postal and courier services) in the UK, had 33,437 companies operating in 2010, with a turnover of nearly £41 billion and an approximate GVA of £17 billion – 1.3% and 1.7% of the total economy respectively (ONS, 2013a). The annual turnover of the road freight transport industry in 2011 was over £22 billion (Table 1), still well below the 2008 figure but steadily rising.

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover (£million)</th>
<th>Approximate GVA at basic prices (£ million)</th>
<th>GVA per employee (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>26,298</td>
<td>11,376</td>
<td>40,600</td>
</tr>
<tr>
<td>2009</td>
<td>20,913</td>
<td>9,509</td>
<td>30,200</td>
</tr>
<tr>
<td>2010</td>
<td>21,116</td>
<td>9,752</td>
<td>39,300</td>
</tr>
<tr>
<td>2011</td>
<td>22,575</td>
<td>9,906</td>
<td>39,300</td>
</tr>
</tbody>
</table>

Table 1. Economic outputs of the UK’s road freight industry, 2008-2011
Source: ONS, 2013a

In 2010, road accounted for 74% of the UK’s freight transport sector turnover and 81% of its GVA (Table 2).

<table>
<thead>
<tr>
<th>UK's freight transport, 2010</th>
<th>Turnover (£million)</th>
<th>Approximate GVA at basic prices (£ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>21,116</td>
<td>9,752</td>
</tr>
<tr>
<td>Waterborne</td>
<td>5,204</td>
<td>1,295</td>
</tr>
<tr>
<td>Air</td>
<td>889</td>
<td>291</td>
</tr>
<tr>
<td>Rail</td>
<td>749</td>
<td>356</td>
</tr>
<tr>
<td>Pipeline</td>
<td>606</td>
<td>341</td>
</tr>
</tbody>
</table>

Table 2. Economic outputs of the UK’s freight transport industry, 2010
Source: ONS, 2013a

In the UK, lorries deliver 4.1 million tonnes of freight daily, equivalent to 65 kg per person. McKinnon (2006a) illustrates the devastating consequences of a major road freight transport disruption to the UK economy (Table 3). A week-long shut-down of the road freight system would result in a serious
economic and social crisis. Furthermore, once the trucks are back on roads, it would take several weeks for most production and distribution systems to recover.

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>All movements of trucks over 3.5 tonnes cease at 12am</td>
<td>Supermarket stocks of many perishable / short shelf-life products run out, including bread, milk and eggs</td>
<td>Most petrol stations run out of fuel</td>
<td>Petrol stations run dry</td>
<td>Half of the car fleet without fuel</td>
</tr>
<tr>
<td>Most mail services and parcel deliveries stop</td>
<td>Milk disposal on farms</td>
<td>Around 15% of the car fleet without fuel</td>
<td>Most of the manufacturing sector shut-down</td>
<td>Large proportion of the labour force laid-off or unable to travel to work</td>
</tr>
<tr>
<td>No newspapers</td>
<td>More manufacturing in low-inventory sectors closes down</td>
<td>Supermarket stocks of fast-moving grocery lines exhausted</td>
<td>Most of non-electrified rail services suspended</td>
<td>Retail stocks of most grocery products exhausted</td>
</tr>
<tr>
<td>Manufacturers operating on just-in-time basis suspend operations</td>
<td>Shortage of cash in ATMs</td>
<td>Introduction of rationing for fuel and some food products</td>
<td>Serious cash shortages</td>
<td>Almost all manufacturing closes down</td>
</tr>
<tr>
<td>No supplies of fresh produce in grocery outlets</td>
<td>Construction work ceases on most building sites</td>
<td>Fast food outlets close</td>
<td>Bus companies reduce off-peak frequencies, esp. in rural areas</td>
<td>Severe disruption of the health service</td>
</tr>
<tr>
<td></td>
<td>Growth of farmers’ markets</td>
<td>Widespread lay-offs from manufacturing sector</td>
<td>Gas and water utilities disrupted by lack of fuel and spare parts</td>
<td>Serious problems from the accumulation of waste</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Busier pubs run out of beer</td>
<td>Congestion at ports stops off-loading of vessels</td>
<td>Range of non-food products in shops substantially depleted</td>
</tr>
</tbody>
</table>

Table 3. Possible effects of the truck stoppage over the first five days  
Source: McKinnon, 2006a

2. Contribution to business competitiveness

The available benchmark data suggests that the UK as a whole has a strong logistics capability by comparison with other countries. It was rated 10th out of 155 countries in the latest Logistics Performance Indicator (LPI) survey conducted by the World Bank (2012). In the World Economic Forum’s (2012) Enabling Trade Index report, UK was rated 11th out of 132 countries. In terms of the sub-indices of ‘availability and quality of transport infrastructure’ and ‘availability and quality of transport services’ it achieved 9th and 7th positions, respectively. DHL (2012) has also compared countries in terms of their ‘global connectedness’, defined as ‘the depth and breadth of a country’s integration with the rest of the world as manifest by its participation in international flows of products and services, capital, information, and people’ (p.13). The UK performed even better against this survey gaining 6th place out of the 140 countries analysed in the report. While the connectedness index is not solely logistics-oriented, one of its key components are merchandise trade flows (26% of the final score). Freight transport and logistics are the key enablers of these flows and, thus, indirectly, contribute to the UK’s high ranking.

Kim and Min (2011) investigate whether some countries achieve logistical efficiency at the cost of the environmental performance. They propose the Green Logistics Performance Index (GLPI), a combination of the World Bank’s Logistics Performance Index (LPI) and the World Economic Forum’s Environmental Performance Index (EPI). The GLPI is suggested as an indicator of a country’s green logistics efficiency, reflecting the impact of logistics competitiveness on the environment. United Kingdom was ranked 14th out of 146 countries for which both the 2010 LPI and EPI data was available. The UK’s consistently high LPI (10th) and GLPI (14th) scores demonstrate high logistics service standards that suggest that maintaining high logistics service standards do not necessarily have an adverse effect on environmental performance of the economy.
3. Employment in logistics

The logistics sector offers a range of occupations including Heavy Goods Vehicles (HGV, defined as a lorry with a gross weight in excess of 3.5 tonnes) and van drivers, transport, purchasing and warehouse managers and supervisors, operators of handling equipment, warehouse staff, employees in rail-, sea- and air-freight operations, and a range of related office jobs. In 2011, there were 33,402 companies operating in freight transport, warehousing and cargo handling sectors (excluding postal and courier services) in the UK, 29,172 of which operated primarily in road transport (ONS, 2013a). It has been estimated that in 2013, nearly 1.6 million people worked in the logistics-related occupations across the UK. This accounts for over 5% of the UK’s workforce (Table 4).

