Assessing the technical feasibility of a trial of longer heavier vehicles on GB roads

Work funded by
UK Department for Transport (DfT)

Undertaken by **WSP** in partnership with

September 2023

Important Context

Regulation

- **1995**: The UK's height limit for HGVs was removed – deFacto 4.9m based on trunk road bridge height
- **2001**: Maximum permitted HGV weights were increased to 44 tonnes on 6 axles 16.5m/18.75m
- **2008**: LHVs were extensively reviewed
  - Increases to semi-trailer lengths to be considered in more detail
  - Increases in mass or increases in length of more than 2.05m were rejected "for the foreseeable future"
- **2011**: A 10-year in-service trial of Longer Semi-trailers (LST) was announced
- **2021**: LST trial deemed successful
- **2022**: A new review of EMS feasibility announced
- **2023**: Longer Semi-trailers legalised

The result.....

- A unique UK vehicle, 15.65m load length, 18.55m overall, 4.9m tall, steered trailer axle
- Pallet capacity increased from 26 for standard artic semi-trailer at 4m height to as much as 60 for 4.9m LST
- **Low density freight has seen a substantial capacity increase without going beyond 18.75m EU length**

Project Overview

Main Research Question

Is it technically feasible to run a GB trial of LHVs that can assess whether benefits found elsewhere can be reproduced in the UK freight market, while maintaining or improving road safety and infrastructure protection?

Initial Project Tasks

- **Literature review**
  - What has changed since last GB Review in 2008?
    - Additional European Experience with LHVs
    - New technical research
- **Gap Analysis**
  - What else do we need to know in GB that EU experience and literature doesn't tell us
- **Stakeholder Engagement**
  - Aimed to fill some gaps in knowledge but also identified new questions
- **Development of feasible policy options** with descriptive advantages and disadvantages, covering the range of possibility for example from:
  - Do nothing – i.e do not trial LHV; to
  - Limited, highly controlled trial
  - Expansive, light touch trial

Policy Outcome

No DfT commitment to any particular outcome

No DfT decisions have been taken yet

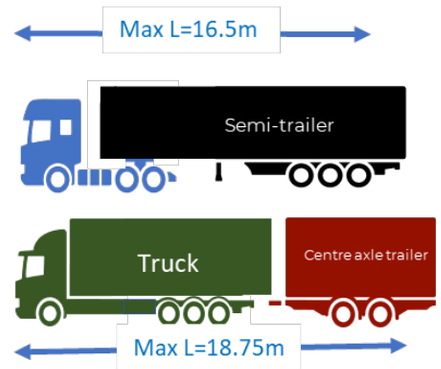
All options will be given due consideration

An additional 2nd Phase of investigation was commissioned to better answer outstanding questions – results later this year

