HIGHER CAPACITY VEHICLES (HCVs)

Briefing Report – Executive Summary

Technical Report CUED/C-SRF/TR16/S

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This briefing document presents an overview of the topic and a summary of the findings from research and trials into the topic of Higher Capacity Vehicles for long-haul freight transport (HCVs). It is aimed at policy makers. A full version of the report, including all references and data is available from the Centre for Sustainable Road Freight[1].

This report has been produced as part of the Centre for Sustainable Road Freight (SRF – EPSRC grant number EP/R035148/1). Further details about the Centre are available at: http://www.csrf.ac.uk/

[1] Piecyk, M. and Allen, J. 'Higher Capacity Vehicles Briefing', Technical Report CUED/C-SRF/TR16/S, Centre for Sustainable Road Freight, March 2020.

1. Introduction

Policy commitments to reduce greenhouse gases (GHG) in the UK and many other countries require the road freight industry to undergo major change in relation to this aspect of vehicle activity. In the UK, the road freight industry has pledged support to the government's voluntary commitment to reduce GHG emissions from heavy goods vehicles by 15% by 2025 (from 2015 levels), and will also play its part in the government's commitment bring all GHG emissions to net zero by 2050. Research for the Committee on Climate Change's Fifth Carbon Budget indicated that the use of Higher Capacity Vehicles (HCVs) for long distance freight transport could play an increasingly important role in reducing GHG emissions from 2025 on if permitted by government (Greening et al., 2015). In addition, the use of HCVs also has the potential to reduce road freight vehicle kilometres and air pollutant emissions and increase productivity.

2. Higher Capacity Vehicles (HCVs)

The size and weight of goods vehicles operated varies considerably between countries. The term 'HCVs' in this report refers to vehicles that are greater in terms of volume and/or weight carrying capacity than those currently permitted.

In the majority of European Union countries (besides the UK) that have trialled or implemented HCVs this refers to a vehicle with a maximum length of 25.25 metres and weights of 60-75 tonnes (referred to as the European Modular System - EMS). In other countries, such as Australia, Finland and South Africa, HCV lengths and weights exceed these.

1. Current vehicle size and weight limits

The current maximum permitted size and weight of articulated goods vehicles permitted in the UK are shown in Figure 1.

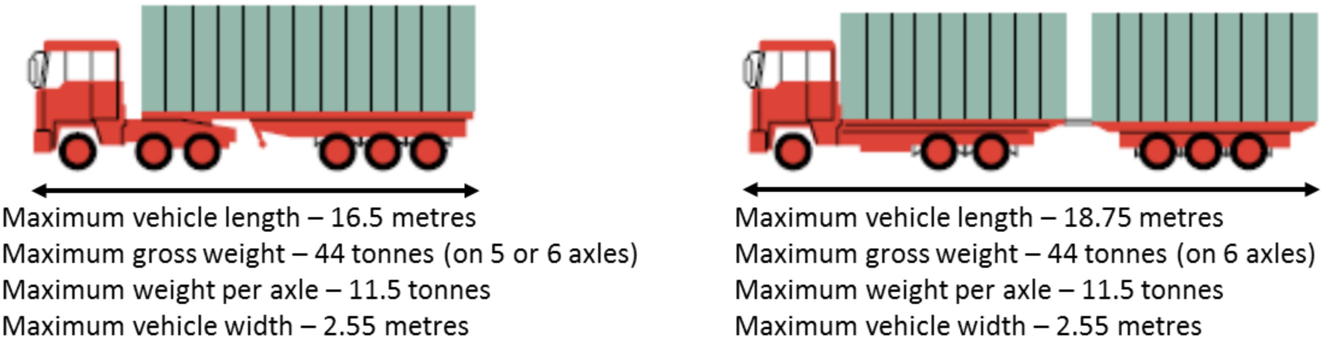

Figure 1. Current maximum goods size and weight in the UK

Many countries have trialled and subsequently adopted HCVs in recent decades. Maximum vehicle lengths up to 25.25 metres (and weights of up to 76 tonnes) are common in EU and Scandinavian countries. HCVs operate in other countries including Australia, Brazil, Canada, Finland, and South Africa. Examples of the maximum goods vehicle sizes and weights introduced in selected countries since 2013 are shown in Table 1.