<table>
<thead>
<tr>
<th>Employment (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchasing managers</td>
</tr>
<tr>
<td>Transport and distribution managers</td>
</tr>
<tr>
<td>Storage and warehouse managers</td>
</tr>
<tr>
<td>Importers, exporters</td>
</tr>
<tr>
<td>HGV drivers (driving vehicles over 7.5 tonnes)</td>
</tr>
<tr>
<td>HGV &amp; Van drivers (driving vehicles up to 7.5 tonnes)</td>
</tr>
<tr>
<td>Elementary storage occupations</td>
</tr>
<tr>
<td>Fork-lift truck drivers</td>
</tr>
<tr>
<td>Transport and distribution clerks</td>
</tr>
<tr>
<td>Stock control clerks</td>
</tr>
<tr>
<td>Buyers and procurement officers</td>
</tr>
<tr>
<td>Post worker, mail sorter or courier</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Table 4. Logistics-related employment in the United Kingdom, 2013

Source: ONS, 2013a

Between 2008 and 2011 the number of enterprises operating in road freight sector declined by 10% (ONS, 2013a). The road freight industry is heavily skewed towards family-owned and micro businesses (Table 5). Companies with up to four employees account for 76% of all enterprises in the sector (as opposed to 68% for the whole economy). This is mainly due to the nature of the industry, where drivers often own their vehicles, obtain licenses, register as transport operators and manage their business on their own or with few employees (Skills for Logistics, 2013a).

<table>
<thead>
<tr>
<th>Size of company</th>
<th>% of companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>76%</td>
</tr>
<tr>
<td>5-9</td>
<td>11%</td>
</tr>
<tr>
<td>10-19</td>
<td>7%</td>
</tr>
<tr>
<td>20-49</td>
<td>4%</td>
</tr>
<tr>
<td>50-99</td>
<td>2%</td>
</tr>
<tr>
<td>100-249</td>
<td>1%</td>
</tr>
<tr>
<td>250+</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 5. Size of road freight transport companies in the UK

Source: ONS, quoted in Skills for Logistics, 2013a
There were 469,009 HGV and van drivers in 2013. These two occupations account for nearly 2% of the UK’s total employment. Road freight transport is traditionally male-dominated, with a negligible proportion of female drivers. According to Skills for Logistics (2013a), there is evidence of an aging workforce within the driving industry, with 60% of large HGV and 49% of smaller HGV and van drivers aged 45 and over. Only 2% of large vehicle and 6% of drivers operating vehicles up to 7.5 tonnes are under 25 years old, partly because of the high cost of insuring drivers in this age group. Drivers tend to work full-time and are prevalently employed (rather than self-employed). Although the recent economic crisis has largely eliminated the problem of a shortfall of qualified professional drivers, it is expected to re-emerge following the general economic recovery. The effects of a limited number of young workers entering the sector (Table 6) are likely to be further exacerbated by a mismatch between the competencies offered by workforce and the professional skills required by companies (Skills for Logistics, 2012).

<table>
<thead>
<tr>
<th></th>
<th>HGV Drivers (vehicles over 7.5 tonnes)</th>
<th>HGV &amp; Van Drivers (vehicles up to 7.5 tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>1%</td>
<td>5%</td>
</tr>
<tr>
<td>Under 25 years old</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>Over 45 years old</td>
<td>60%</td>
<td>49%</td>
</tr>
<tr>
<td>Part-time</td>
<td>5%</td>
<td>24%</td>
</tr>
<tr>
<td>Self-employed</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Average weekly hours</td>
<td>48</td>
<td>43.9</td>
</tr>
<tr>
<td>Average salary</td>
<td>£25,982 p.a.</td>
<td>£19,518 p.a.</td>
</tr>
<tr>
<td>Salary range</td>
<td>£17,681 - £34,302</td>
<td>£13,238 - £30,725</td>
</tr>
</tbody>
</table>

Table 6. HGV & van drivers – population characteristics
Source: Skills for Logistics, 2013b, 2013c

4. UK freight transport activity
The amount of freight transport activity can be measured in three ways (McKinnon and Piecyk, 2012):

- **Tonnes-lifted:** this is a measure of the weight of goods loaded onto vehicles, rail-wagons, ships or planes at the start of a journey. As the movement of products from their first point of production to their final point of sale comprises several journeys there is multiple counting of the goods as they pass along the supply chain. The final tonnes-lifted figure is therefore much larger than the physical quantity of goods produced and consumed in the country, but, in the short to medium term, the tonnes-lifted statistic is quite a good barometer of changes in the level of economic activity.

- **Tonne-kms:** this is a composite measure that takes account of both the weight transported and the distance moved. Like the tonnes-lifted statistic it is subject to multiple counting. Overall, it is considered a better measure of the amount of work done by the freight transport sector and correlates more closely with transport expenditure and energy use. It is by far the most widely collected and analysed freight transport statistic.

- **Vehicle-kms:** this indicates the amount of vehicle movement but takes no account of the quantity of freight moved. It is also a statistic that is only available for road transport: no published statistics exist on the numbers of train-km, ship-km or plane-km moving freight.
Road vehicle-kms correlate much more closely than road tonne-kms with levels of traffic congestion and the environmental impact of freight transport.

The total weight of freight lifted in the UK increased by 32% from 1.8 billion tonnes in 1980 to 2.3 billion tonnes in 2007. As a result of the economic downturn, in 2009 the UK freight volumes dipped back to the 1980 level (1.8 billion tonnes). The freight market showed signs of recovery in 2010, with nearly 2 billion tonnes of cargo lifted across the country (Figure 1).

![Figure 1. Freight lifted in the UK, 1980-2010](Source: Department for Transport, 2013)

The trend in tonne-kms has followed a similar pattern (Figure 2). Since 1980 the total UK tonne-kms rose from 175 billion to 257 billion in 2005 (a growth of 47%). There was a decline to 215 billion tonne-kms in 2009 (-16% from the 2005 peak), followed by an increase to 222 billion tonne-kms in 2010. Even at the recent lowest point in 2009, the tonne-kms stayed at 23% above the 1980 level. This is a result of increasing average distance in freight travel. For example, the average length of haul by rail increased from around 120km in 1980 to 201km in 2008 (Department for Transport, 2009).

![Figure 2. Freight moved in the UK, 1980-2010](Source: Department for Transport, 2013)
4.1. HGV fleet
Between 1994 and 2007 the number of UK-registered HGVs increased by 21% from 421 to 511 thousand vehicles. More recently, the number of UK-registered lorries declined to 461 thousand in 2012 (Figure 3).