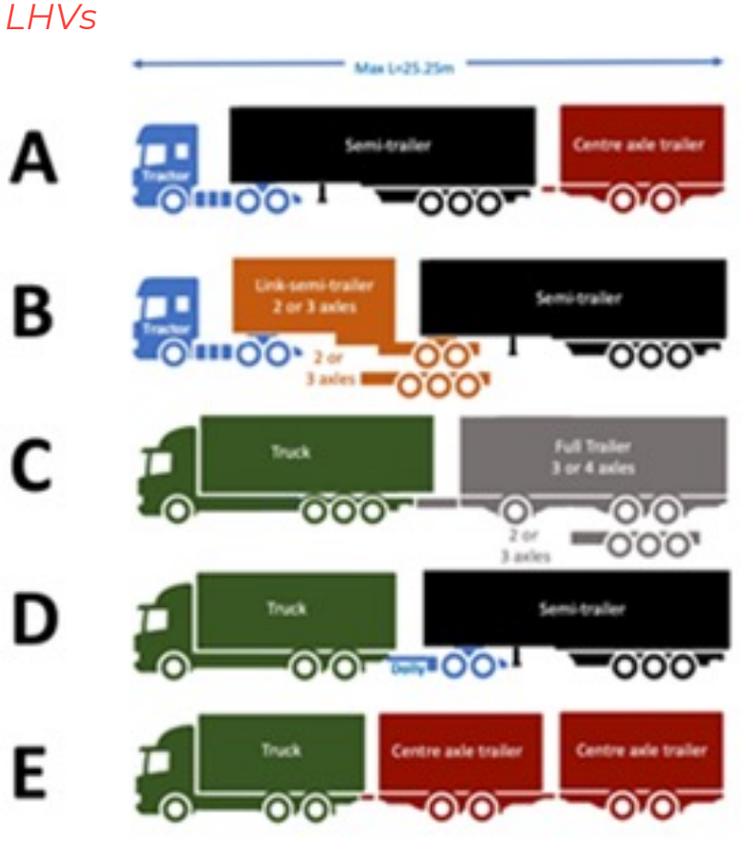
Vehicles considered in-scope

- **LHVs up to 25.25m / 60 Tonne**
- **Basic premise: Standard EU “modules” rearranged into longer combinations**
  - European Modular System
  - Load capacity of 2 LHVs equal to 3 standard HGVs
  - Significant increase in transport efficiency per unit of goods transported if capacity well utilised and road transport demand does not substantially increase
  - Standard modules means same max axle load
- **Sub-options for consideration**
  - Non-standard components at intermediate lengths <25.25m
  - 25.25m combinations at lower GVW in low density goods markets
  - Height limit (EU 4m, UK defacto 4.9m with double deck trailers common)
  - Additional length allowance for aero cabs and tail fins
  - Additional mass allowances for ZEV