Table 1. Maximum goods vehicle size and weights in selected countries (OECD/ITF, 2019)

COUNTRY	REGULATION (MASS / LENGTH)	YEAR ESTABLISHED
The Netherlands	60 t / 25.25 m	2013
Finland	76 t / 25.25 m	2013
Denmark	60 t / 25.25 m (long-term trial)	2014
Norway	60 t / 25.25 m	2014
Sweden	64 t / 25.25 m	2015
Spain	60 t / 25.25 m (special permits)	2016
Germany	40/44 t / 25.25 m	2017
Brazil	91 / 74 t; 91 t, max 60 km/h	2017
Argentina	75 t / 25.25 m	2018
Sweden	74 t / 25.25 m	2018
Finland	76 t / 34.5 m	2019

The maximum mass of goods vehicles in the UK was last increased to 44 tonnes in 2001, and the maximum length of a semi-trailer (a tractor unit towing a trailer), was last increased to 16.5 m in 1990.

This report summarises findings from HCV field trials and implementations in many other countries. Some of these countries, such as Australia and South Africa, have very different conditions to the UK in terms of operating conditions such as traffic levels, geographical scales and population densities. In these countries the size and weight of HCVs is not necessarily practical in a UK context. HCV trials and implementations in European countries such as Denmark, Germany, the Netherlands and Spain with conditions that are broadly comparable to the UK, and which have trialled or implemented HCVs up 25.25 metres and 60 tonnes, are likely to provide the greatest relevance to considerations about HCVs in the UK.

In 2012, the UK Department for Transport (DfT) set up a 10-year longer semi-trailer (LST) field trial in which 2000 vehicles in two length categories are permitted on British roads “to test the impact of such operations on efficiency, and on emissions”. The trial vehicles are restricted to the existing 44 tonnes mass limit. The trial was recently extended to 2027.

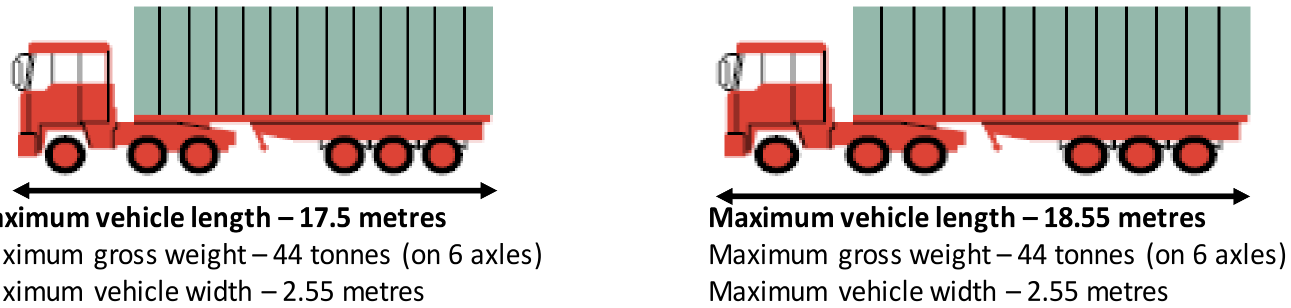

Figure 2. Longer semi-trailers trialled in the UK since 2012

3. Potential impacts of HCV use

Four major review studies into the effects of HCVs have been carried out in recent years commissioned by the following entities:

- European Commission published in 2009,
- OECD/ITF in 2011,
- OECD/ITF in 2019,
- European Parliament in 2013

All four are positive' towards HCVs with statements such as the introduction of HCVs "would be beneficial for the EU economy and, under certain conditions, environment and society as a whole", HCVs, "would be unlikely to work against the EU's objective of reducing road deaths by 50% from 2010 levels by 2020" and "could help with the EU's objective of reducing greenhouse gas emissions by 20% from 1990 levels by 2020", and HCVs "can contribute to improving the efficiency and safety of road transport operations and reduce transport costs and energy demand".

Table 2 provides a summary of: the type and number of field trials and desk studies that have investigated HCV impacts, the countries in which these have taken place; some key research findings, and an indication of whether HCV use is likely to result in a positive (+) or negative impact or (-) or no change (0) (based on these findings). A fuller version of Table 2 which provides references to all the field trials, post-implementation analyses and modelling studies reviewed is provided in the full briefing paper.