![Figure 3. HGVs licensed in the UK, 1994 – 2012](image)
Source: Department for Transport, 2013

This reduction in HGV numbers is primarily a result of the economic downturn and a contraction of the UK road haulage market. Other possible contributing factors include:
- Operation of fleets more intensively over the twenty-four hour cycle: across the UK road network as a whole the proportion of lorry traffic run between 8 pm and 6 am increased from 8.5% in 1985 to 20% in 2007, taking advantage of the move to 24 hour operation at industrial and commercial premises. This trend not only makes better use of the vehicle asset, it also minimises exposure to day-time traffic congestion and relieves pressure on the road infrastructure at peak times.
- Increase in maximum lorry weight: Companies have taken advantage of the increases in maximum gross lorry weight in 2001 (from 41 to 44 tonnes for 6-axle vehicles). By the end of 2011, 18% of all the lorries licensed in the UK were plated at the heaviest weight.
- Consolidation of loads in double-deck vehicles and, more recently, also in longer semi-trailers.

<table>
<thead>
<tr>
<th>Gross weight (tonnes)</th>
<th>2001</th>
<th>2011</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of HGVs (thousands)</td>
<td>% of year total</td>
<td>Number of HGVs (thousands)</td>
</tr>
<tr>
<td>3.5 to 7</td>
<td>39.8</td>
<td>8%</td>
<td>51.9</td>
</tr>
<tr>
<td>Over 7 to 8</td>
<td>155.5</td>
<td>33%</td>
<td>129.9</td>
</tr>
<tr>
<td>Over 8 to 18</td>
<td>104.0</td>
<td>22%</td>
<td>92.2</td>
</tr>
<tr>
<td>Over 18 to 31</td>
<td>61.1</td>
<td>13%</td>
<td>58.9</td>
</tr>
<tr>
<td>Over 31 to 41</td>
<td>92.0</td>
<td>19%</td>
<td>48.1</td>
</tr>
<tr>
<td>Over 41</td>
<td>25.1</td>
<td>5%</td>
<td>84.5</td>
</tr>
<tr>
<td>Total</td>
<td>477.5</td>
<td></td>
<td>465.5</td>
</tr>
<tr>
<td>Average weight</td>
<td>19.2</td>
<td></td>
<td>20.7</td>
</tr>
</tbody>
</table>

Table 7. Heavy goods vehicles licensed in the UK at 31 December 2001 and 2011
Source: Department for Transport, 2013
4.2. Number of HGV operators in the UK

To operate an HGV (defined as a lorry with a gross weight in excess of 3.5 tonnes), a business must obtain one of three types of license:

- **Restricted licenses** authorise operators to carry their own goods in the course of their trade or business in Great Britain and on international journeys.
- **Standard National licenses** authorise operators to carry both their trade and business and goods for other people for hire and reward in Great Britain.
- **Standard International licenses** are like Standard National licenses but operators are also allowed to carry goods for themselves and other people to countries outside Great Britain.

![Graph showing the number of goods vehicle operators registered in Great Britain from 1999 to 2012. The graph has two vertical axes: one for the number of licenses and one for the percentage of HGV operators. The x-axis represents the years from 1999 to 2012, divided into 2-year intervals. The y-axis represents the number of licenses from 0 to 120,000. The colors used in the graph are blue for Restricted, green for Standard National, and yellow for Standard International.](image)

**Figure 4. Goods Vehicle Operators Registered in Great Britain: 1999-2012**

Source: Office of the Traffic Commissioners, 2000-2013

The number of licenses ‘in issue’ to goods vehicle operators has been declining continuously over the past decade (Figure 4). Overall, there were nearly 26k fewer licensed HGV operators in Great Britain in 2011-12 than in 1999-2000, a drop of 36%. Over this period, the number of Restricted licenses issued fell by 17%, Standard National licenses by 28% and Standard International by 36%. The largest decline in the number of registered operators has been in the international category, reflecting the fact that UK hauliers have found it increasingly difficult to compete on the European market. This trend is also likely to be related to the decline in exports to other European countries, as UK exporters tend to use their local hauliers for international distribution to foreign markets. The proportions of HGV licences in the three categories have, nevertheless, changed little over the past decade (Figure 5).
Average fleet size varies widely between operators with the different types of license. Own account operators with restricted licences typically have much smaller fleets than ‘hire-and-reward’ hauliers operating in the UK and internationally. In 2011-12 own account operators held 52% of the licences in Great Britain but operated only 27% of the HGVs (Figures 5&6). Across the entire population of HGV operators the average fleet size increased between 1999 and 2012, but only marginally from 3.6 to 4.1 vehicles. The road haulage industry in the UK, like its counterparts in virtually every other country in the world, remains highly fragmented.

5. Sustainability of the UK road freight transport sector

CO₂ emissions from road freight transport are directly related to the type and amount of energy used by HGVs (Piecyk, 2012). As virtually all HGVs are diesel powered, the energy use equates directly to the amount of diesel fuel consumed. For every litre of diesel burnt 2.6 kilograms of CO₂e are emitted to the atmosphere (DEFRA, 2013). Energy use, in turn, is driven by the demand for road freight transport, which until around 1997 was quite closely related to economic growth (McKinnon, 2007a). Thus, on a macro-level, the trend in CO₂ emissions is underpinned by the relationship between the volume of road freight movement and economic growth. This relationship can be then
broken down into a series of aggregate logistics-related values and key variables, giving a micro-level perspective on the problem. The recent trends in the key logistics variables are presented below.

All statistics presented in this section are based on the UK-registered HGV vehicles and exclude foreign-registered vehicles operating in the UK. Unless otherwise specified, the data presented below excludes freight movements in vans.

5.1. Greenhouse gas emissions from road freight transport

GHG emissions from road freight transport have attracted increasing attention in recent years. The sector accounts for 5-6% of the UK’s carbon footprint. In 2008 the UK government passed climate change legislation, committing the country to reduce its emissions of GHGs to at least 80% below 1990 levels by 2050. At a sectoral level, the Freight Transport Association (FTA) has set a voluntary target for its Logistics Carbon Reduction Scheme (LCRS) member companies, to reduce the carbon intensity of their freight transport operation by 8% between 2010 and 2015 (FTA, 2011).

![GHG emissions from freight transport in the UK](image)

Over the last 20 years, the total annual GHG emissions from road freight transport oscillated around 18 million tonnes of CO₂e (Figure 7), despite the underlying growth in road freight transport activity (Figure 9). There was a pronounced drop to 15.7 million tonnes of CO₂e in 2009, primarily as a result of contraction of the road freight transport market.

The GHG intensity of road freight transport movements (Figure 8) increased slightly in 2008 and 2009, reversing the long-term improving trend, evident since at least 1993. Faced with a sudden drop in demand caused by the recession, operators were not able to maintain efficiency. The GHG intensity of road freight movement declined again in 2010, suggesting at least some re-attainment of the long-term efficiency improvements. It is worth noting that the overall reduction in the GHG

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1 The total fuel consumption was estimated by multiplying the vehicle-kms travelled by different categories of rigid and articulated lorries, by average fuel efficiency for each vehicle class. The GHG emissions were then calculated by multiplying the total fuel consumption by GHG intensity value for diesel fuel (assuming a standard 5% biodiesel blend was used), provided by DEFRA (2013). The analysis does not account for the change in the carbon content of diesel fuel over the specified timeframe, as the data is not available. The total GHG emissions were divided by the tonne-kms carried by each vehicle class, in order to derive the GHG intensity values (Figure 8).
intensity of the sector has been primarily driven by the improvements in the carbon efficiency of freight movements in large articulated trucks. Over the same period, the GHG intensity of movements performed by smaller rigid lorries has fluctuated between 0.24-0.25 kg CO₂e/tonne-km.

