



Direct Vision Standard

Transport for London

Phase 2B Cost and Business Impact Assessment report

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**Transport for London
Phase 2B Cost and Business Impact Assessment**

Direct Vision Standard

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Executive Summary

The Mayor of London is adopting a ‘Vision Zero’ approach to road danger reduction based on the view that no loss of life is inevitable or acceptable. The Mayor’s Vision Zero strategy is looking to make streets safer, especially for cyclists and pedestrians by eliminating road danger at source. A Direct Vision Standard (DVS) has been proposed to reduce the danger posed by HGVs to cyclists and pedestrians. This standard will ban or restrict “the most dangerous” HGVs from London’s roads.

In 2017, Jacobs was commissioned by Transport for London (TfL) to undertake the Phase 2A Cost and Business Impact Assessment (CBIA) of the Direct Vision Standard scheme. The Phase 2A CBIA informed the Phase 2A Integrated Impact Assessment (IIA), a process that provided opportunity to consider ways by which the DVS could contribute to improvements in environmental, social and economic conditions, as well as a means of identifying and mitigating any potential adverse effects the proposed policy might otherwise have. Following the submission of the Phase 2A CBIA and IIA to TfL in 2017, TfL has confirmed the **HGV Safety Permit scheme** is the preferred option and to be taken forward for further assessment.

- **HGV Safety Permit Scheme:** all N3 HGVs (over 12 tonnes) will require a permit to enter Greater London. From the year 2020, vehicles rated zero stars will need to demonstrate they are “above par” on a number of key safety aspects. From 2024, vehicles rated below three stars will be required to prove a “safe system”, i.e. demonstrate they have adopted additional mitigating safety measures.

In June 2018 TfL asked Jacobs to update the Phase 2A CBIA for the HGV Safety Permit Scheme in line with new information including updated costs and the proportion of HGVs operating in Greater London by DVS ratings. This document incorporated these changes and presents the updated results.

This document is titled Phase 2B to indicate it is a development of the earlier analysis and it is important to note that it only presents results for the HGV Safety Permit Scheme.

Table 1-1 presents the cost to businesses by sector as a result of the scheme. For businesses opting to retrofit their vehicles with additional safety equipment, two costs are incurred: the cost of purchasing and retrofitting additional safety features into their non-compliant vehicles, and the cost of undertaking the safety assessment to prove the safety measures meet compliance.

Table 1-1: Total Cost to Businesses by Sector, Undiscounted, £k (2017 prices)

	Retrofitting Safety Equipment	Safety Mitigation Test	Total, £k
General Distribution	£ 55,000	£ 7,000	£ 62,000
Construction	£ 67,000	£ 8,000	£ 76,000
Food & Drink	£ 18,000	£ 2,000	£ 20,000
Utilities and Support	£ 28,000	£ 3,000	£ 31,000
Office, Light Freight and Service	£ 4,000	£ 500	£ 5,000
Total	£ 172,000	£ 20,500	£ 194,000

Businesses are estimated to incur the total cost of £194m as a result of the scheme (undiscounted) over the appraisal period 2020-2030. Businesses operating in the Construction Sector are forecast to incur the highest cost across the five sectors assessed; the highest proportion of HGVs rated below three stars operate in the Construction sector (32% of HGVs as of 2018).

The cost of enforcing DVS and operating the scheme were provided by TfL, and include an Optimism Bias of 50% to account for cost uncertainties. The core scenario assumes *all newly registered vehicles from 2020 will be minimum three stars*, given there is enough supply of three star or higher rated vehicles to meet the demand. The total cost to businesses of £194m is considered as the best case scenario.

Table 1-2 presents the cost to businesses by sector, in the event *older vehicles rated below three stars are replaced by their equivalent rated model as part of the natural replacement cycle*. For example, an aging tipper truck rated zero stars will be replaced by a new zero rated equivalent.

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Table 1-2: Total Cost to Businesses by Sector – Sensitivity Test, Undiscounted, £k (2017 prices)

	Retrofitting Safety Equipment	Safety Mitigation Test	Total
General Distribution	184,590	22,276	206,866
Construction	247,420	29,858	277,278
Food & Drink	61,327	7,401	68,727
Utilities and Support	120,782	14,576	135,358
Office, Light and Service	17,870	2,157	20,027
Total	631,989	76,266	708,255

The sensitivity test presents a total cost of around £708m, considered to be the worst case scenario. The cost to businesses is forecast to fall between the range of £194m - £708m to account for the uncertainty of the ability of the manufacturers to supply three star or higher rated vehicles sufficient enough to meet increased demand for minimum three star rated HGVs.

Table 1-3: Total Cost of Implementation and Operation, Undiscounted, £k (2017 prices)

Cost (£000s)	Cost (appraisal period)
Implementation Costs	5,000
Operational Costs	4,000
Total	9,000
Optimism Bias (15%)	5,000
Total (OB included)	14,000

The cost assessment has not taken into account the impact of avoided casualties and other benefits associated with the scheme. These benefits, as well as other effects, will be quantified and assessed in the Phase 2B IIA.

Benefit-Cost Ratio

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Table 1-4 presents the summary of the cost and benefits of the HGV Safety Permit Scheme, the Net Present Value (NPV) and the BCR, estimated between 0.10:1 and 0.33:1. The casualty benefits calculated by TRL for the best case scenario (low) has been used for this assessment. For more details on the casualty benefits, please refer to TRL's "A Direct Vision Standard for HGVs – Casualty Impact Analysis for Proposed Implementation in London" report (September 2017).

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Table 1-4: Summary of the costs and benefits of the scheme (core and sensitivity test), £000s

	Core Scenario		Sensitivity Test	
	Undiscounted, £000s	Discounted, £000s	Undiscounted, £000s	Discounted, £000s
Benefits				
Casualty	£ 7,000	£ 5,000	£ 7,000	£ 5,000
Cycling	£ 73,000	£ 52,000	£ 73,000	£ 52,000
Total Benefits	£ 80,000	£ 57,000	£ 80,000	£ 57,000
Costs				
Cost to Businesses	£ 193,000	£ 163,000	£ 708,000	£ 550,000
Cost of Enforcement and Operation	£ 14,000	£ 12,000	£ 14,000	£ 12,000
Total Costs	£ 207,000	£ 175,000	£ 722,000	£ 562,000
Net Present Value (£000s)		-£ 118,000		-£ 505,000
Benefit-Cost Ratio		0.33		0.10