Standard Vehicles

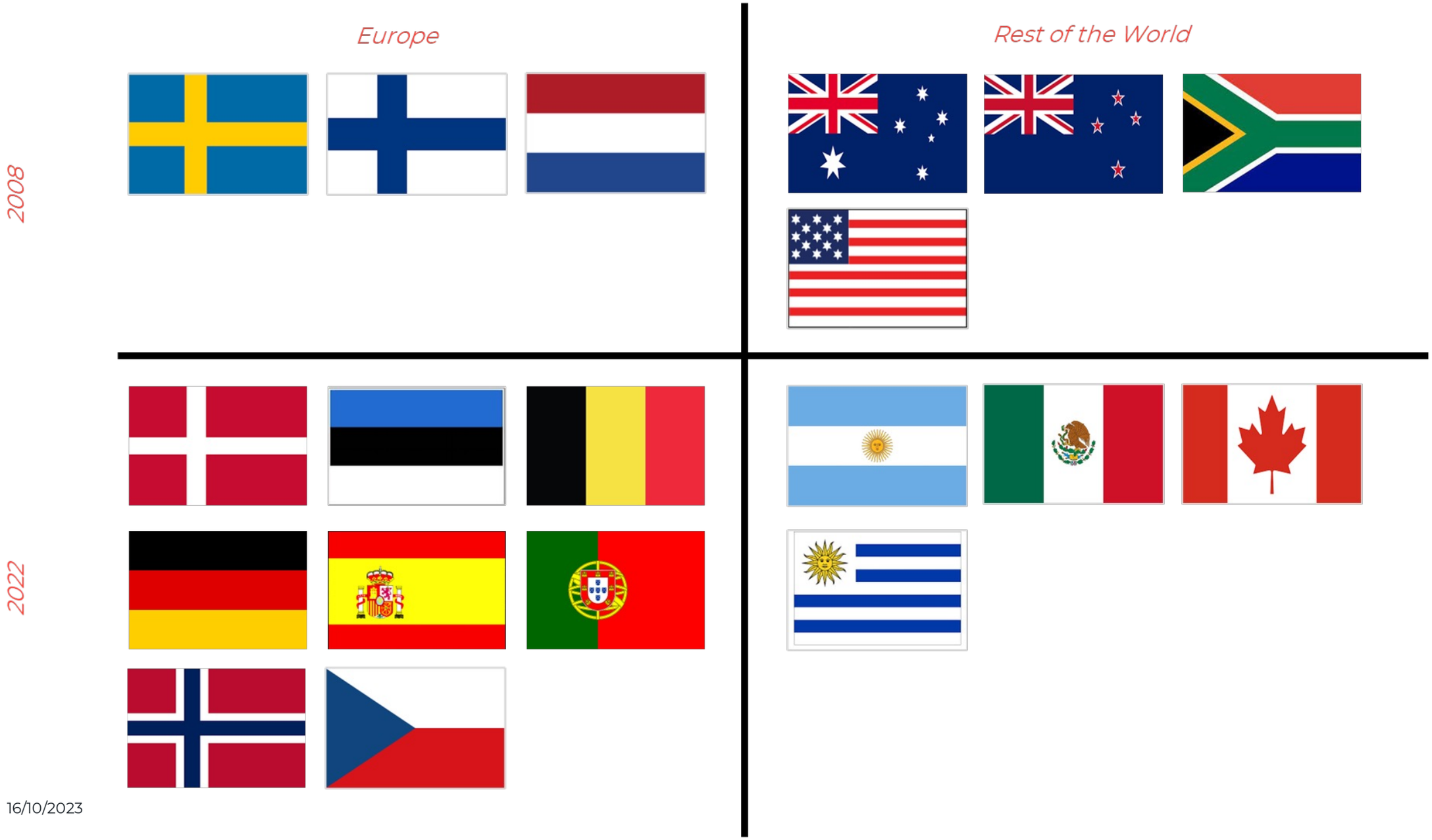


LHVs



Evidence: Experience with LHVs around the world

What is the biggest change since 2008? Experience, particularly in Europe



Evidence: Is there sufficient demand to justify a UK trial?

Engagement with UK freight industry

- **Phase one**: A survey was completed by participants in the Longer Semi-trailer trial.
  - Largely positive - Most but not all confirmed interest
  - Affected by sample bias – innovative operators already engaged in a form of HCT but possibly not involved in industries benefiting from additional weight
- **Phase two**:
  - Survey extended across the whole industry via trade associations
  - Specific and detailed ‘use cases’ requested – definitions of real uses including:
    - Origin and destination
    - Nature of goods, current mode of transport, mass of goods, frequency of journeys etc
    - Proposed LHV route
    - Preferred vehicle configuration
  - Case studies – Selected 2 use cases and ‘shadowed’ current operation to help understand routes and risks in more depth.

International experience

Country	Years in use	Size of HCV market
Spain	5	c. 0.5% (# HGVs)
Netherlands	20	c. 1.5% (# HGVs)
Sweden	>50 (27 in EU form)	74% (# T kms)

Sources:

ES: direct consultation with approval bodies estimated about 1,000 EMS certified HGVs but noted that since legalisation it was not directly monitored

NL Direct consultation with ministry officials identified c 2,000 EMS certified vehicles, out of 130,000 total fleet

SE Vierth et al 2008

Evidence: Emissions effects & Modal Split

- Emissions effects well documented & unchanged
  - e.g. Vierth et al 2008, Knight et al 2008, Morrison et al 2013, de Save et al 2019
- One key reason for UK rejection of 25.25m/60t in 2008 was potential for reverse modal shift to cause adverse emissions effect
- Subsequent evidence suggests Knight et al 2008, represents an outlier, generally much lower figures prevail
- Vehicle electrification and energy efficiency is an increasingly relevant factor
  - Lower tailpipe emissions less relevant, effect on green energy supply more relevant
  - Environmental advantage of rail reduced
- One of the main aims of the trial would be to quantify GB emissions / energy use effects in this new context
  - Limiting mode shift risk an option for trial as per Belgium/Walloon