5.2. Demand for road freight transport

Figure 9 shows the trends in road tonne-kms, tonnes lifted and vehicle kms between 1980 and 2010. As explained above, tonnes lifted are derived by adding together the weight of all the loads carried. Tonne-kms are derived by multiplying the weight of a load by the distance over which it was hauled. Vehicle kms represent the total distance travelled by HGVs in a given year. As measures of the level of freight transport activity, both tonnes-lifted and tonne-kms have one major limitation – they are both weight-based and take no account of the cubic volume of goods moved. It clearly takes much more lorry traffic to move 100 tonnes of a low density product like clothing than a dense product such as cement. Changes in the average density of freight through time, reflecting for example a shift from heavy industry to the manufacture of lighter consumer goods, can distort the relationship between tonne-kms and vehicle-kms. Therefore it is important to supplement the analysis of tonnes-lifted and tonne-km trends with some consideration of vehicle-kms trends.
There were 90 billion tonne-kms performed by HGVs in 1980. This had been increasing until 1990, when the freight transport activity contracted following the economic downturn in early 1990s. Since 1992 the road freight tonne-kms rose again until 2007, when they peaked at 157 billion. Tonnes lifted and vehicle kms had followed a very similar pattern until early 2000s. The total distance travelled by lorries stabilised between 2002 and 2007 since then, while tonnes lifted continued to grow until 2007. The 2008 and 2009 data for all indicators show a downward change from 2007, resulting from the recent slowdown in the economic activity. Overall, between 1980 and 2010 HGV tonne-kms rose by 54% (from 90 to 139 billion), tonnes lifted by 13% (from 1.3 to 1.5 billion) and vehicle kms by 18% (from 16 to 19 billion). As freight transport activity is intensifying, negative social and environmental impacts associated with it are very likely to worsen too. Hence, it is important to understand the underlying causes of this growth to improve the overall sustainability of freight transport sector in the future.

5.3. Economic Activity and Road Freight Traffic Growth

Historically, there has been a close relationship between economic growth (typically measured as Gross Domestic Product (GDP)) and freight transport growth. The underlying rationale used to explain the relationship between GDP and freight volumes often refers to the fact that transport is generated by other economic activities and, as such, can be described as ‘a second-order activity’ or a derived demand. Thus, changes in the production and consumption of goods and services will determine the demand for freight transport. Indeed, a cross-sectional study of thirty-three countries at different stages of development undertaken by the World Bank using 1989 data found that differences in GDP explained 89% of the variation in road tonne-kms (Bennathan et al., 1992).

While economic growth increases the welfare of a country, externalities associated with road freight transport reduce that welfare. Thus, the question of how a country can experience economic growth without facing the negative side effects of transport growth is receiving increasing attention. This highly desired ability of an economy to grow without a corresponding increase in road freight transport activity is commonly referred to as ‘decoupling’.
In terms of freight transport in general, the UK case is different from the situation in the European Union as a whole, where there is a continuous strong link between freight transport demand and GDP and, in fact, in some of the countries freight transport is growing at a much faster rate than GDP.

Figure 10. Decoupling of economic growth and freight transport
Source: Department for Transport, 2012, Office for National Statistics, 2013b

Figure 10 shows the relationship between UK GDP and road freight movements. Overall, this relationship was relatively stable until the late 1990s. The recent experience, however, suggests that there has been a pronounced decoupling of economic growth and the growth in road freight movement. Between 1997 and 2007, GDP rose by 37% in real terms while road tonne-kms grew by only 5%. If this decoupling were to continue, it would indicate a long-term structural change in the UK economy, in which increasing national prosperity would not generate a proportional increase in freight traffic volumes. Stabilisation and subsequent reduction in freight-related externalities would help to promote the sustainable development policy and sustainable logistics strategy advocated by the British Government and European Union.

Figure 11. GDP and HGV tonne-kms: annual growth rates, 2007-2010
Source: Department for Transport, 2012, Office for National Statistics, 2013b

The potential for decoupling economic growth has been recognised and promoted by the Government over the last decade. Nonetheless, it is questionable if this trend is going to endure, as most recent evidence suggests that expectations of the long-term decoupling may have been premature (McKinnon et al., 2008). In 2007, after more than 10 years in which the annual growth
Rates for road tonne-kms were lower than that of GDP, the two rates converged again at 3% (Figure 11). Also, the effect of the recent economic downturn is clearly visible in 2008 and 2009 data, leading to a contraction of the road freight market at a greater rate than the economy in general. Conversely, in 2010, road tonne-km grew by 11% on the previous year, whereas GDP increased by a marginal 2%.

Overall, there is evidence of long term decoupling of GDP and tonne-km trends, although, at present, its potential to contribute to the long-term environmental sustainability of road freight transport remains uncertain. The current instability of the domestic and international freight markets is most likely to affect also data sets in the near future, temporarily distorting longer-term decoupling trend. It is expected, however, that while the economy gradually recovers, the level of GDP growth will continue to outpace the increase in the freight traffic volumes.

McKinnon (2007a) carried out a comprehensive assessment of possible causes of the decoupling of GDP and road freight transport in the UK and their relative importance. Based on the available data:

- increased penetration of UK haulage market by foreign operators explained 33% of the observed decoupling;
- decline in road’s share of the freight market explained a further 22%;
- increase in the real cost of road freight transport explained 12%;

Diminishing rate of spatial concentration, erosion of industrial activity to other countries, increasing share of service activities in the composition of GDP, and the geographical location of the country limiting the amount of European transit freight movements, were also believed to have a ‘very significant’ (even though impossible to quantify) impact.

In conclusion, McKinnon (2007a) suggested that although the signs of decoupling are encouraging and definitely in the right direction, “the recent decline in the road tonne-km intensity of the UK economy will need to be supplemented by further reductions in empty running, higher vehicle load factors, improvements in fuel efficiency, tightening emission controls and a continuing modal shift to rail and water” (p.61).