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1. Glossary

Term	Abbreviation	Description
Automatic Number Plate Recognition	ANPR	A technology for automatically reading vehicle number plates.
Benefit Cost Ratio	BCR	An indicator which summarises the overall value for money of a project.
Casualty Impact Assessment	CIA	Casualty Impact Assessment produced by TRL, a consultancy commissioned by TfL
Cost and Business Impact Assessment	CBIA	Cost and Business Impact Assessment produced by Jacobs, a consultancy commissioned by TfL
Construction Logistics and Community Safety	CLOCS	An industry-led project to reduce injuries and deaths due to work-related road risk.
Cycling Network Model for London	Cynemon	Developed by TfL, Cynemon is a model which estimates cycling routes, journey times and flows at a strategic level across London for scheme and policy appraisal.
Department for Transport	DfT	Government department responsible for the English transport network
Direct Vision Standard	DVS	An objective measure of a HGV's driver's direct vision.
DVS Star Rating		A simple description of an HGV's DVS articulated on a zero (worst) to five (best) star system
Economic and Business Impact Assessment	EBIA	Identifies and assesses impacts on London's economy as a result of the DVS
Gross Domestic Product	GDP	A monetary measure of the market value of all final goods and services produced in a period of time.
Gross Value Added	GVA	A measure of the value of goods and services produced in an area, industry or sector of an economy.
Fleet Operator Recognition Scheme	FORS	A voluntary accreditation scheme that promotes best practice for commercial vehicle operators.
Integrated Impact Assessment	IIA	The IIA, produced by Jacobs, is a systematic and iterative process that provides opportunity to consider ways by which a policy could contribute to improvements in environmental, social and economic conditions, as well as a means of identifying and mitigating any potential adverse effects that the policy might otherwise have.
Internal Rate of Return	IRR	IRR is a method to calculate the rate of return of an investment.
Limited Liability Company	LLC	A corporate structure whereby the members of the company cannot be held personally liable for the company's debts or liabilities.
Light Goods Vehicle	LGV	Light Goods Vehicle (under 3.5 Tonnes Maximum Permissible Weight)
Loughborough Design School	LDS	From Loughborough University, LDS was commissioned by TfL to develop the DVS rating system
Heavy Goods Vehicle	HGV	Heavy Goods Vehicle (over 3.5 Tonnes Maximum Permissible Weight)
Killed or Seriously Injured	KSI	A standard metric for safety policy.
	N3	Vehicles over 12 Tonnes Maximum Permissible Weight

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Term	Abbreviation	Description
	N3G	N3 class vehicles that operate off-road
Transport for London	TfL	Local government body responsible for the transport system in Greater London
Transport Research Laboratory	TRL	Consultancy firm
Ultra-Low Emission Zone	ULEZ	An area within which all vehicles will need to meet exhaust emission standards. ULEZ is due to be implemented in 2020.

2. Introduction

2.1 The Mayor's Transport Vision for London and Road Safety – Vision Zero

The Mayor's vision for London, set out in the Mayor's Transport Strategy 2018, is to create a future London that is not only home to more people, but is a better place for all of those people to live in.

The Mayor believes that the success of London's future transport system relies upon reducing Londoners' dependency on cars in favour of increased walking, cycling and public transport use.

Minimising road danger is fundamental to the creation of streets where everyone feels safe walking, cycling and using public transport. Road danger disproportionately affects people travelling on foot, by cycle or by motorcycle, with 80% of all those killed or seriously injured on London's roads travelling by these modes. Safety concerns are the main reasons people give for not cycling more, and for being unwilling to let their children walk unaccompanied.

Research has shown that, in terms of pedal cyclist casualty rates per billion cyclist kilometres, London is at a much higher risk than the United Kingdom as a whole. When compared to other cities, Manchester is the only other city coming close to a comparable level of risk.

The safety concerns have led to the Mayor's proposal to adopt Vision Zero for road danger in London. The Mayor of London is adopting a 'Vision Zero' approach to road danger reduction based on the view that no loss of life is inevitable or acceptable. This means that road danger will be targeted at its source by ensuring the street environment incorporates safe speeds, safe people, safe street design and safe vehicles. This proposal aims to reduce the dominance of motor vehicles on streets, and make the remaining essential motorised journeys as safe as possible. The Mayor's aim is to work towards eliminating all deaths and serious injuries from road collisions from London's streets by 2030.

2.2 Using the Direct Vision Standard for Large HGVs to Support Vision Zero

In September 2016, Transport for London (TfL) launched the world's first Direct Vision Standard (DVS) for Heavy Goods Vehicles (HGVs), designed to reduce the danger posed by HGVs to cyclists and pedestrians. DVS is an objective measure of a HGV's driver's direct vision. A formal method of assessing and rating the quality of direct vision from HGVs was developed using a rating system from zero stars to five stars.

As part of a Vision Zero approach to road danger, the Mayor proposes using the DVS to ban or restrict the most unsafe 'zero star' rated HGVs from London's streets by 2020, and allow only vehicles with 'good' three-star direct vision ratings from 2024.

2.3 Purpose of this report

The purpose of this report is to present an update to the Phase 2A CBIA undertaken in 2017, presenting the findings for only the HGV Safety Permit Scheme. This scheme has been identified as the preferred option from an initial list of 5 options that were considered in the Phase 2A CBIA.

Findings from the Phase 2B CBIA will inform the Phase 2B IIA also produced by Jacobs, bringing together the total cost of the proposed policy, estimated by Jacobs, and the total benefits, produced by TRL to calculate the benefit cost ratio (BCR). The BCR will provide an indication of the Value of Money of the HGV Safety Permit Scheme.

The objective of the CBIA is to assess the financial impact of mandating the compliance of DVS for HGVs on London's businesses. The report will provide the following main elements:

- Consider the potential costs to businesses as a result of DVS,
- Establish the methodology of quantifying the costs,

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- Estimate the number of vehicles likely to bear financial cost as a result of DVS,
- Estimated cost to businesses, and
- Estimated cost to implement and operate DVS.

3. Methodology

Working with TfL, TRL and Loughborough Design School (LDS), a cost and business assessment (CBIA) model has been developed to estimate the number of N3 vehicles that would comply by 2020 and 2024 respectively based on their likely behavioural response for non-compliant vehicles and the financial implications of their actions as a result of DVS.

The Phase 2B CBIA would take the following steps:

1. Development and assessment of the HGV Safety Permit Scheme;
2. Define the business sectors to be assessed;
3. Identify the cost of implementation and operation of the scheme;
4. Identify all potential costs to businesses;
5. Apply behavioural research which identified responses to DVS;
6. Identify the limitations and key assumptions;
7. Estimation of the number of vehicles impacted;
8. Describe findings for the quantified costs;
9. Findings of the non-quantified costs; and
10. Conclusion.
11. Sensitivity Analysis

3.1 Assessment of Options

An initial set of five options were developed and assessed under the Phase 2A CBIA that was finalised in October 2017.

The opportunities to use the DVS to restrict access are limited by what is practically enforceable. This is because the DVS is a novel technical standard and does not exist in law (for example, it cannot be identified from existing vehicle registration data). Any scheme option that uses the DVS rating will have to either:

- A. Require all large HGVs entering London to have a permit, proving their DVS star rating, or
- B. Restrict vehicles based on other already identifiable criteria.

The following five options were assessed:

- **Option 1 – outright restriction** - requires all large HGVs (i.e. N3 class, over 12 tonnes) intending to enter London must apply for a permit in order to prove their DVS star rating. A permit would not be issued to any vehicles with a zero-star rating from 2020, and would not be issued to any vehicles with a zero, one or two-star rating from 2024.
- **Option 2 – phased introduction of the outright ban**. As for the core option (Option 1), i.e. all large HGVs have to apply for a permit to prove their star rating, but the ban only applies to newly registered vehicles up to 2024.