Evidence on Mode Shift

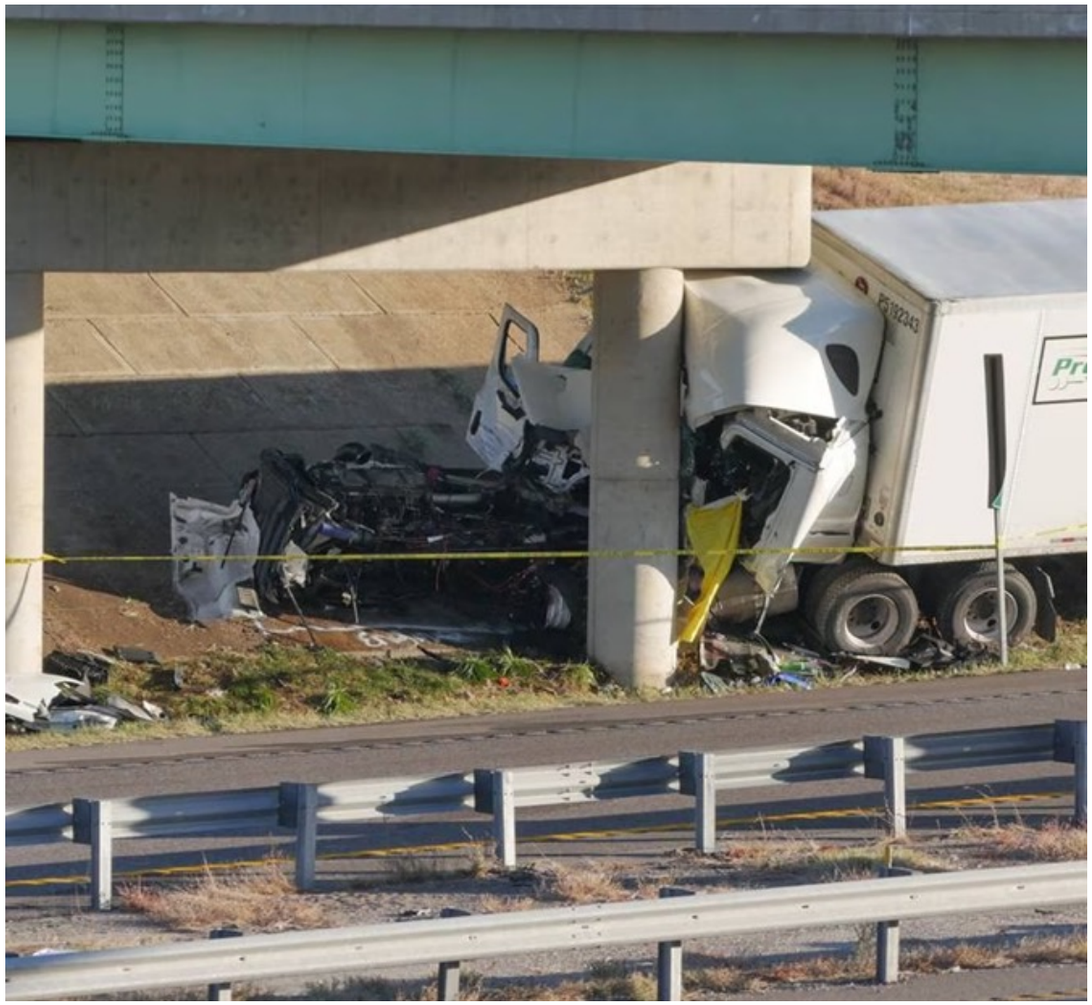
- Theoretical studies (e.g. elasticities)
  - Knight et al (2008) 8%-18% of rail tkms switch to road
  - Christidis & Leduc (2009) 1.2% - 1.8% of rail tkms
  - K&P 2011 8%-30% combined transport
  - K&P 2011 14%-35% single wagonload
  - Kraaijenhagen et al 2014 – 1.4% - 5%
  - Palsson & Sternberg 2018 – 8.7% if SE permitted 74 tonnes/34m
- Measurements of effects in trials
  - Aarts & Feddes 2009 1.4% - 2.7%
  - Kindt 2011 No Modal Shift
  - Vlaanderen MOW 2020 No evidence but thought unlikely
  - Risk Solutions 2017 – zero due to UK LSTs, noting rail had responded by integrating extended containers on rail wagons
  - Walloon 2018 restricted competition

Evidence: Vertical Loading on Bridges

- Knight et al (2008) – Assessed LHVs against the UK bridge design standard (BD37)
  - Result: No more onerous than 44 tonne baseline vehicle
- Since that time, UK bridge standards have changed
  - Design code – upgraded to EuroCode
  - Assessment Code CS454 to prove in-service bridges remain ‘good enough’ after allowing for degradation in-service
- Performance against EuroCode was assessed by de Saxe et al 2019 but country specific variations in design limit the degree to which international experience can quantify
- No assessment against CS454
- Dramatic consequences of getting bridges wrong understandably leads to significant caution from road owners
- Results of additional analyses to be reported with Phase 2