5.4. Green Logistics Framework

Although the signs of decoupling are a positive development, it can be argued that explaining the growth in road freight transport and related CO₂ emissions solely in terms of underlying economic growth or other industrial indices is not sufficient to be able to target the problem effectively. There is a need for a framework providing an understanding of how changes in logistics systems can help to break the link between economic growth and road freight transport-related GHG emissions. The structure of freight transport growth in Europe has changed in the last few decades and this change relates to “the logistically induced demand for transport, especially the increase in flexibility of the production and distribution structures” (Drewes-Nielsen et al., 2003, p.295). Thus, there is a strong need to disaggregate the relationship between GDP and road tonne-kms into a series of logistical variables to enable an in-depth analysis of the underlying causes of freight traffic growth (McKinnon and Woodburn, 1996).

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2 Foreign vehicle activity is not recorded in the Continuous Survey of Road Goods Transport (CSRGT) survey, the key source of tonnes-lifted and tonne-kms data.
The relationship between economic output, the demand for road freight transport, and related GHG emissions is determined by seven key variables (Figure 12):

- **Modal split** – represents the division of the tonnes or tonne-kms transported by the different modes of transport
- **Handling factor** – indicates the number of links in a supply chain
- **Average length of haul** – the average distance each unit of freight is moved on a single journey
- **Lading factor** – the ratio of what a HGV actually carried to the maximum that it could have carried if, whenever loaded, it was loaded to its maximum carrying capacity (in weight terms)
- **Empty running** – the proportion of total vehicle kms run without a load
- **Fuel efficiency** – expressed as distance travelled per a unit of fuel used (e.g. mpg)
- **Carbon intensity of fuel** – the amount of CO\(_2\)e emitted per unit of fuel used

![Diagram of Green logistics framework](image)

*Figure 12. Green logistics framework*
The starting point is total production or consumption measured in terms of output weight. It is linked by a number of conversion factors to the amount of lorry traffic measured in vehicle kms and associated GHG emissions. Handling factor and the average length of haul determine the supply chain structure. Lading factor and empty running are the two parameters of vehicle utilisation and fuel efficiency and carbon intensity of fuel can be subsumed under the heading ‘fuel management’. This framework can be used to estimate how changes in each of the variables can contribute to an increase or a reduction in the GHG emissions from road freight transport.

5.5. Modal split

Road is by far the dominant mode for goods movement in the UK. Road freight transport by HGVs was responsible for 76% of goods lifted and 63% of tonne-kms moved in 2010 (Figure 13), compared with 7% / 5% by vans, 5% / 9% by rail, 5% / 19% by water and 8% / 5% by pipeline (Department for Transport, 2012, 2013).

The share of tonnes lifted by HGVs increased from 74% in 1980 to 78% in 1984 and, since then, it has been relatively stable at around 76-78%. In terms of tonne-kms moved, trucks’ share of the UK freight market had been increasing up to 1997 and then declined by 8% between 1997 and 2005. McKinnon (2009) suggests that this break in the earlier trend can be partly associated with the privatisation of rail freight services in 1996. Nevertheless, road’s share increased again to 63% in 2007. McKinnon (2007b) attributes this increase to the reduction in coastal shipping tonne-kms, due to the decline in the North Sea oil production. In total, over the period between 1980 and 2010, tonne-kms moved grew by 54% from 90 to 139 billion tonne-kms.

![Figure 13. HGV freight market share by tonne-kms and tonnes lifted. Source: Department for Transport, 2012, 2013](image)

In the UK, the volumes of freight moved by rail had been in a long-term decline since the 1950s, with this trend continuing over the mid-1980s and 1990s “though with a shorter-term cyclical trend within the longer-term downward one” (Woodburn, 2001, p.2). Tonne-kms moved by rail reached a low point of 13 billion tonne-kms in 1994 and 1995. More recently, the volumes have been increasing gradually to 19 billion tonne-kms in 2010, though the percentage share of rail in the freight transport market has been relatively stable at 8-9% over the last decade. Coal and coke accounted for 38% of tonne-kms moved and 46% of tonnes lifted by rail in 2008.
In 2010, 106 million tonnes were lifted and 42 billion tonne-kms were moved by waterborne transport. Looking at the longer term trend, tonnes lifted peaked at 156 million tonnes in 1988 and have been declining gradually since then. Tonne-kms have been relatively stable since the early 1980s, with two peaks at 67 billion tonne-kms in 2000 and 2002. Crude petroleum and petroleum products are the main cargo moved by waterborne transport, accounting for 73% of its total tonne-kms and 47% of tonnes lifted in 2008.

Given that, after airfreight, road is the most CO₂ intensive transport mode (McKinnon, 2007b), shifting more freight to rail, waterborne or pipeline transport would lead to a reduction in the absolute level of energy consumption and GHG emissions from moving freight. Significant modal shift could be achieved by promoting intermodal services. Intermodal transport can be defined as the movement of goods in one loading unit or vehicle by successive modes of transport without handling of the goods while changing modes (Woodburn, 2008). The volume of intermodal transport represents around 5% of total freight in Europe (Savy, 2009). Although an equivalent figure for the UK is not known, as rail intermodal is simply subsumed in the rail figure, intermodal freight transport is developing into a significant sector of the freight transport industry and helps to improve the environmental performance of freight transport sector as a whole.

5.6. Supply chain structure
Supply chain structure is characterised by two variables: the number of links in the supply chain and the average distance between them.

5.6.1. Handling factor
The number of links in the supply chain can be measured by the handling factor. It can be estimated by dividing tonnes lifted by the total weight of goods moved. As tonnes lifted are recorded every time goods are loaded onto a vehicle, the same load gets recorded several times as it makes its way through the supply chain. Thus, dividing tonnes lifted by the actual weight of loads moved gives a crude estimate of how many times, on average, goods are being handled as they move along the supply chains, i.e. number of links in the chain.

Handling factor is relatively difficult to estimate mostly because of different commodity classification systems used by different surveys employed to gather economic output and freight transport data. Production / consumption data is typically reported in ‘value’ rather than ‘volume/weight’ units. Hence, it needs to be converted to volume / weight but, there is a lack of reliable value-to-weight conversion ratios. Thus for the purpose of this report a slightly modified approach was applied. Instead of trying to find proxies for the unavailable data, which had previously proven highly problematic (Sorrell et al., 2009), an approximate handling factor was calculated by dividing the tonnes-lifted estimates by corresponding material flow value published in the UK National Accounts.

The Direct Material Input (DMI) was used as a substitute for the weight of output data. DMI is defined as the sum of the total amounts of primary resources extracted from the UK environment and the amount of imports into the UK. DMI includes the weight of goods exported and excludes the excess material or hidden flows associated with the domestic extraction and import of materials. It can be considered as the most appropriate estimate of the weight of goods produced and/or
consumed within an economy. The DMI has been relatively stable over the last four decades, with only a modest 7% increase from 799 million tonnes in 1970 to 851 million tonnes in 2007, and a recent reduction to 707 million tonnes in 2011 (Office for National Statistics 2013c). The estimated handling factors for all modes and road freight transport are shown in Figure 14.