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- **Option 3 – outright ban with transitional exemptions.** As for the core option (Option 1), i.e. all large HGVs have to apply for a permit to prove their star rating, but for the period up to 2024 only, zero rated vehicles will be issued a permit if they can prove a mitigating set of safety measures have been adopted.
- **Option 4 – N3G (off-road configuration) ban.** Without the need for all HGVs to apply for a permit, ban N3G (off-road variant) HGVs.
- **Option 5 – HGV Safety Permit.** All large HGVs have to apply for a permit to prove their star rating, but avoid an outright ban by allowing for vehicles with poor Direct Vision to improve their overall road safety impact with other measures. I.e. HGVs with poor Direct Vision can get a permit but only if they meet a higher safe system standard across all aspects of vehicle safety.

Following the findings of the Phase 2a CBIA informed the Integrated Impact Assessment, which led to Option 5, the safe system scheme, to be selected as the *preferred option*.

For more details on the findings of the Phase 2A CBIA, please refer to Jacobs’ Direct Vision Standard – Cost and Business Impact Assessment report (October 2017).

3.2 Scheme Description

Table 3-1 describes the principle and enforcement of the Do Something option, the HGV Safety Permit scheme from the year 2020 and 2024 respectively, assessed against the Do Nothing Option.

Table 3-1: HGV Safety Permit Scheme Description

Scenario Description	Scheme at 2020	Scheme at 2024
<p>Do Nothing – informing consumer choice and incentivised through public sector procurement.</p> <p>The DVS being used to inform purchasing decision but not being mandated. There is no restriction scheme.</p>	None	None
<p>Do Something – HGV safe permit system scheme.</p> <p>All N3 HGVs to apply for permit to prove a safe system standard is met. All vehicle rated 1* or better on DVS automatically given permit (from 2020, 3* from 2024).</p> <p>Permits only issued to vehicles 0* (from 2020, less than 3* from 2024) where they can demonstrate they are “above par” on a number of key safety aspects.</p>	<ul style="list-style-type: none"> • All N3 HGVs to have a permit to enter London • Permits issued to 1-5 star DVS HGVs automatically <p>Zero star HGVs required to prove a “safe system”, i.e. demonstrate they have adopted additional mitigating safety measures.</p>	<ul style="list-style-type: none"> • All N3 HGVs to have a permit to enter London • Permits issued to 3-5 star DVS HGVs automatically <p>Zero to two star HGVs required to prove a “safe system”, i.e. demonstrate they have adopted additional mitigating safety measures.</p>

3.3 Business Sectors

As well as assessing the scheme on the economy as a whole, the scheme was assessed by business sectors in order to understand the distributional impact of the scheme and identify the businesses that may be impacted more significantly than others.

The financial impact on businesses was assessed by the following sectors, defined by TfL that covers the economy as a whole:

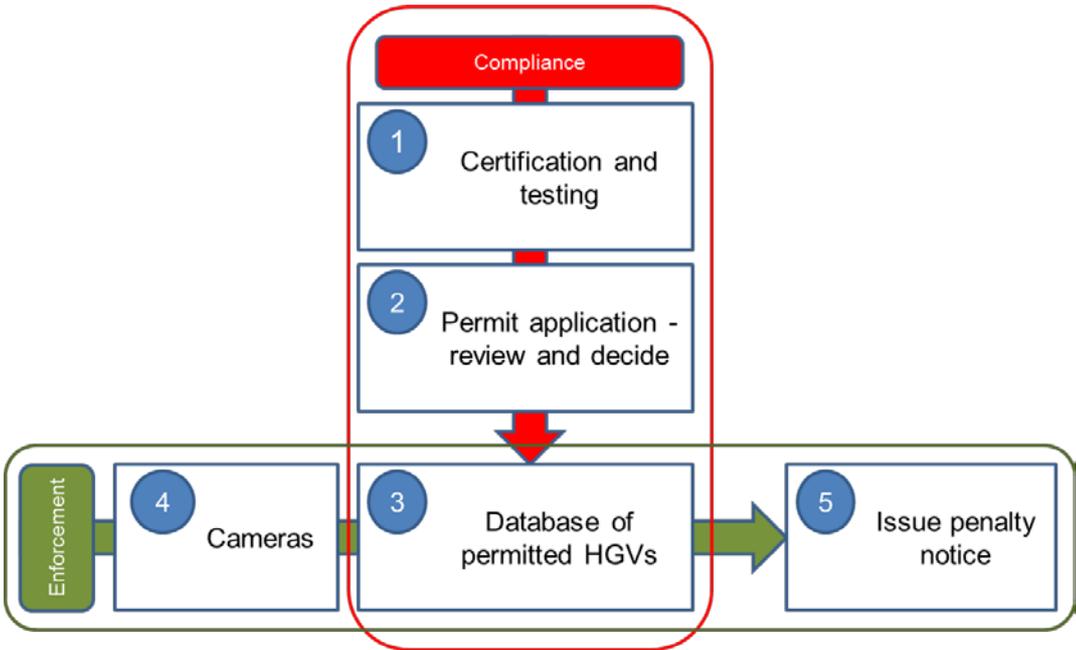
- **General Distribution:** retail, wholesale, manufacturing specialised cargo distribution
- **Construction:** delivery of goods and services to/and from construction sites
- **Food & Drink:** deliveries to accommodation and food service facilities
- **Utilities and Servicing:** refuse and waste management, utility and communications service providers
- **Office, light freight and servicing:** post and package deliveries and other services

Additionally, the financial impact on the Small to Medium Enterprises (SMEs) would be considered as we predict the proportional magnitude of impact on SMEs to be more significant, relative to the larger, more established businesses.

3.4 Cost of Implementation and Operation

Jacobs considered the costs to set up, operate and enforce the scheme. These have been estimated by TfL and are categorised in the following cost model:

Figure 3-1: Cost Model of the DVS scheme



The following costs are taken into consideration for the CBIA:

Table 3-2: Implementation and Operating Costs of the DVS Scheme to the Public Sector

Stage/Cost	Description	Quantified
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Implementation Costs	1. Certification & Testing	Set up national network of vehicle testing stations to prove DVS and other safety measures. (Assumed based on expanding FORS assessor network; secure link to permit administration database)	✓
	2. Permit Administration	Upfront cost of registering all vehicles in advance of scheme starts (est +/- 50%). Assumes £6/vehicle cost Office set up costs - equipment fit out (zero if existing estate used; notional provision if charged to project)	✓
	3. Database of Permits	Develop vehicle database and / or registration process and incorporate into existing back office workflow. Cost assumes a TfL or TfL service provider solution; synergies with London Council and Limited Liability Company (LLCS) administration to be considered also.	✓
	4. Cameras	ANPR camera network (use existing network at no marginal cost, unless transaction volumes require an upgrade - thought unlikely)	
	5. Issuing Penalties	Receiving contravention packs from processing engine; Issuing PCNs; Processing payments; Appeals and other enquiries; including on line and call centre services. Cost estimate for building new PCN processes into existing service contract provider (est +/- 50%)	✓
	6. Other	Signage (use existing SLS signs or new installation) Project contingency. None calculated as cost estimates are indicative.	
Operating Costs	1. Certification & Testing	Audit and assurance of vehicle testing regime. Subject to operating model design (subject of Feasibility work to be commissioned). Likely to be self-funded - a charged for service.	
	2. Permit Administration	Ongoing team of two (2x£100 including on costs)	✓
	3. Database of Permits	Provided for as part of project set up costs	
	4. Cameras	ANPR running costs	✓
	5. Issuing Penalties	On-street enforcement: an annual investment in	✓

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		overtime to deliver a level of focused enforcement. (Other processes provided for in set-up costs as variation to existing TfL supplier contract)	
	6. Other	Assessment of new vehicle design (call-off contract for ad hoc work; major manufacturers self-certify) Maintenance of signage	✓

The operating cost have been assumed equal per annum at this stage, prior to adjustment of inflation and optimism bias.