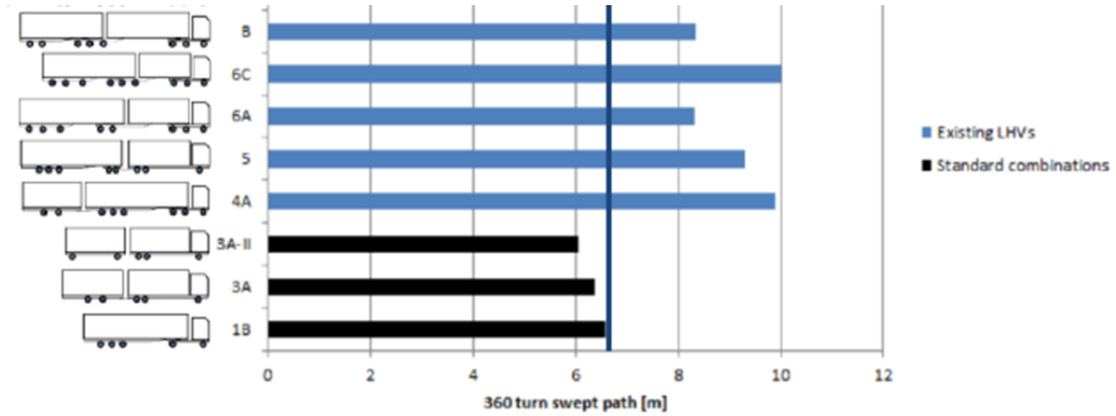
Evidence: Impacts with Vehicle Restraint Systems & Structures

- Will LHVs make VRS less effective at containing HGVs on the carriageway?
- Several studies mention this risk but do not examine in detail. Risk arguments tend to be:
  - Most barriers do not contain HGVs
  - “Very high containment” barriers designed to contain a 30t rigid or 38t artic (EN1317) – used only in sensitive location (e.g. bridge over rail).
  - 30t rigid vehicles are considered worst case
  - Artic heavier but articulation distributes energy across 2 impacts (tractor/trailer), loads barrier in 2 places
  - LHV will have 2 articulation points - further distribution of load
  - Reduced number of vehicles will reduce exposure to risk
- Irzik 2016 undertook tests in accordance with international standard EN1317 (38 tonnes)
  - Fears that the vehicle would be more prone to rolling over the barrier “*proved unfounded*”
- No test results at 60 tonnes were identified



Evidence: Safety

- Vehicle safety performance of EU vehicles now well documented e.g. Kraaijenhagen (2014), de Saxe et al (2019)
- Not all are equal:
  - trade-off between manoeuvrability and high-speed stability. Modern tech e.g steered axles, ESC can help
- Engineering predictions of casualty effects suggest increased risk per Vkm (e.g. Knight et al 2008: +10%), outweighed by reduced Vkm
- Statistical studies suggest LHVs have a lower risk per Vkm (e.g. Balint, 2014: -21%) than standard HGV, PLUS benefit of reduced vkms
  - The former ignores possibilities such as the driver treating LHVs with more caution
  - The latter assumes the average collision rate of operations that choose to move from standard HGVs to LHVs is the same as those that choose to stay with standard HGVs – not a certainty
- The truth may lie in between
- One certainty - no EU country implementing HCT has increased total casualties from HGV crashes.



What about 25.25m long, 60t, and 4.9m tall? Do EU analyses at 4m hold true at 4.9m? Is there any relevant experience??