The handling factors for all modes of transport increased gradually from 2.2 in 1980 to 2.8 in 2010. The handling factor for goods moved by road had first decreased from 3.2 in 1980 to around 2.9 in the mid-1990s and then the trend has reversed, reaching the value of 3.4 in 2010. This suggests that supply chains served by road were subject to restructuring pressures causing a reduction in the number of links in the supply chain up to mid-1990s, but recently structures with more handling points have started to emerge.

The increasing number of links within domestic road-based supply chains is likely to be a result of the following developments:

1. **Development of primary consolidation and centralised sortation** – in order to improve / maintain vehicle fill during a period of tightening JIT pressures, companies are channelling more consignments through consolidation centres where their products are combined with those of other suppliers for delivery in a fully loaded vehicle. Also, the development of hub-and-spoke networks for handling parcel and pallet loads has added to the average number of links in the supply chains.

2. **Growth of online retailing** – this adds an extra link to the supply chain where it ends at the customer’s home rather than at the shop.

3. **Reverse logistics** – with more waste being recycled or reused instead of being sent to landfill, new reverse channels comprise more nodes and links for sorting and reprocessing.

4. **Insertion of additional stages in the production process** – for example changes in consumption habits such as shift to more pre-prepared or ready-made food, can require insertion of more processing points into the food supply chain.

5. **Vertical disintegration of production** – occurs when some intermediate activities are outsourced to subcontractors, resulting in products moving between a greater number of facilities in the production process.
6. **Changes in product mix** – as economies develop, consumers switch a greater proportion of their expenditure away from basic commodities towards more complex products, for instance electronic equipment, requiring multistage assembly operations.

The relative contributions of the factors listed above are virtually impossible to quantify as their strength varies across industry sectors, commodity groups, countries and even regions (McKinnon, 2008). Overall, Figure 14 clearly suggests that in the UK a trend towards increasing the number of links in supply chains has been prevalent since the early-2000s.

### 5.6.2. Average length of haul

The average length of haul had increased significantly over the 20th century from just 35 kms in 1953 to 95 kms in 1999. It then stabilised at 86-87 kms until 2009 when it started to increase again to 93 kms in 2011. Articulated lorries have significantly longer average length of haul than rigid vehicles. Also, the average haul lengths of the two categories of trucks have followed different paths over the past thirty years. The trend for articulated vehicles exhibits a steeper increase until the late 1990s and a falling average length of haul since then. Rigid vehicles show a relatively stable pattern over the last three decades with slight peaks around early and late 2000s (Figure 15).

![Figure 15. Average length of haul](image)

Source: Department for Transport, 2012

One of the most frequently mentioned reasons offered for the lengthening of the average length of haul is centralisation of economic activity. Spatial concentration of economic activity enables companies to exploit economies of scale in operations but results in greater distances between factories, warehouses and other facilities within the logistics system. Also, the concentration of international freight on main hub ports and airports results in expanding hinterlands and longer domestic feeder movements (McKinnon, 2008). According to McKinnon (1989), concentration of inventory was likely to have been a major cause of the over 50% increase in the average length of haul between the late 1960s and early 1980s.

The supply chain structure considerably affects the overall performance of logistics, particularly since there is a close correlation between the distance travelled and probability of empty running. Cundill and Hull (1979) established that the percentage of empty running declines as the length of a
trip increases, reflecting the greater economic incentive to carry a load over longer distances. They indicate that for hauls up to about 300 km, the empty running declines steadily at a rate of a little under 1% per 10 km. Also, only about 15% of all trips over 500 km are empty, well below the overall average of 28%. On the other hand, there is also a strong relationship between distances travelled and maximum and minimum trip times, i.e. the longer the journey the more variable the travel times (Palmer and Piecyk, 2010), which may result in limited opportunities to carry a backload on the return journey. Hence, as the average length of haul increases, more adaptation measures may be required to adjust the logistics system to less reliable transit times.

5.7. Vehicle utilisation
The level of vehicle utilisation is measured by key variables: empty running and lading factor.

5.7.1. Empty running
“A fundamental difference between passenger and freight transport is that people generally return to their starting point, whereas almost all freight consignments move in one direction, from point of production to point of consumption” (McKinnon and Ge, 2006, p.391). Empty running is inherent in any freight transport system as empty vehicles need to be repositioned to the point where the next demand arises. Empty running contributes to road congestion, increases cost to road haulage operators and results in a range of negative environmental impacts. Consequently, the reduction of empty running should be a priority in every sustainable transport system.

![Figure 16. Empty running](image)

In the UK, empty running decreased from over 31% of the total distance travelled in the mid-1980s to 26% in 2001. However, since then it has risen again, reaching nearly 29% in 2010. As a result, around 5.4 billion kms were driven unladen in 2010. The empty running by rigid vehicles had been persistently a few percentage points higher than by articulated vehicles until 2008, when the two values merged at 29%. There is virtually no difference in the percentage of empty running for the own account and hire and reward operators. The average levels of empty running for the two groups of operators have remained very similar over the past two decades.
Factors influencing empty running
The long-term decrease in the percentage of lorry kms run empty can be attributed to the following factors (McKinnon, 1996, McKinnon and Ge, 2006):

1. **Increase in the average length of haul** – the economic incentive to find a suitable load increases with the distance over which a vehicle has to travel
2. **Change in trip structure** – the proportion of kilometres run empty declines as the number of drops per trip increases. On a multi-stop journey only the last leg would normally be run empty and, at the same time, it is also likely to be relatively short
3. **Greater use of load-matching services** – as load matching agencies provide an increasingly comprehensive range of services, including credit rating assessment of potential customer, the risk associated with picking up backload traffic on a spot hire basis is significantly reduced. Using the UK as a case study, Davies et al. (2007) examined the extent to which information communication technology (ICT) and Internet freight exchanges affect the road freight transport industry. Their research shows that almost 33% of companies investigated used the Internet at least sometimes to access backloads and, out of them, 69% indicated that using freight exchanges had helped to reduce empty running
4. **Reverse logistics**, this includes the reverse flow of waste packaging material and re-usable handling equipment which has been growing in recent years
5. **Management initiatives to improve backloading**, e.g. retailers using returning shop delivery vehicles to collect loads from by suppliers sometimes on a factory gate pricing basis (Potter et al., 2007)
6. **Increasing cost of road transport**

Although backloading has become an increasingly common practice in the road freight industry, there is still a significant proportion of vehicles returning to base without a load. No research has yet been done to explain why the percentage of kms travelled empty has been increasing in recent years. It is uncertain whether this rise is going to endure or if it is a temporary discontinuity in the statistical data series.