Table 2. Review of results of trials and desk studies into impacts of HCV use

Impact topic and sub-topic	Number and type of studies	Countries	HCV impact	Impact
1. Freight transport vehicle activity				
a) Consolidation of loads onto fewer vehicles	5 field trials & 2 post-implementation analyses	Australia, Finland, Germany, Norway, South Africa, Sweden, UK	**South Africa**: average 22% reduction in vehicle km per vehicle. **UK**: average 7% reduction in vehicle km per operator (LST trial of vehicles with greater length but unchanged weight, so less scope to reduce vehicle kms).	+
	2 theoretical modelling studies	Spain, UK	**Spain**: 1-3% reduction in national road freight kms (taking account of modal shift)	+
b) Modal shift from rail to HCVs	3 field trials & 2 post-implementation analyses	Netherlands, Sweden, UK	No discernible effect on modal shift.	0

	6 theoretical modelling studies	UK, Germany, EU-wide	Very marginal to 18% reduction in rail freight activity.	-
c) Traffic flow	1 field trial and 1 post implementation analysis	Norway, EU	**Norway:** Marginal worsening in traffic flow. **EU**: no significant effect on traffic flow found.	0/-
d) Increased demand for freight transport ('rebound effect')	1 post-implementation analysis	UK	Little evidence of additional demand for freight transport.	0
	1 theoretical modelling study	Sweden	1-17% increase in road freight depending on assumed HCV weight/length.	-
2. Environmental impact on freight transport				
a) Road vehicle emissions and noise pollution from HCV use	7 field trials	Australia, Canada, Denmark, Netherlands, Germany, Norway, South Africa, UK	Reductions in fuel consumption and CO_2 emissions per tonne-km and in total operations reported in all trials. Benefits are 7% in the UK LST trial and up to 30% in **Canada and Australia**. **Denmark and Netherlands**: No impact on vehicle noise.	+
	2 desk study	UK, Germany	Reductions in emissions per unit of goods transported.	+
b) Modal shift from rail to road	1 desk study	Germany	Estimated 0.01% increase compared to total GHG emissions from rail freight in 2010.	0/-
3. Freight transport operating costs				
a) Changes in vehicle operating costs	2 field trials	Australia, Germany	HCVs have lower operating costs than conventional non-HCVs (if additional volume and/or weight capacity is utilised.	+

4. Road freight traffic collisions and casualties				
a) Collisions with HCV use	3 field trials	Australia, Germany, South Africa	**Australia/SA**: HCVs have lower collision rates per million km than non-HCVs. **Germany**: No measureable impact on road safety at motorway sites.	
b) Casualties with HCV use	2 field trials & 1 post-implementation analysis	Australia, Sweden, UK	**Australia**: HCVs have lower fatality rate per million km than non-HCVs. **Sweden**: Longer vehicles (18.75 m) have lower fatal and serious casualty rate per billion km than shorter vehicles. **UK**: HCVs have lower rate of injury incidents than non-HCV articulated vehicles.	+
5. Road infrastructure costs				
a) Road and bridge maintenance costs due to HCV use	3 field trials	Australia, Norway, South Africa	**South Africa & Australia**: estimated reduction in road wear and road maintenance costs. **Norway**: Impact of HCVs on roads compared to conventional vehicles varied from marginally better to marginally worse.	0/+
	2 desk studies	UK and EU	**UK**: HCVs pose no greater risk to bridge damage than conventional vehicles as axles load are not increased. **EU**: Bridge loading - HCVs no more aggressive than conventional vehicles. Road wear - conventional drawbar combination more aggressive to the pavements than most of the LHVs studied.	0

b) Expenditure on road and bridge modifications for HCVs	1 field trial and 1 actual implementation	Denmark, Norway, Sweden	**Denmark/Norway**: little expenditure on road infrastructure adjustments for trials. **Sweden**: Sizeable expenditure for load bearing when increasing permissible vehicle weights from 51.4 to 60 tonnes.	0/-

4. Key findings and recommendations

The results of field trials and desk studies, together with the everyday use of HCVs in a number of European countries, indicate that application of HCVs in the UK would have positive effects on greenhouse gas emissions, safety and infrastructure impact. Concerns about the adverse impacts of HCVs have been overstated. Key findings and recommendations from the study are summarised here. Full details can be found in the main report.

1. **Reduction in total goods vehicle kilometres**

Key finding: This review has found a growing consensus among the research community that well-loaded HCVs will, through their greater load capacity, result in a reduction in vehicle journeys and hence vehicle kilometres.