Policy Options– Examples from other countries

Criteria	Level of Regulation		
	Permissive	Intermediate	Restrictive
Vehicle Configurations	60t	⟷	44t
Vehicle Performance	Any type approved vehicle/trail to 25.25m	⟷	Only highly manoeuvrable, highly stable vehicles with SOA ADAS
Network Access	Any road subject to operator risk assessment	⟷	Motorway only plus independently approved 'tails' <XX miles
Stages of trial/Degree of Monitoring	St to in service ight touch monitoring	⟷	Single vehicle experimental to in service in stages with maximum telematic monitoring

Spain

Germany

Netherlands

- English saying – there are many ways to skin a cat
- Each country has reached a way of implementing LHVs that meets their efficiency, safety and Infrastructure needs, but each in different ways
- None have been extremely permissive or extremely restrictive in all areas – a mixed approach is taken

Policy Options (common elements)

Policy Option 0 is to do nothing – No trial is permitted.

For all 'Do Something' options some common principles were agreed

Criteria	Level of Regulation			Principles based on engagement
	Permissive	Intermediate	Restrictive	
Vehicle Configurations	60t	⟷	44t	There is a preference to maximise the potential efficiency benefits wherever feasible
Vehicle Performance	25m any EMS combination with 8+ axles.	⟷	Only highly manoeuvrable, highly stable vehicles with SOA ADAS	
Network Access	Any road subject to operator risk assessment	⟷	Motorway only plus independently approved 'tails' <XX miles	Demand (operator) led route by route application should be considered the most appropriate approach for all options because evidence suggests take up will increase slowly not 'overnight' wholesale change. Large parts of a pre-determined widespread network may remain unused for many years
Stages of trial/Degree of Monitoring	Straight to in service trial, Light touch monitoring	⟷	Single vehicle, experimental to in service in stages, maximum telematic monitoring	Although exceptions exist, most other countries have adopted a relatively cautious, staged approach to implementation

All options will
- Be considered at 4m and 4.9m height, outcome to be informed by vehicle testing/simulation in pre-trial preparation phase
- Require accredited driver training (potentially based on NL model)

Option 1: Route Based Risk Control

Criteria	Level of Regulation		
	Permissive	**Intermediate**	**Restrictive**
Vehicle Configurations	✓ 60t	⟷	44t
Vehicle Performance	✓ Em any EMS [illegible] nation with 8+ axles.	⟷	Only highly manoeuvrable, highly stable vehicles with SOA ADAS
Network Access	Any road subject to operator risk assessment	⟵ ✓	Motorway only plus independently approved 'tails' <XX miles
Stages of trial/Degree of Monitoring	Straight to in service trial, Light touch monitoring	⟵ ✓	Single vehicle, experimental to in service in stages, maximum telematic monitoring

Conclusion
This option permits the widest range of vehicle configurations, but only permits routes that the 'worst case' configuration could navigate. This results in the simplest regulation and route/vehicle approvals process, but a more limited route network that would require robust compliance monitoring and a common database of approved routes. Time to trial would be moderate, integrating worst casing analysis of multiple configurations with route analysis, Hazchem risk assessment, development of mode shift assessment method key tasks.

Outcomes	
Operator take-up	Medium
Impact on infrastructure risk	Low
Impact on safety risk	Low
Policy effort (Gov)	Medium
Compliance effort (industry)	Medium
Trial cost	Medium

Option 2: Vehicle Based Risk Control

Criteria	Level of Regulation		
	Permissive	Intermediate	Restrictive
Vehicle Configurations	60t		44t
Vehicle Performance	25m any EMS combination with 8+ axles.		Only highly manoeuvrable, h stable vehicles wi ADAS
Network Access	Any road subject to operator risk assessment		Motorway only plus independently approved 'tails' <XX miles
Stages of trial/Degree of Monitoring	Straight to in service trial, Light touch monitoring		Single vehicle, experimental to in service in stages, maximum telematic monitoring

Conclusion
This option permits only the most stable and manouevrable vehicle configuration, in combination with multiple additional vehicle or operational restrictions to minimise risks. The process of determining network access is the same but the 'worst case' vehicle is MUCH better performing so more routes should be available. Reduced risk of non compliance allows for slightly less restrictive monitoring of the trial and simplifies the work needed in advance such that this produces the shortest time to commercial trial.