Based on past research, the most commonly listed factors inhibiting backloading include (McKinnon, 1996, Davies et al., 2007):

- **Requirements of the outbound delivery service** – due to customer service requirements, priority is given to outbound deliveries
- **Internal management structure**, particularly lack of co-ordination between purchasing and logistics departments that may result in many backloading opportunities being unnoticed
- **Incompatibility of vehicles and products**, the risk of cross-contamination between products can also limit backloading opportunities
- **Rates available for backhauls are too low**
- **Need to recover handling equipment / packaging**
- **Time limitations and poor matching of locations and schedules** – available loads take too long to load and deliver and/or working practices such as booking-in schedules or opening times can make picking up a backload impossible
5.7.2. Lading factor
Lading factor is expressed as a ratio of the actual weight of goods to the maximum weight that could have been carried on a laden trip. The average load factor declined in the UK from 66% in 1984 to 59% in 2010, reaching its lowest point at 56% in 2006. The lading factor has been consistently higher for articulated than for rigid vehicles (Figure 17).

[Figure 17. Lading factor
Source: Department for Transport, 2012]

As the lading factor is a weight-based measure, it gives no indication of how the vehicle loading has changed in terms of cubic volumes carried. Also, as it is expressed as a percentage of available vehicle capacity, the changes in the maximum permissible weight and dimensions of HGVs have affected the lading factor over the years. Figure 18 shows the trend in the average weight carried per HGV journey. The average load increased gradually to 10.4 tonnes in 2010. The inverse relationship between average load weight and lading factor suggests that available carrying capacity is growing faster than the actual average load.

[Figure 18. Average load carried on laden trips.
Source: Department for Transport, 2012]
Factors influencing lading factor

The declining levels of vehicle loading can be attributed to the following constraints (McKinnon, 2006b):

- **Demand fluctuations** – when a company faces variable demand, the vehicles acquired with sufficient capacity to accommodate peak orders, will inevitably be running with excess capacity during periods of low demand.
- **Just-in-time (JIT) delivery** – when more frequent replenishment of supplies in smaller quantities is required, this tends to depress vehicle loading.
- **Unreliability of delivery schedules** – if schedules are unreliable, due to for example road congestion, more vehicles may be needed to serve a given number of delivery points within the required period. As a result, these vehicles will be travelling only partially loaded.
- **Vehicle size and weight restrictions** - as lading factor is an exclusively weight-based measure, it may underestimate the actual utilisation of vehicles as an increasing proportion of loads are volume, rather than weight-limited (Figure 19). In 2010, 30% of tonne-kms carried by HGVs were limited by volume, while only 3% were limited solely by weight (Department for Transport, 2012).
- **Health and safety regulations** may also constrain weight and dimensions of loads.
- **Capacity constraints at company premises** – sometimes the size of load is constrained by the storage capacity at one end of the trip, for example pallet stacking may be constrained by the standard slot height of warehouse racking systems.

![Figure 19. Proportion of tonne-kms limited by weight and/or volume, 2010](image)

Source: Department for Transport, 2012

The trends in the two key variables determining vehicle utilisation, i.e. empty running and lading factor seem to have reversed their longer-term directions in a last few years in the UK. Empty running has been increasing since 2003, despite increasing attention and numerous industry initiatives aimed at reducing it. The lading factor increased slightly over the last few years. This should help companies to at least partially offset the negative consequences of empty running. Consolidation of loads in larger / heavier vehicles (for example through the use of double-decks or longer semitrailers) and inter- company collaboration (both vertically as well as horizontally across supply networks), are the two initiatives believed to offer the greatest potential for further improvements in vehicle utilisation in the near future.
5.8. Fuel management
Fuel management focuses on two main ratios, the fuel efficiency and carbon intensity of fuel used.

5.8.1. Fuel efficiency
Fuel efficiency data for road freight transport have been collected by the Department for Transport since 1989. The fuel consumption figures for 1993 onwards have been revised, hence, data for 1992 and earlier years are not comparable with the later series. Since 1993, articulated vehicles have become increasingly fuel efficient with the average distance travelled per litre of fuel increasing from 2.5 kms in 1993 to 2.9 kms in 2005 and 2.7kms in 2010. For comparison, in the US, the efficiency of medium and heavy trucks improved only modestly from 2.4 km/litre in 1966 to 2.5 km/litre in 2006 (Sivak and Tsimhoni, 2009). The average fuel efficiency for the UK-registered rigid vehicles, on the other hand, has decreased from 3.4 km/litre in 1993 to 3.2 km/litre in 2010 (Figure 20).

![Figure 20. Fuel efficiency (km/litre)](image)

Source: Department for Transport, 2012

In the UK, fuel constitutes around 32% of annual vehicle operating costs (Burns Inquiry, 2005) and this can rise to over 35% during periods of high oil prices (McKinnon, 2012). Fuel prices in the UK are amongst the highest in Europe (14% above the EU28 average in October 2013 (European Commission, 2013)). Increases in these prices give operators a strong incentive to improve the fuel efficiency of their fleets. Relying on high fuel price alone to encourage companies to improve their fuel efficiency, however, may not be sustainable in the longer term.

**Improving fuel efficiency**
In a typical modern diesel truck engine, 53% of the fuel energy is lost as heat through the exhaust system and cooling system, and another 5% is dissipated through engine friction and pumping losses, leaving 42% available as engine output (Ang-Olson and Schroer, 2003). This energy is used to overcome the following factors:

- Aerodynamic drag
- Rolling resistance
- Drive train friction
- Operation of ancillary equipment
- Inertial forces (during acceleration or climbing).
The contribution of each of these factors to energy losses depends on operating speed, vehicle weight, terrain, driver behaviour, weather and pavement conditions, etc. Thus, these are the areas that should be targeted when fuel efficiency improvements are sought. Leonardi and Baumgartner (2004) classify fuel efficiency measures into four categories:

- **Logistics efficiency** - ensuring optimal loading of vehicles, selecting the most suitable vehicle category and optimising all transport links from the point of origin to the final destination
- **Vehicle efficiency** - vehicle technology, design and maintenance
- **Driver efficiency** - training and / or assistance from on-board units used for measuring components of driving behaviour that influence fuel use
- **Route efficiency** - optimal routing based on information about itinerary, road and traffic conditions, etc.

![Bar chart showing top ten fuel efficiency interventions, FTA survey 2012](image)

*Figure 21. Top ten fuel efficiency interventions, FTA survey 2012
Source: FTA, 2013*

Data collected by the UK Freight Transport Association (2013) indicates that 73% of responding companies regularly monitor the fuel performance of their drivers. Implementing automated manual transmission, reducing engine idling and installing cab roof air deflectors are the three most popular measures to improve fuel efficiency (Figure 21). However, the survey was conducted amongst companies who are already members of the FTA’s Logistics Carbon Reduction Scheme, hence are likely to be more pro-active in reducing their GHG emissions. Therefore, there seems to be a great potential for further fuel efficiency savings within the industry. A study by RICARDO (2009) for the UK Department for Transport identified aerodynamic trailers, vehicle platooning (i.e. HGVs driving in
‘convoys’ on motorways) and Safe and Fuel Efficient Driving (SAFED) driver training as having the greatest potential to reduce fuel consumption and related GHG emissions.