3.5 Cost to Businesses

Jacobs identified the potential costs to businesses through field research, consultation with stakeholders and manufacturers, previous experience of similar policy implementations and professional judgement & expertise. Please note, for economic analysis purposes, all businesses affected by DVS are assumed to comply with the mandate i.e. no HGVs would enter London illegally. No fines imposed on businesses are considered in the analysis.

For each sector, the following costs were considered as quantifiable:

- **Safety mitigation features** – the cost of retrofitting the existing, zero-rated vehicles to be “above par” zero stars temporarily.
- **Safety Mitigation Measure Assessment** – the cost of assessing the compliance of safety mitigating measures/equipment installed for vehicles opting to retrofit.

More details of the stakeholder engagement can be found in Section 3.6. All costs quantified are presented in undiscounted 2017 prices.

Businesses may incur other costs that have not been quantified at this stage but analysed qualitatively:

- **Loss of residual value** – vehicles rated below 3 stars would be expected to lose residual value as a result of the scheme (i.e. fall in demand non-compliant vehicles)
- **Downtime due to the change in fleet** – the additional time spent adjusting the fleet to comply with the DVS scheme
- **Switching manufacturers** – purchase of new, three star rated vehicles from another manufacturer may incur the indirect cost of additional training for drivers and mechanics and purchase of additional equipment/features compatible with the new manufacturer produced vehicles

3.6 Stakeholder Engagement

Understanding how businesses would react to the proposed policy is crucial to estimating the number of vehicles forecast to incur financial costs.

Initial feedback from businesses regarding DVS was received by TfL through the first round of consultation, held in Spring 2017. Many responses were received. These showed strong support for the concept of the DVS rating system but concerns over the potential costs that would be faced by businesses. Feedback from the first round of consultation did not provide details of specific issues related to DVS. Jacobs (in collaboration with TfL) then held workshops with focus groups in a second round of stakeholder engagement.

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3.6.1 16th June 2017 workshop

Stakeholder engagement sessions were held on 16th June 2017 via focus groups with businesses from four sectors; Construction, Food & Drink, Retail and Specialist Operators. The sectoral focus groups were established based on the number and type of businesses who attended the workshop on the day. Each focus group was asked a series of questions for the options under consideration, focussing on their behavioural response, how they would like the scheme to be enforced and operated and other comments/issues. A short, paper survey was also conducted afterwards, to better understand the current fleet arrangements of businesses, and their likely behavioural response to the scheme under various hypothetical scenarios (for example *“if 25% of your vehicles were non-compliant...”*)

The main comments/issues raised during the focus groups were:

Policy Issues:

- Most operators are already complying with existing schemes (for example Safer Lorry Scheme, FORS)
- The DVS standard may conflict with existing construction site regulations
- Conflict with complying with ULEZ
- The short time scale from the announcement of the scheme to the proposed implementation year – two-year time period to adjust is unrealistic/too ambitious.

Cost Issues:

- The potential (extreme) high cost of replacing non-compliant vehicles would force businesses to withdraw from operating in London or go out of business altogether
- Concerns on the impact of prices due to limited supply of compliant vehicles.
- Businesses are already in the process of adjusting their vehicles to comply with the Ultra-Low Emission Zone scheme (ULEZ).
- Loss of residual value on vehicles rated below three stars.

Operational Issues:

- The DVS scheme does not allow enough time for businesses to comply.
- Growing trend to operate larger HGVs to improve efficiency.
- Purchase lead times could be more than 18 months.
- Electronic enforcement systems preferred.
- Geographical or time period exemptions were not considered practical.

The feedback from the focus groups was considered and formed the basis of the assumptions applied to the uptake of compliant vehicles for the Phase 2A CBIA. Please note, the DVS rating system was not finalised at this stage by LDS and subsequently the focus groups responded based on a series of hypothetical scenarios posed by Jacobs and proxy data (produced by TfL) of the estimated number of vehicles rated 0 stars and 3 stars respectively.

Further stakeholder engagement was set to take place with manufacturers (specifically body builders), the Small to Medium Enterprises (SMEs) and the Public Sector as the three groups were not represented at the focus

group. Trade associations provided a list of potential volunteering businesses to participate in the telephone interviews. However, late responses and poor availability limited the amount of data that could be collected

3.7 Limitation of the CBIA

To undertake the CBIA with the greatest accuracy and integrity, Jacobs have used the best data available and professional judgement required. However, there were limitations of the data available/not known to Jacobs, TRL and TfL. Limitation to data collection has either led to the development of working assumptions based on professional judgement and consultation with experts, or to not quantify the costs and provide a qualitative analysis. For more details of the assumptions, please refer to Appendix A.

3.7.1 DVS Ratings

Jacobs was unable to provide substantial information regarding the DVS rating system during the stakeholder engagement due to the unavailability of the ratings at that stage, therefore the feedback taken from the focus groups was based on proxy data and their biased view/concept on how DVS would be enforced influenced their response. The behavioural response assumptions developed by Jacobs therefore was not solely developed from the stakeholder engagement, but additionally developed with Jacob's professional expertise and previous experience on similar policy implementations.

Since the DVS ratings were finalised by LDS, TfL have developed more robust vehicle composition of the existing HGV fleet rated zero to five stars, based on the HGV survey conducted by the consultancy firm AECOM.

3.7.2 Supply-Side Factors

The uptake of compliant vehicles (i.e. compliant with the conditions of the scheme) outlined in Section 4.2 was derived under the assumption "*there is sufficient supply of 3 star rated vehicles*", this assumption may not be true depending on the imminent DVS ratings. If the DVS ratings of each vehicle type and model show a limited supply of 3 star rated vehicles currently on the market, the uptake of compliant vehicles would be very minimal. Those willing to replace their vehicles early would most likely to incur an increased cost premium of the 3 star rated vehicles due to the shortage in supply.

To account for the uncertainty of the supply of 3 star or higher rated vehicles after the year 2020, a sensitivity test was undertaken to assess the cost impact on businesses, assuming *HGVs replaced as part of the natural cycle would be replaced by the equivalent rated vehicle*. For example, a zero star rated HGV would be replaced by a new zero star rated model. The percentage of vehicles rated under three stars and three stars or above today (as of 2018) will remain constant throughout the appraisal period of 2020-2030.

For more details of the sensitivity test, please refer to Section 6.

4. HGV Impact Analysis

To assess the cost of the DVS scheme to the industries General Distribution, Construction, Food & Drink, Utilities and Servicing and Office, Light Freight & Servicing, we must first understand how each industry behaves in response to the scheme. As discussed in Section 3.6, the behavioural responses of each sector were derived from direct stakeholder engagement with key businesses from each sector, as well as the survey responses. The behavioural response research would inform the CBIA model, forecasting the number of vehicles facing potential financial cost as a result of the scheme.

4.1 DVS Ratings

Since the Phase 2A CBIA report was submitted for review to TfL (October 2017), TfL has developed more robust data on the proportion of N3 vehicles rated zero to five stars following the Spring 2018 public consultation and further research conducted by AECOM.