Outcomes	
Operator take-up	Medium
Impact on infrastructure risk	Low
Impact on safety risk	Low
Policy effort (Gov)	Low
Compliance effort (industry)	Medium
Trial cost	Low

Option 3: Rules Based Risk Control

Criteria	Level of Regulation		
	Permissive	Intermediate	Restrictive
Vehicle Configurations	60t	⟷	44t
Vehicle Performance	25m any [illegible] combinati[illegible] 8+ axles	⟷	Only highly manoeuvrable, highly stable vehicles with SOA ADAS
Network Access	Any road subject to operator risk assessment	→	Motorway only plus independently approved 'tails' <XX miles
Stages of trial/Degree of Monitoring	Straight to in service trial, Light touch monitoring	⟷	Single vehicle, [illegible]rimental to in service [illegible]stages, maximum [illegible]ematic monitoring

Conclusion
This option maximises the potential use cases of LHVs by permitting the widest possible vehicle configurations and allowing full optimisation of those configurations for both the economics of operation and the safety and infrastructure protection on the routes they need to travel on. Given the extent to which this pushes the envelope robust compliance monitoring is essential. The rules required to achieve this maximisation and optimisation safely are inevitably more complex to develop meaning that substantial time would be required before a trial could be commenced. Once developed, the rules make it very easy for regulators to accommodate new innovations, but industry have to go to increased effort to prove their vehicle complies and route approvals may be more complex. This may slow initial uptake.

Outcomes	
Operator take-up	High
Impact on infrastructure risk	Low
Impact on safety risk	Low
Policy effort (Gov)	High
Compliance effort (industry)	High
Trial cost	High

Option 4: Hybrid of Option 2 and Option 3

Criteria	Level of Regulation		
	Permissive	Intermediate	Restrictive
Vehicle Configurations	60t		44t
Vehicle Performance	25m any EMS combination with 8+ axles.		Only highly manoeuvrable, highly stable vehicles with SOA ADAS
Network Access	Any road subject to operator risk assessment		Motorway only plus independently approved 'tails' <XX miles
Stages of trial/Degree of Monitoring	Straight to in service trial, Light touch monitoring		Single vehicle, experimental to in service in stages, maximum telematic monitoring

Criteria	Level of Regulation		
	Permissive	Intermediate	Restrictive
Vehicle Configurations	60t		44t
Vehicle Performance	25m any EMS combination with 8+ axles.		Only highly manoeuvrable, highly stable vehicles with SOA ADAS
Network Access	Any road subject to operator risk assessment		Motorway only plus independently approved 'tails' <XX miles
Stages of trial/Degree of Monitoring	Straight to in service trial, Light touch monitoring		Single vehicle, experimental to in service in stages, maximum telematic monitoring

Implement Option 2 and Option 3 in parallel

- Get to a limited trial in a short time using option 2
- In parallel, begin work to expand the trial to a larger section of the market using option 3

Conclusions

- Has the situation changed since 2008? **Yes**
  - Greatly increased European Experience
  - Weight of evidence showing less than predicted mode shift – potential to control in a trial
  - New technology can help with safety and compliance issues
  - UK bridge codes have changed, new bridges will be built to a higher standard, existing bridges must be assessed more carefully than before
- The potential for a feasible trial has clearly improved but evidence remained limited in some areas such that it was not yet proven:
  - Stakeholder concerns around loading of structures and impact with structures remain substantial and evidence was limited (in relation to current GB standards and processes)
  - Some situations relatively unique to the UK remain – e.g. 4.9m tall vehicles, ‘Smart Motorways’

