Final stage impact assessment

Title:	**Bus Services Bill – Reduction in the use of new, non-zero emission bus on local bus services**
Type of measure:	Primary legislation
Department or agency:	Department for Transport
IA number:	DfT00487i
RPC reference number:	DFT-24013-IA(1)
Contact for enquiries:	Buses.Bill@DfT.gov.uk
Date:	26/11/2024

Contents

1. Summary of proposal

Modernising transport infrastructure and delivering better buses is at the heart of the Government's plan to kickstart economic growth in every part of the country and get the country moving. The Bus Services Bill aims to support the delivery of the Government's national missions, including improving the bus network.

Government is also committed to tackling climate change and limiting the increase in global temperature. In June 2019, the UK became the first major economy to legislate to end its contribution to climate change by 2050, committing to net zero greenhouse gas emissions (GHG).

Transport is the largest contributor to UK domestic GHG emissions, contributing 28% of UK domestic emissions in 2021[1]. We must deliver a step change in the breadth and scale of our ambition on transport emissions to reach net zero. New vehicles offer more than environmental benefits – with more comfortable journeys and a reduction in vehicle noise and vibration they provide an opportunity to attract new users.

The aim of this policy is to support efforts to reduce GHG emissions from transport, specifically in the bus sector, to net-zero by 2050. The Climate Change Act 2008 requires the UK Government to set legally-binding 'carbon budgets[2]' which act as stepping stones towards the 2050 target. To meet both overall and interim carbon budgets, there is a need to increase the pace of roll out of zero emission buses. The added incentive is that we expect that zero emission buses will achieve operating cost savings in the longer term, which can be reinvested in more frequent services, lower fares and other improvements for passengers.

We intend to legislate to reduce the use of new non-zero emission buses on English local bus routes (excluding London and franchised services), While the date the measure will come into effect will be set out in secondary legislation, we will state in primary legislation that the measure will not come into effect before 2030. This will provide certainty to operators and manufacturers and focus R&D activities on achieving zero emissions, thereby reducing the need for subsidy support by making zero emission buses cheaper and reducing operator running costs.

The policy will deliver significant environmental and air quality benefits contributing to the UK meeting its net-zero GHG emissions target by 2050. This is covered in more detail in the evidence base.

Zero emission bus services, that meet the needs of passengers and communities, and attract passengers from other forms of transport, are at the heart of our plans.

2. Strategic case for proposed regulation

According to the Climate Change Committee, the annual reduction in surface transport emissions across the rest of the decade must be more than four times what we have seen in 2023[3]. Furthermore, on an absolute basis, buses are disproportionately polluting –

[1] Department for Transport: *Transport and Environment statistics 2023*: 2023
[2] A carbon budget is a cap on the amount of greenhouse gases emitted in the UK over a five-year period.
[3] Climate Change Committee: *2024 Progress report to Parliament*: 2024

making up only 1% of total road vehicle miles travelled, but 3% of road transport GHG emissions[4].

Transport vehicles also emit gases or other substances which don't have a significant greenhouse gas effect but do have significant health consequences. The most significant air pollutants from the transport sector are nitrogen oxides (NOX) and particulate matter (PM). Road transport contributed 30% of emissions of NOx[5], and 18% of total PM2.5 emissions and 16% of total PM10[6] emissions in 2022.

However, some bus operators have already begun to invest in new, green, battery electric and hydrogen fuel cell buses, supported by government initiatives such as the Zero Emission Bus Regional Area (ZEBRA) programmes in England. Many local transport authorities have also begun to move to, or plan for, zero-emission fleets. However, there is much more to do. As of March 2023, only 4% of Britain's local bus fleet was zero-emission – so it is vital that we go further and faster[7].

It is widely acknowledged that transport is one of the more challenging sectors to decarbonise, and as such delivering net zero emissions will require significant action across all segments of the sector, hence the need for further government intervention. Moreover, we must go faster and further to ensure compliance with the Climate Change Act 2008.

Importantly, reducing the usage of new non-zero emission buses on local bus routes would deliver significant environmental and air quality benefits contributing to the UK meeting its net-zero GHG emissions target by 2050.

In the absence of this policy, total cost of ownership analysis shows that in the national average central scenario, diesel and zero emission buses will not reach cost parity until 2032. This is assuming a discount rate of 3.5%, as per TAG, which is lower than many private bus operators' own discount rates. This means the bus sector will not purchase zero emission buses independently at the rate needed to achieve the necessary carbon emissions reductions in line with UK Government and international targets. In addition, poor air quality remains the largest environmental risk to public health. Public Health England (now the UK Health Security Agency) found that the health and social care costs of air pollution in England could reach £5.3 billion by 2035[8].

Moreover, failure to act may result in the UK missing out on opportunities for greater investment and trade than currently exists. The three largest UK bus manufacturers, Wrightbus, Alexander Dennis and Switch Mobility, all produce zero emission models, so there is existing potential to scale up, creating more jobs, alongside developing domestic industry's ability to export globally.