Table 4-1 presents the proportion of vehicles, by sector and by star rating, as of 2018. The Construction Sector shows the highest proportion of vehicles rated under 3 stars (32%), and businesses operating in the Office, Light Freight and Service sector show the lowest proportion of vehicles rated under 3 stars (1%).

Table 4-1: Proportion of Vehicles by DVS ratings (of the total number of N3 Vehicles in London), %

Sector	0 Star	1 - 2 Star	3+ Star
General Distribution	9%	7%	6%
Construction	10%	22%	4%
Food & Drink	3%	3%	2%
Utilities and Support	7%	10%	14%
Office, Light Freight and Service	0%	1%	1%

Please note, the proportion of vehicles by ratings shown above is an estimate, based on a HGV Survey undertaken by AECOM in April 2018 completed across Greater London to establish the make up of HGVs by cab height.

4.1.1 Total number of HGVs

The Society of Motor Manufacturers and Traders (SMMT) produces a database of the UK vehicle parc¹. This is compiled by merging data from the DVLA registration database with data obtained direct from UK offices of their member vehicle manufacturers. This dataset still contains some anomalous entries, but for the vast majority of cases the make and model fields are properly completed.

The proportion of vehicles by DVS ratings was applied to the total number of N3 vehicles in Greater London, **224,530** to estimate the number of vehicles rated zero to five stars.

For full details on the HGV vehicle dataset used for the analysis, please refer to TRL's Casualty Impact Assessment report (September 2017).

4.2 Number of Vehicles Rated Below Three Stars

The estimated number of vehicles that are non-compliant to the scheme was provided by TfL, as discussed in Section 4.1.

¹ HGV 'parc' is the term to define the total number of vehicles collectively.

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Although the businesses are not currently required to comply with DVS, feedback from the stakeholder engagement and survey shows evidence of businesses strongly in favour of the concept of DVS, and would take DVS into consideration when purchasing new vehicles.

One of the key assumptions applied to the analysis is that businesses would be able to replace their vehicle with a compliant vehicle at no extra premium:

- *Newly registered vehicles (i.e. vehicles due to be replaced as part of the natural cycle) will be replaced by a three-star compliant vehicle.*

Additionally, the assumption that 8.9% of the fleet would be replaced due to the natural cycle has been applied.

Table 4-2 and Table 4-3 presents the number of vehicles that are rated zero stars and 1-2 stars respectively, based on the forecast of N3 vehicles in the opening year of 2020 and 2024 respectively. By the year 2020, approximately 48,000 N3 vehicles are estimated to be rated zero stars, and by the year 2024, approximately 36,000 N3 vehicles are estimated to be rated either one or two stars.

Table 4-2: Number of vehicles rated zero stars and 1-2 stars, year 2020

Sector	Zero Stars		1-2 Stars	
	No. of Vehicles	Percentage of Total (224,530 N3 Vehicles), %	No. of Vehicles	Percentage of Total (224,530 N3 Vehicles), %
General Distribution	15,002	7%	11,820	5%
Construction	16,818	7%	36,618	16%
Food & Drink	4,485	2%	4,125	2%
Utilities and Support	10,814	5%	15,775	7%
Office, Light Freight and Service	821	0%	2,160	1%
Total	47,940	21%	70,499	31%

Table 4-3: Number of vehicles rated zero stars and 1-2 stars, year 2024

Sector	Zero Stars		1-2 Stars	
	No. of Vehicles	Percentage of Total (224,530 N3 Vehicles), %	No. of Vehicles	Percentage of Total (224,530 N3 Vehicles), %
General Distribution	7,716	3%	6,079	3%
Construction	8,650	4%	18,834	8%
Food & Drink	2,307	1%	2,122	1%
Utilities and Support	5,562	2%	8,114	4%
Office, Light Freight and Service	422	0%	1,111	0%
Total	24,657	11%	36,259	16%

The forecast of the number of vehicles presented in Table 4-2 and Table 4-3 would form the basis to calculate the number of vehicles subject to financial cost as a result of the scheme. For more details, please refer to TfL's "A Direct Vision Standard for HGVs - Casualty Impact Analysis for Proposed Implementation in London" report.

4.3 Explanation of Behavioural Response Assumptions

The development of the behavioural response assumptions by Jacobs incorporated both the feedback from the stakeholder engagement and Jacob’s expertise, ensuring the economic theory of rational behaviour is considered. Although the focus groups provided a direct indication from businesses themselves on how they would react, their responses were based on proxy data (as explained in Section 3.7.1) and should be viewed as containing a certain degree of bias. For example, one of the survey points of feedback stated that “if 100% of their vehicle fleet were non-compliant” the respondent selected the option to “re-allocate fleet to ensure only compliant vehicles enter Greater London”, which realistically cannot happen. The behavioural response assumptions had to be developed to show a degree of rationality of the behaviour of businesses, ensuring the core economic theory/principles applied balanced out the bias skew of the stakeholder engagement feedback.

The HGV Safety Permit Scheme requires all N3 HGVS to have a permit to enter London. Permits are issued to vehicles rated one to five stars automatically. Zero star rated HGVS are required to prove a “safe system”, i.e. demonstrate they have adopted additional mitigating safety measures. Additionally, the safety permit is extended to vehicles not compliant to a minimum standard of three stars from 2024.

Based on the feedback from the focus group conducted on 16th June 2017, the survey results and economic analysis conducted by Jacobs, the potential reaction to DVS was narrowed down to the following two responses:

1. Reallocate the fleet to ensure only compliant vehicles enter Greater London
2. Retrofit the non-compliant vehicles with extra mitigating safety measures

Table 4-4: Behavioural response to DVS (2020-)

Response	25% of Vehicles are non-compliant	50% of Vehicles are non-compliant	75% of Vehicles are non-compliant	100% of Vehicles are non-compliant
Reallocate compliant vehicles from the existing fleet	75%	35%	20%	0%
Purchase/lease vehicles that meet the required 2024 DVS rating early	0%	0%	0%	0%
Retrofit the vehicles	25%	65%	80%	100%

The assessment assumes all vehicles that are due to be replaced as a result of the natural cycle, not DVS, would be replaced by a 3-star compliant vehicle equivalent.

4.4 Number of Vehicles Subject to Financial Cost

This section provides the estimation of the number of vehicles affected by DVS (calculated based on Section 4.3) and subsequently be borne with a financial cost against the baseline scenario.

4.4.1 Baseline Scenario

The Do-Nothing scenario will serve as the baseline for the assessment and assumes the DVS ratings are non-mandated. The baseline scenario assumes **no costs** will be incurred as a result of the DVS ratings as no intervention or mandate imposed by TfL is anticipated.

Table 4-5 presents the number of vehicles forecast to be compliant to at least a DVS level of three stars by 2020 and 2024 for the baseline scenario. The number of compliant vehicles for the year 2020 and 2024

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respectively include the vehicles currently compliant to DVS and the older vehicles replaced by a compliant vehicle.

Table 4-5: Number of 3+ star Compliant Vehicles (Baseline Scenario)

	Total	Year 2020	Year 2024
Number of Compliant Vehicles	224,530	106,091	163,614
Percentage (%)		47%	73%

4.4.2 The HGV Safety Permit Scheme

Table 4-6 presents the number of vehicles that are forecast to be subjected to financial cost, as a consequence of the scheme, whereby approximately 21,000 zero star rated vehicles are forecast to retrofit extra safety features to meet compliance by 2020. By 2024, approximately 21,000 vehicles rated one or two stars are forecast to retrofit extra safety measures. Please note, once the permits have been granted, businesses are not required to apply again. Only newly registered N3 vehicles will require a permit application.