A 2008 desk study estimated that if the maximum number of trips that were applicable to HCVs were transferred to them then the reduction in kilometres travelled by goods vehicles of 32 tonnes and heavier in the UK would be considerable (a 13-52% reduction in vehicle kilometres travelled if there were no road restrictions on HCVs, and a 3-13% reduction in vehicle kilometres travelled if HCVs were allowed on motorways and other roads within 20 km of a motorway only (depending on the size/weight configuration of HCV). This same UK study indicated that the actual transfer from conventional articulated trucks to HCVs would be less than the maximum theoretically possible.

Preliminary analysis from the current UK longer semi-trailer (LST) field trial indicates that operators in the trial would like to replace 9-30% of their current trailer fleet with longer vehicles. The uptake will depend on the sector in which the vehicles are used and whether or not collection and delivery locations are updated in future to facilitate the handling of longer vehicles.

The UK LST trial results indicate an average vehicle kilometre saving of 7% per operator, which varies by operator from 1% to 14%. It should be noted that the savings in potential distance travelled per vehicle in the LST trial are lower than those possible for EMS vehicles which accommodate greater mass capacities as well as greater vehicle length.

The findings of the 2008 UK study are still considered to be applicable, and together with the results to date from the on-going UK LST field trial, indicate that in the UK this would be expected to result in a significant reduction in vehicle kilometres travelled.

Important factors in the extent to which the use of HCVs in the UK would alter total truck kms include:

- the road network over which their use is permitted,
- the vehicle size/mass limits permitted,
- the perceived financial costs and benefits of HCV use by freight operators,
- the type of product carried and transport service provided, and
- the extent to which collection and delivery locations are updated to facilitate handling HCVs.

The sectors in which HCVs are most likely to be used include:

- the Fast Moving Consumer Goods (FMCG) sector (for movements between factories, distribution centres and retail sites),
- trunk routes in pallet-load networks,
- raw material and industrial product distribution,
- mail and parcels transport (to and from national sortation hubs),
- container transport to and from deep-sea ports, and the forestry sector.

The reduction in total goods vehicle kilometres as a result of permitting the operation of HCVs depends on several factors including:

- the HCV regulations implemented (i.e. the maximum vehicle length and mass permitted),
- the operating conditions imposed on these HCVs (such as route restrictions), and
- the applicability of HCVs to prevailing freight transport sectors and their operations (which will depend on factors including types of products carried, journey types made, vehicle costs, and the ease with which HCVs can accommodated at existing delivery and collection facilities).

Recommendations:

HCVs are suited for use in long-distance freight movements on trunk roads, but not for operations in built-up urban streets or villages. They should be restricted to operate on designated routes, as they are in other countries.

HCVs should only operate on suitable routes on the UK road network. While HCVs may need to use a limited road network other than trunk roads in order to collect and deliver product to distribution centres and other facilities, it is not recommended that general use of HCVs in urban areas or rural roads be considered. It is recommended that the government commence work into the consideration of suitable roads and routes for HCV operation in the UK.

HCVs are best suited to trunking operations on motorways and dual carriageways in the movement of products between factories and distribution centres in various sectors including manufacturing and retail supply chains, pallet-load networks, parcel and mail transportation to and from national sortation hubs, transport to and from deep-sea ports, and in the forestry industry.

In considering the configuration and operating conditions of HCVs in the UK, it is important to make use of best practice that has been developed in other countries where vehicles that are longer and/or heavier than those currently permitted in the UK have been trialled and implemented. There is a wealth of international knowledge and experience that can be drawn on.

2. Lower GHG emissions and air pollutants than conventional road vehicles per unit of goods carried

Key finding: As a consequence of the higher capacity, reduced ratio of tare weight to gross vehicle weight and reduced aerodynamic drag per vehicle unit, HCVs are significantly more fuel efficient per freight task than conventional vehicles. This significantly reduces fuel consumption, greenhouse gas emissions, other gaseous pollutants and operating costs. It also improves productivity for individual vehicles and for the sector as a whole.

Depending on the details of the implementation, use of higher capacity vehicles in field trials has reduced greenhouse gas emissions between 7% (for the UK LST trial) and 30% (in Australia and Canada). This is ‘low-hanging fruit’ in the roadmap to reducing greenhouse gas emissions due to transport. The improved energy efficiency through widespread implementation of HCVs is a relevant and necessary intervention for any future vehicle propulsion technology scenario: be that biofuels, synthetic fuels, electrification or hydrogen.