Next Steps

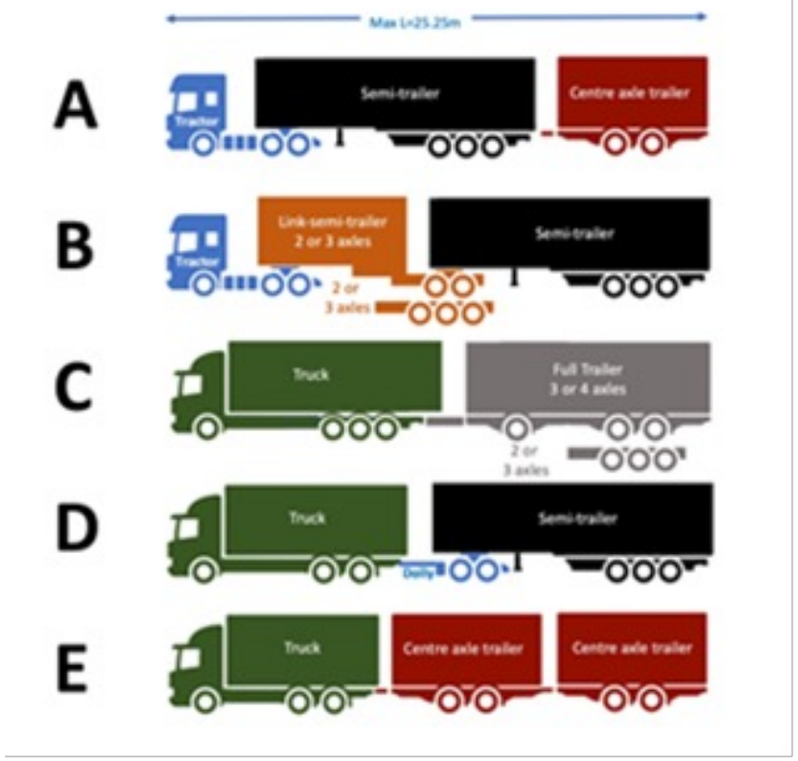
- DfT commissioned a second phase of work, which is now nearing completion but cannot yet be reported. It considers:
  - **Understanding real world use-cases** – What is the demand, where do industry want to go with LHVs? Carrying what loads with what vehicles? How are the goods currently transported?
  - **Extensive engagement with road authorities** - understanding what the scientific literature says is not enough – we need to work with every affected department to ensure they properly understand the risks, and to reach a set of mitigations that they are comfortable signing off
  - **Bridge assessment to CS454** – We need to be sure a trial is safe and that very high costs of bridge reinforcement is not needed
  - **Development of a draft 'safety case'** – road authorities have risk assessment processes and trials processes that must be followed.
  - **Preliminary cost benefit analysis** – the Minister needs a good idea of costs and benefits before making a decision to proceed
  - **Creating draft processes** for trial conditions in terms of vehicle, route and operator approvals., as well as for the Monitoring & Evaluation of the trial
    - Can't define costs and benefits unless we know what we are asking of industry.
- We will still appreciate any input from stakeholders that can help inform these tasks

DfT Statement

As part of the Government's commitment to decarbonise road transport and improve air quality, the Department for Transport (DfT) has set up a contract with WSP for the provision of technical consultancy services to continue assessing the feasibility of a trial for Longer/Heavier Vehicles (LHVs) on roads in Great Britain (GB).

This work includes the development of the structure for any potential trials as part of considering how trials could be done in GB and the likely costs involved. Here, LHV refers to a variety of vehicle combinations at around 25m length and operating at 50 or 60 tonnes, as seen in many European countries.

Stage 2 of the project builds on the Stage 1 review of other existing trials across the globe, initial Industry Engagement (trade associations and operators) to test potential demand and with Road Authorities (National Highways, Transport Scotland, the Welsh Government, and Local Authorities) and Regulatory and Compliance Bodies to identify to discuss issues around LHVs. Stage 1 recommended five policy options aimed a structuring a trial, as well as identifying key research and assessment activity required before a decision can be taken as to whether to permit trials of LHVs on roads in GB. The Stage 1 report and literature review can be accessed on the DfT website: https://www.gov.uk/government/publications/national-longer-heavier-vehicle-trial



Stage 2 is being undertaken by WSP, Apollo Vehicle Safety Risk Solutions and Tavistock Institute and seeks to answer the following questions.

1. What is the industry demand/appetite for LHVs on GB roads?
2. Are trials of LHVs technically and economically feasible on GB roads?
3. What is the estimated cost (and benefits) of running a trial on GB roads?

DfT have made no decision yet on whether such a trial should take place.

To support stage 2 of the LHV Feasibility Study, DfT are seeking further and more detailed engagement with Industry, Road Authorities and Compliance Bodies to define specific route use cases, review specific impacts on infrastructure and collaboratively develop trial methodologies.