Although approximately 48,000 vehicles are estimated to be zero stars in the year 2020 (as outlined in Table 4-6) under half of the zero star vehicles are assumed to be reallocated to serve outside of Greater London as businesses will choose to re-allocate their existing fleet such that only compliant vehicles will enter Greater London. The vehicles re-allocated to not enter Greater London are assumed to not be subjected to financial cost, as shown in **Error! Reference source not found.** The same principles apply for N3 vehicles rated below three stars in 2024.

Additionally, all N3 vehicles which are registered to the voluntary Fleet Operator Recognition Scheme (FORS) and have Silver or Gold membership will be compliant as this level of membership will demonstrate they meet the Safe System standard. It should also be noted that while FORS is an industry recognised standard, there could in the future be other HGV safety recognitions schemes that could also demonstrate compliance. The forecast number of vehicles presented in Table 4-6 takes into account the proportion of vehicles that are re-allocated to serve outside of London and vehicles registered to the FORS scheme (Silver/Gold membership).

Table 4-6: Number of vehicles subject to financial cost

	Year 2020		Year 2024		Comments
	No. of Vehicles	Percentage of the total no. of HGVs in London	No. of Vehicles	Percentage of the total no. of HGVs in London	
Total No. of Non-Compliant Vehicles	47,940	21%	60,916	27%	
Vehicles registered to FORS Silver/Gold Membership	9,941	4%	19,853	9%	
Total No. of Non-Compliant Vehicles NOT exempt from the DVS HGV Safety Permit Scheme	38,000	17%	41,064	18%	

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Re-allocation of Existing Fleet	16,801	7%	5,514	2%	
Retrofitting Additional Safety Measures	21,198	9%	20,584	9%	Note: 20,584 refers to the number of HGVs rated one or two stars in 2024 forecast to retrofit additional safety measures. HGVs rated zero stars do not incur an additional cost in 2024 as they are only subjected to safety assessment once.

For full details of the number of vehicles subject to financial cost by sector, please refer to Appendix B.

5. Outcome of Cost Analysis

5.1 Implementation and Operational Costs to the Public Sector

5.1.1 Implementation Costs

The following table presents TfL's cost estimate of implementing the scheme, adjusted for inflation using the GDP deflator series² (source: DfT's WebTAG Databook July 2017) and an optimism bias of 50% to account for unforeseen cost overruns. The scheme is currently under the design and development phase, meaning there are uncertainties over a number of cost elements. However, TfL anticipates some of the implementation costs will be contract variations to suppliers of existing services. For example, expanding the congestion charging contract to run DVS number plate checks and penalty charges, and expanding the network of vehicle certifiers.

Table 5-1: Implementation Costs, £000s

Cost	One-Off Cost	One-Off Cost with Inflation	Total (incl. inflation + OB)
Certification & Testing	1,000	1,039	1,559
Permit Administration	1,500	1,559	2,339
Database of Permits	1,500	1,559	2,339
Issuance of Penalties	1,000	1,039	1,559
Total	5,000	5,197	7,795

The implementation costs would be incurred in the year 2019, one year prior to the introduction of the DVS scheme, and would be borne by the Public Sector.

5.1.2 Operating Costs

The operating cost of the scheme would be the ongoing costs outlined for the implementation costs, excluding certification costs, whereby the latter would be borne by businesses. The following table presents TfL's estimate of operating the scheme, adjusted for inflation using the GDP deflator series (source: DfT's WebTAG Databook July 2017) and an optimism bias of 50% to account for unforeseen cost overruns.

Table 5-2: Operating Costs, £000s

Operating Costs	Cost per Annum	Cost (Appraisal Period)	Optimism Bias	Total Operating Cost (with OB)
Permit Administration	200	2,610	1,305	3,915
ANPR Camera Maintenance	50	653	326	979
Issuance of Penalties	25	326	163	489

² Gross Domestic Product (GDP) deflator is a measure of the level of prices of all new, domestically produced, final goods and services in the economy,

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Other	50	653	326	979
Total	325	4,241	2,121	6,362

The cost “other” includes assessment of new vehicle design and maintenance of signage.

Although the cost of issuing penalties has been quantified and taken into account for financial purposes, for the purpose of the economic and business analysis, vehicles have been assumed to comply with the circulation regulation in place (i.e. No non-compliant vehicles entering Greater London after 2020 and 2024).

5.2 Quantified Cost to Businesses

5.2.1 Safety Mitigation Equipment

Under the HGV Safety Permit Scheme, vehicles not compliant to 1 star or above by 2020 have the option to demonstrate mitigating safety equipment/features that is considered “above par” the zero-star rating standard, yet not considered sufficient enough to meet the three-star rating. Vehicles rated below 3 stars would need to demonstrate mitigating safety equipment/features from 2024 onwards.

Although the safety mitigation measures are yet to be defined at this stage, Jacobs are basing the estimated cost of safety mitigation measures on the general safety measures of Indirect Vision, Sensors, Under-Run and Training.

Under the HGV Safety Permit scheme, the majority of the businesses would choose to retrofit zero-star rated vehicles with extra mitigation equipment rather than withdrawing from the Greater London market.

Table 5-3: Cost of Mitigating Equipment, £k (undiscounted)

	Year 2020	Year 2024	Total
No. of Vehicles	21,198	20,584	41,782
Cost, £k	£83,804	£88,732	172,536

By the year 2020, approximately 21,000 HGVs rated zero stars are forecast to retrofit extra safety features, amounting to the cost of £84m (undiscounted, inflation adjusted). By the year 2024, approximately 21,000 HGVs rated 1 to 2 stars are forecast to retrofit extra safety features, amounting to the cost of £89m (undiscounted, inflation adjusted).

5.2.2 Safety Mitigation Measure Assessment

Non-compliant vehicles that opt to retrofit their vehicles with additional safety equipment considered “above par” would require assessment of the equipment during the permit application process. As the process of assessing the safety mitigation equipment have not been finalised at this stage, a proxy price of £450 per vehicle test was applied.

Table 5-4: Safety Mitigation Measure Assessment, £ 000s

	Year 2020	Year 2024	Total
No. of Vehicles	21,198	20,584	41,782
Cost, £k	£10,113	£10,708	£20,821

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By the year 2020, approximately 21,000 HGVs rated zero stars are forecast to be subjected to the assessment, amounting to the cost of £10m (undiscounted, inflation adjusted). By the year 2024, approximately 21,000 HGVs rated 1 to 2 stars are forecast to be subjected to assessment, amounting to the cost of £11m (undiscounted, inflation adjusted).

For full details of the costs to businesses by sector, please refer to Appendix C.