Recommendation: Use of HCVs should be part of the UK national roadmap to decarbonise transport emissions.

3. Lower total vehicle collision and injury rates

Key finding: The reduction in total vehicle kilometres required to transport the same quantity of goods (compared to using conventional non-HCVs) has an important benefit in terms of reducing exposure to accident situations and consequently lowering total vehicle collision and injury rates. This road safety improvement can be further assisted by the application of Performance Based Standards (PBS) to HCVs to improve underlying vehicle safety performance.

In addition, evidence suggests that the application of Performance Based Standards (PBS) to HCVs including better inherent vehicle dynamic performance, improved driver training and vehicle maintenance, together with route selection/compliance and overloading controls can result in substantially lower collision and injury rates per vehicle kilometre travelled than for non-HCVs. Experiences running HCVs utilising such best practice methods in Australia and South Africa have yielded significant safety benefits with much reduced collision and injury rates compared to conventional vehicles.

Recommendation: In planning for the role of HCVs in the UK, the government should consider adoption of appropriate standards for vehicle dynamics performance as well as associated vehicle maintenance management, automated in-service monitoring systems and driver training requirements for these vehicles. This will result in improved road safety and route compliance.

4. Reduced road infrastructure wear

Key finding: The review work carried out does not support the notion that HCV use will lead to worse outcomes in terms of road infrastructure wear, which is dependent on the vehicle size and mass combinations and permitted axle loads.

During field trials and implementations in other countries, HCVs have lower weight per axle through the use of an increased number of axles, thereby better spreading the load. As a result, HCVs do not increase road infrastructure wear per unit of freight moved, and can reduce it overall.

Recommendation: Include infrastructure interaction performance standards in the regulatory regime for HCVs in the UK, as is the norm in Australia, South Africa and Canada.

5. Insignificant modal shift

Key finding: while theoretical modelling work suggests that HCVs could possibly lead to modal shift from rail to road, and the lower operating cost of HCVs could result in a greater total demand for freight transport, real-world field trials and actual implementations of HCVs have provided no evidence of either of these outcomes.

Evidence indicating that HCVs could lead to these negative impacts is from theoretical modelling work that use assumptions concerning the relationship between freight operating costs and the demand for freight transport (i.e. elasticity values) and vehicle load factors. There is limited evidence and consensus about the appropriate elasticity values to use in such modelling. It should be noted that real-world field trials and actual implementations of HCVs in a number of countries have provided no evidence of modal shift towards HCVs, or increased total demand for freight transport.

Overall Report Recommendations

Given the evidence available from field trials and implementations about the contribution that HCVs can make to reducing goods vehicle traffic, GHGs and air pollutant emissions, and potential reduction in vehicle collision injury rates, we recommend that the UK government reconsider its policy regarding adoption of HCVs.

We recommend that the government commissions a detailed study to gain insight into HCV implementation issues appropriate for the UK, including vehicle performance (in terms of road safety, and road wear), designated routes, driver training, vehicle maintenance, vehicle and load monitoring and any infrastructure modifications necessary.

Widespread, tightly-controlled use of HGVs on designated long-haul routes in the UK would substantially reduce greenhouse gas emissions, while improving safety and national productivity.

The Centre for Sustainable Road Freight (SRF)

SRF was founded in 2012 to help industry and Government minimise carbon emissions from the road freight sector.

SRF brings together three of the UK's leading academic groups: the Cambridge University Engineering Department, the Logistics Research Centre of Heriot Watt University and the Freight and Logistics Research Group at the University of Westminster, along with industry and government partners; to make road freight environmentally, economically and socially sustainable.

The overall aims of the SRF are to:

a. perform a comprehensive programme of research on the opportunities for improving the environmental sustainability of road freight transport;
b. develop innovative technical and operational solutions to road freight transport challenges;
c. assess solutions to meet Government emissions reduction targets for the road freight sector;
d. bring together organisations from across the road freight industry in a cooperative group: to develop innovative solutions to reduce fuel consumption and test them in practice.

SRF receives funding from various UK Government and European sources, particularly EPSRC, ETI and InnovateUK, as well as from industry members. Industry members include: Denby Transport, Freight Transport Association, Goodyear Tires, John Lewis Partnership, Optrak, SDC Trailers, Tesco, Transdek, Turners Transport, Sainsbury's, Value Chain Lab and Volvo Trucks.