5.8.2. Carbon intensity
Currently, diesel fuel is the main source of energy for road freight transport throughout the world. Burning one litre of diesel fuel emits 2.6 kg CO$_2$e (DEFRA, 2013). One way to reduce GHG emissions from road freight transport is to switch to less carbon intensive fuels. Alternative fuels include biofuels and other non-diesel fuel sources e.g. natural gas, electricity or hydrogen.

In terms of carbon intensity, however, the reduction in CO$_2$ emissions attributable to biodiesel can only be assessed on a life-cycle basis. The exhaust CO$_2$ emissions are comparable for bio- and conventional diesel fuel, with some of the recent studies suggesting even a 10% increase in the tailpipe CO$_2$ emissions when using biodiesel (Department for Transport, 2007). This is because of the lower heat value of biodiesel which results in lower fuel efficiency. It is the carbon sequestration effect of growing the plants to produce biodiesel that contributes to lower CO$_2$ emission factors for biodiesel on a life-cycle basis. The full impact of biofuels, taking account of land use change, still remains uncertain. For example, Fargione et al. (2008) show that biodiesel, if produced on converted tropical rainforest in Indonesia and Malaysia (these two countries currently account for 86% of global palm oil production), could increase greenhouse gases when compared with refining and using the fossil fuels it typically displaces. The adverse effects of land conversion necessary for biofuel production may be overcome by the use of ‘second-generation’ biodiesel “derived from waste and forest products grown on land unsuited to agricultural production (…), though large-scale commercial production may take years to develop” (McKinnon, 2008, p.19). Biomethane/biogas now seem more promising biofuels for trucks and vans.

Other alternative fuels include hydrogen, natural gas – compressed or liquid (CNG, LNG), and liquid petroleum gas (LPG). However, their applications in HGVs are at present still very limited. The main challenge to successful adaptation of alternative energy sources is ensuring the availability of relevant fuels. Provision of storage facilities and refuelling infrastructure is a key to wide industrial acceptance of a given energy option (Beresford et al. 2003). Also, availability of raw materials, as well as production and distribution costs are crucial (Johansson, 2003).

Electric vehicles are becoming increasingly popular around the world, despite still having relatively limited driving distances and lengthy battery charge times. There are two major advantages of electric vehicles – they emit virtually no tailpipe emissions and they are much quieter than conventional trucks. This makes electric vehicles particularly suited for the demands of urban distribution. Although electric trucks are virtually pollution free at point of use, their overall environmental performance depends on the source of electricity used to recharge the batteries. Thus, “until electricity is produced from renewable sources, the burden of environmental damage is merely being transferred from the vehicle to upstream power plants” (Leonardi, Cullinane and Edwards, 2012, p.321). Further, electric or hybrid (diesel-electric) engines are only likely to be used in rigid vehicles. The opportunities for their application to long haul articulated lorries seem to very limited, except to power ancillary equipment (McKinnon et al., 2012). Electrification of the vehicle
body equipment, such as refrigeration and refuse handling, although still limited to specific body types, offers a significant potential for CO₂ reduction (RICARDO, 2009).

It is important to note that in the case of alternative fuels, reduction of CO₂ emissions is not the sole objective and consideration needs to be given to the whole range of air pollutants. Different fuels emit different mixes of pollutants, both on a tailpipe and life cycle basis. Although minimising carbon emissions is a priority in preventing climate change, other health and non-health effects of air pollution associated with exhaust emissions need to be taken into account when evaluating alternative fuel options.

6. Traffic accidents

Involvement of freight vehicles in road traffic accidents is an important external effect of freight transport. Since 2001 the annual number of HGVs involved in accidents in the UK has more than halved, from 14,813 to 7,126 (Figure 22). This reduction in the level of accident involvement has been achieved despite significant increase in the volume of HGV traffic. Between 2001 and 2011 accident involvement per million vehicle-kms dropped from 0.53 to 0.28.

![Figure 22. Annual number of HGVs involved in traffic accidents](source: Department for Transport, 2013)

The reduction in accident involvement has been paralleled by a steep reduction in the number of casualties in accidents involving HGVs over the past decade. Rigid vehicles were involved in four fatal, 239 serious and 1543 slight accidents more, than articulated lorries (Figure 23). It should be noted too that accident involvement does not necessarily mean that the freight vehicle was to blame for the accident.
7. Conclusions

This study has reviewed the available data on many aspects of the UK's logistics and road freight transport systems. Several key messages emerged from this review:

- Logistics is a vital part of the UK economy and a key enabler of long-term prosperity and socio-economic wellbeing.

- The UK freight market shows signs of recovery with the volumes of freight increasing since 2010. This trend is also evident in the road freight transport sector. In 2010, HGVs travelled 18.8 billion kilometres, carrying nearly 1.5 billion tonnes of freight.

- The road haulage industry remains highly fragmented with the average fleet size of four vehicles. 87% of road haulage companies employ fewer than 10 people and there are only 55 road haulage companies in the UK employing 250+ workers.

- The GHG intensity of road freight transport increased in 2008 and 2009, breaking the preceding long-term reduction trend. The sudden decline in freight volumes during the recession made it very difficult for businesses to maintain the efficiency of their road freight transport operations. In 2010, the GHG intensity declined again to 0.12 kg CO$_2$e / road tonne-km, suggesting at least some restoration of the past efficiency improvement trend.

- Road-based supply chains typically comprise 3.4 nodes with an average distance of 93kms between them.

- The proportion of vehicle-kilometres run empty has been increasing since 2001. In 2010, 29% of HGV kilometres were driven without carrying a load. On laden journeys, on average 10.4 tonnes of freight was carried.
• Had the empty running remained at the lowest recorded levels (i.e. 27.2% for rigid and 25.2% for articulated trucks), 471 million truck kms could have been avoided in 2010, saving 164 million litres of diesel fuel, 426 thousand tonnes of CO₂e, and £160 million in fuel costs.³

• There have been steep reductions in the involvement of HGVs in traffic accidents and in the number of related casualties.

Published statistics in the UK permit a thorough analysis of the road freight transport sector. However, recent cutbacks in government-sponsored freight surveys are very worrying. Without detailed and accurate freight data it is very difficult to make informed decisions about freight-related policy measures and infrastructure investment decisions. As the UK economy continues on its path to recovery, it is important that public and private resources are allocated with full appreciation of business realities and the complexity of modern supply chains. With the ambitious sustainability targets set for the country and the industry, an in-depth understanding of the road freight transport market is crucial to address the real logistics challenges lying ahead.

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³ The calculations are based on an assumption that reduction of empty running will not cause an increase in laden kms. Bulk diesel prices at 30.09.2010 = 97.90 pence per litre, as recorded by the RHA (2012).
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