5.3 Non-Quantified Costs to Businesses

5.3.1 Loss of Residual Value

One of the main issues raised in the stakeholder workshop (see Section 3.6.1) relates to businesses losing a proportion of their residual value of the non-compliant vehicles, where the DVS scheme is expected to drive down the demand for 0-2 star rated vehicles. However, the estimated loss of residual value of HGVs rated zero-two stars have not been estimated at this stage for the following complex considerations that need to be accounted for when estimating the loss of residual value:

- The opening year of the DVS scheme coincides with the opening year of the ULEZ scheme, to estimate how much residual value lost as a direct result of DVS would be complex, along with other policy implementations.
- Businesses have the opportunity to sell their non-compliant vehicles overseas (in particular outside of Europe), as mentioned by businesses in the stakeholder engagement. Although this option may incur additional costs such as export costs which needs to be considered.
- The scheme, at this time, is only being considered for Greater London. However, would other cities/countries adopt the proposed DVS? For example, if the scheme were adopted across Europe, businesses would find it extremely difficult to sell within the European market, and therefore restricted to a smaller second-hand market.
- The current supply of HGVs rated 3 stars or more available for purchase to businesses.

However, for the preferred scheme, the loss of residual value is not anticipated as such for zero-two star rated HGVs. The scheme is tailored to allow those that are not rated three stars or above to retrofit with additional safety mitigation measures, negating the need to replace their vehicles earlier than planned. Businesses, in particular SMEs, would still have the option to purchase second-hand vehicles rated below three stars and be able to retrofit in order to comply with the scheme.

5.3.2 Cost of Downtime

For businesses opting to retrofit their non-compliant vehicles, businesses would also incur downtime costs as a result of time spent adjusting the operational fleet to meet compliance. Cost of downtime would have a bigger impact on small to medium businesses, as they tend not to have the capacity or resources to allow for such disturbance to their operations.

Additionally, there is the loss of business time towards certification of the vehicles and assessment of the ratings. Non-compliant vehicles opting to retrofit their vehicles with extra safety mitigating equipment would require assessment. The loss of business time equates to the opportunity cost of operating rather than proving compliance to the scheme. Such cost includes the Value of Time for the HGV drivers and mechanics, as well as any revenue that could have been earned by each vehicle.

The cost of downtime to businesses has not been quantified at this stage.

5.3.3 Switching Manufacturers

In order to comply with the DVS scheme, the current supply of three star compliant vehicles may mean businesses would buy from a different manufacturer. Feedback from the focus groups showed that there are

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costs associated with switching manufacturers such as re-training for drivers, additional mechanical training and purchase of additional equipment/features compatible with the switched manufacturer produced vehicles.

The costs of switching manufacturers have not been quantified at this stage.

5.4 Impact on Small Businesses

The DVS scheme is expected to have a severe impact on small businesses that operate a smaller fleet, relative to larger, established businesses; compliance with DVS would potentially require substantial capital and time dedicated to adjusting the fleet. Small businesses simply do not have the capital and flexibility to adjust their fleet within two years (assuming information on DVS would become public by 2018 and opening year is 2020).

Stakeholder engagement with small businesses via telephone interviews have been attempted to further identify all potential impact on small businesses, however, a very small number of businesses responded, proving to be difficult to verify our assumptions.

6. Sensitivity Analysis

As discussed in Section 3.7, although feedback from the stakeholder engagement revealed businesses would consider replacing their older non-compliant fleet with three star or high rated vehicles, there is no clear indication at this stage the manufacturers are able to meet the increased demand for three star rated vehicles sufficiently in the short run. This sensitivity analysis measures the cost and business impact of the scheme, assuming:

- **HGVs replaced as part of the natural cycle would be replaced by the equivalent rated vehicle. For example, a zero star rated HGV would be replaced by a new zero star rated model.** The percentage of vehicles rated under three stars and three stars or above today (as of 2018) will remain constant throughout the appraisal period of 2020-2030.

The percentage of vehicles rated zero to five stars as of 2018, as outlined in Table 6-1, is assumed to remain constant throughout the appraisal period of 2020-2030. This represents the ‘worst case scenario’ of no take-up of new vehicles and is the opposite extreme of the central assumption that all vehicles are replaced with three stars or above. This analysis helps to understand the sensitivity of the results to the rate of take-up of three stars or above vehicles. Table 6-1 presents the number of vehicles rated zero stars and one or two stars respectively, given that older vehicles due for replacement would not be replaced by minimum three star rated vehicles.

Table 6-1: Number of vehicles rated zero stars and 1-2 stars

Sector	Zero Stars		1-2 Stars	
	No. of Vehicles	Percentage of Total (224,530 N3 Vehicles), %	No. of Vehicles	Percentage of Total (224,530 N3 Vehicles), %
General Distribution	20,467	9%	16,125	7%
Construction	22,944	10%	49,957	22%
Food & Drink	6,119	3%	5,628	3%
Utilities and Support	14,753	7%	21,521	10%
Office, Light Freight and Service	1,120	0%	2,947	1%
Total	65,403	29%	96,178	43%

Table 6-2 presents the number of non-compliant vehicles opting to retrofit additional safety measures, along with the associated cost of purchasing the additional safety measures and the safety assessment to prove compliance.

Table 6-2: Number of vehicles subjected to financial cost and the cost to businesses, £000s (undiscounted)

Year	Number of Vehicles Subject to Financial Cost	Safety Equipment	Safety Test	Total
2020	28,920	114,000	14,000	128,000
2021	2,574	10,000	1,000	11,000
2022	2,574	11,000	1,000	12,000
2023	2,574	11,000	1,000	12,000
2024	58,131	251,000	30,000	281,000

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2025	8,392	37,000	4,000	41,000
2026	8,392	38,000	5,000	43,000
2027	8,392	39,000	5,000	44,000
2028	8,392	40,000	5,000	45,000
2029	8,392	41,000	5,000	46,000
2030	8,392	41,000	5,000	46,000
Total		633,000	76,000	709,000

By the first year of enforcement (year 2020), approximately 29,000 zero star rated HGVs are estimated to retrofit their vehicles with additional safety features, incurring a total cost of £128m. The estimate of 29,000 zero rated HGVs is higher than the forecast number of 21,000 from the core analysis as the former includes newly registered HGVs rated zero stars.

Between 2020 and 2024, approximately 3,000 newly registered HGVs rated zero stars would opt to retrofit additional safety feature per annum. In the core analysis, no newly registered HGVs are forecast to retrofit additional safety features between 2020 and 2024 as the core analysis assumed any newly registered vehicles would be rated three stars or higher. This assumption holds for any newly registered HGVs post-2024.

By 2024, approximately 59,000 HGVs rated under three stars are estimated to retrofit their vehicles, incurring a cost of £280m in that year. From 2024 to 2030, approximately 8,000 HGVs rated under three stars would opt to retrofit their vehicles per annum.

Benefit-Cost Ratio

Table 6-3 presents the summary of the cost and benefits of the HGV Safety Permit Scheme (sensitivity test), the Net Present Value (NPV) and the BCR. The BCR of the scheme is now estimated at 0.10:1.

Table 6-3: Summary of the costs and benefits of the sensitivity test, £000s

	Undiscounted, £000s	Discounted, £000s
Benefits		
Casualty	£ 7,000	£ 5,000
Cycling	£ 73,000	£ 52,000
Total Benefits	£ 80,000	£ 57,000
Costs		
Cost to Businesses	£ 708,000	£ 550,000
Cost of Enforcement and Operation	£ 14,000	£ 12,000
Total Costs	£ 722,000	£ 562,000
Net Present Value (£000s)		-£ 505,000

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Benefit-Cost Ratio	0.10:1
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7. Conclusion

Table 7-1 presents the summary of quantified costs to businesses for each sector assessed (undiscounted) over the 10-year appraisal period from the year 2020.

Table 7-1: Summary of Quantified Costs to Businesses, £k (2017 prices)

	Retrofitting Safety Equipment	Safety Mitigation Test	Total, £k
General Distribution	£ 55,000	£ 7,000	£ 62,000
Construction	£ 67,000	£ 8,000	£ 76,000
Food & Drink	£ 18,000	£ 2,000	£ 20,000
Utilities and Support	£ 28,000	£ 3,000	£ 31,000
Office, Light Freight and Service	£ 4,000	£ 500	£ 5,000
Total	£ 172,000	£ 20,500	£ 194,000

The key findings of the cost to businesses assessments are as follows:

- The total cost to businesses is estimated at approximately £194m (undiscounted).
- The distribution of cost to businesses vary greatly between General Distribution and Construction in comparison to Food & Drink, Utilities and Support, and Office, Light Freight and Service.
- The Construction sector is forecast to incur the highest cost of £76m, followed by General Distribution, as a result of the higher proportion of HGVs rated zero stars and under three stars respectively.

The cost estimate to businesses, £194m, may change, depending on the ability of vehicles manufacturers supplying enough (minimum) three star rated vehicles sufficiently enough to meet increased demand. However, the cost to businesses may increase if businesses are unable to purchase a higher rated HGV to replace their older vehicle. Therefore, in the short run, businesses may continue to buy zero to two star rated HGVs due to the limited availability of three star or higher rated vehicles.

Additionally, defining the vehicle models by DVS rating may lead to a reduction in the price of zero-two star rated HGVs. If the price of zero to two star rated HGVs reduce, this may lead to an increase in demand, especially if the combined cost of purchasing a new, non-compliant vehicle and retrofitting costs/FORS membership is lower than the purchase of a new, three star rated vehicle. Other factors that may influence the uptake of three or higher rated vehicles include the number of times the vehicles enter Greater London. For example, if a furniture company based outside of London only enters London, on average, once a month then the cost of complying with the scheme may not be justified.

As a result of the uncertainty over the supply of three star or higher HGVs and other factors explained above, we forecast the cost to businesses to fall in the range of £194m to £708m (calculated in the sensitivity test).

The following table presents the cost of operating the DVS scheme to the Public Sector, provided by TfL. An Optimism Bias of 50% was applied to account for cost uncertainties yet to be forecast at this stage.

Table 7-2: Summary of Operational Costs of the Scheme, £ 000s

Cost	Cost (appraisal period)
Implementation Costs	5,000

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Operational Costs	4,000
Total	9,000
Optimism Bias (50%)	5,000
Total (OB included)	14,000

Benefits of the scheme

For Phase 2A, the CBIA presented a lower and upper bound range of BCRs for each option; the research done by Transport Research Laboratory (TRL) was not able to accurately determine the number of vehicles that may be affected by the DVS. As a result, a range of potentially affected vehicles was applied in the assessment.

TfL have since been able to narrow down the range to a singular set of vehicle proportions by DVS ratings. When comparing the latest estimated proportion of vehicles rated zero stars and 1 to 2 stars, as outlined in Section 4 (Table 4-1), against the previous findings provided by TRL, the latest vehicle composition by DVS ratings best aligns with the vehicle composition for the best case scenario (low).

The benefits of the scheme quantified and monetised include:

- Casualty Benefits – the reduction in the number of casualties caused by the reduction in road collisions as a result of the scheme
- Cycling Benefits – the increased cycle demand and subsequent health benefits as a result of increased positive road safety perception as a result of further restricting the entry of the most dangerous vehicles in London (i.e. the Direct Vision Standards).

The casualty benefits calculated by TRL for the best case scenario (low) has been used for this assessment. For more details on the casualty benefits, please refer to TRL's "A Direct Vision Standard for HGVs – Casualty Impact Analysis for Proposed Implementation in London" report (September 2017).

Benefit-Cost Ratio

Table 7-3 presents the summary of the cost and benefits of the HGV Safety Permit Scheme, the Net Present Value (NPV) and the BCR.

The BCR of the scheme is now estimated at 0.33:1, higher than the BCR Phase 2A CBIA (BCR of 0.17:1). The increase in BCR is a result of the decrease in the estimated costs borne by businesses (no certification cost and one safety mitigation feature test per vehicle only).

Table 7-3: Summary of the costs and benefits of the scheme, £000s

	Undiscounted, £000s	Discounted, £000s
Benefits		
Casualty	£ 7,000	£ 5,000
Cycling	£ 73,000	£ 52,000

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Total Benefits	£ 80,000	£ 57,000
Costs		
Cost to Businesses	£ 193,000	£ 163,000
Cost of Enforcement and Operation	£ 14,000	£ 12,000
Total Costs	£ 207,000	£ 175,000
Net Present Value (£000s)		-£ 118,000
Benefit-Cost Ratio		0.33:1

Appendix A. Assumptions

The following assumptions were applied to undertake the CBIA, based on various sources such as focus groups, survey, technical expertise, desktop research and professional judgement:

- No HGVs would enter London illegally, i.e. all HGVs entering London will be compliant.
- There will be sufficient supply of vehicles rated three stars or above in the market.
- No businesses would switch to operate LGVs.
- No certification cost will be incurred by businesses.
- No growth rate has been applied to the forecast N3 class vehicles due to the full capacity of the London road network and the feedback from the focus groups suggested operators are looking to switch to larger vehicles to further consolidate their loads in response to the growing problem of congestion.
- HGVs replaced as a part of the natural cycle would be replaced by 3-star compliant vehicles (core analysis only).
- TRL estimated that approximately 8.9% of vehicles per annum would be replaced due to the natural cycle of the vehicles (without DVS intervention); based on the 2015 vehicle registration database, 8.9% of vehicles were newly registered.
- New/existing competitors with compliant vehicles would eventually replace the non-compliant vehicles that are forecast to withdraw from operating in London.

Appendix B. Number of vehicles subject to financial cost by sector

Sector	Year 2020	Year 2024
	Retrofitting extra safety equipment (zero stars)	Retrofitting extra safety equipment (1-2 stars)
General Distribution	9,120	4,387
Construction	6,976	9,246
Food & Drink	2,914	1,565
Utilities and Servicing	2,007	4,593
Office, Light Freight & Servicing	182	793
Total	21,198	20,584

Appendix C. Cost estimation to businesses by sector

Purchase of Additional Safety Equipment, £k (undiscounted)

Sector	Year 2020	Year 2024
General Distribution	£ 36,054	£ 18,912
Construction	£ 27,577	£ 39,857
Food & Drink	£ 11,522	£ 6,745
Utilities and Servicing	£ 7,933	£ 19,799
Office, Light Freight & Servicing	£ 719	£ 3,418
Total	£ 83,804	£ 88,732

Safety Mitigation Measure Assessment, £k (undiscounted)

Sector	Year 2020	Year 2024
General Distribution	£ 4,351	£ 2,282
Construction	£ 3,328	£ 4,810
Food & Drink	£ 1,390	£ 814
Utilities and Servicing	£ 957	£ 2,389
Office, Light Freight & Servicing	£ 87	£ 413
Total	£ 10,113	£ 10,708