There is a global impetus to move to zero emissions, across all sectors and segments of society. The United Nations Framework Convention on Climate Change (UNFCCC) provides the international strategic framework.

---

[4] Department for Transport: *Transport and Environment Statistics 2023*: 2023
[5] Department for Environment, Food and Rural Affairs: *Emissions of air pollutants in the UK – Nitrogen oxides (NOx)*: 2024
[6] Department for Environment, Food and Rural Affairs: *Emissions of air pollutants in the UK – Particulate matter (PM10 and PM2.5)*: 2024
[7] Department for Transport: *Annual bus statistics 2023*: 2024
[8] Public Health England: *Estimation of costs to the NHS and social care due to the health impacts of air pollution*: 2018

We have a series of legally binding carbon budgets that track progress against our long-term ambition to reduce economy-wide emissions to net zero by 2050.

This policy intends to ensure that the transition to zero emission buses happens in a manner that is compliant with the UK's carbon emissions reductions targets, and consistent with the UK's Nationally Determined Contribution to the UNFCCC. It also aims to ensure that the transition to zero emission buses is delivered in a cohesive manner, to support the green transformation of the bus sector and deliver on the Government's missions and five-point plan for improving the bus network; as well as ensure value for money for the taxpayer.

Currently, there is considerable uncertainty in the bus industry around the vision and policy direction for zero emission buses in England. The proposed policy will provide a clear steer to industry as to government's intention. This is covered in more detail in the evidence base.

3. SMART objectives for intervention

This measure sits within a broader framework that seeks to deliver on both the Government's commitment for bus reform and to enable decarbonisation in line with the 2050 net-zero target. Each option (2030, 2032, and 2035) provides a specific starting point from which the intervention, and its effectiveness against objectives, can be measured from.

Objectives:

- Deliver a decarbonised bus fleet, in line with net-zero targets
    - Carbon budgets, under the Climate Change Act 2008, place a restriction on the total amount of greenhouse gases the UK can emit over a 5-year period. Each carbon budget period provides a time horizon over which the pace of decarbonisation, in terms of sectoral emissions, can be measured against.
- Ensure the UK remains a leader in zero emission bus manufacturing
    - The objective is for domestic manufacturers to maintain a 60%, or higher, market share for new zero emission bus registrations. We also intend to measure this across carbon budget periods to provide both consistency and a reasonable time horizon to measure impacts of investments in capital, i.e. additional plant and machinery, which can take time to come to fruition.
- Help local authorities deliver on their transport ambitions
    - The Transport Act 2000 requires all local authorities to produce a local transport plan, setting out how they intend to maintain and improve transport in the area. The Department has also produced a toolkit to provide guidance on incorporating zero emission buses into local plans. This provides a set criteria that is measurable across all local authorities. For consistency, and to account for the local electoral cycle, we intend to also measure this across carbon budget periods.

It aligns with several of the Government's missions and the Department's strategic priorities:

- **Kickstart economic growth** – the bus sector directly employs 105,000 people in Britain, with a further 53,000 involved in supply chains. The total net value of direct, indirect, and induced employment is estimated at more than £11bn per year, in all local areas across the country.[9]

- **Make Britain a clean energy superpower** – moving to zero emission buses, will help achieve net zero targets, cleaner air, green growth and improved health and wellbeing outcomes
- **Build an NHS fit for the future** – Air pollution costs the NHS hundreds of millions of pounds, supporting the transition to clean transport will support the Government's mission to build an NHS fit for the future.
- **Break down barriers to opportunity** – buses are key to reducing inequality; users are disproportionately from less advantaged social groups and places. Improved services will strengthen communities, sustain town centres, and connect disabled and isolated people.

This impact assessment is linked to the other measures that are contained in the Bus Services Bill impact assessment, focusing on 6 main objectives which include:

- **Empower Local Transport Authorities (LTAs) and reform funding**
- **Allow every community to take back control of their buses**
- **Accelerate the bus franchising process**
- **Step in to safeguard local bus networks**
- **Support public ownership**
- **Making buses and the bus network safer, more accessible and inclusive for all passengers**.

Though this measure sits within the broader framework of the Bus Services Bill, and is linked to these objectives, for the purpose of this impact assessment the objectives are not based on the six objectives covered in the other Bus Services Bill impact assessment. This is as the specific critical success factors for the measure, set out in section 15, differ and thus it would not be appropriate to measure success against them in the same manner.

Potential indicators to monitor progress:

The Department has started to consider potential indicators that could be used to monitor both the outcomes and progress in delivering the objectives.

- *Deliver a decarbonised bus fleet, in line with net-zero targets*: The Department's annual bus statistics capture the size and composition of the bus fleet in England, including emissions status, and the Department's Transport and Environment statistics capture the total emissions from the sector.
- *Ensure the UK remains a leader in bus manufacturing:* The Secretary of State announced the formation of a UK Bus Manufacturing Expert Panel, which will examine this objective in more detail. In the interim, the proportion of new buses registered which are produced by a domestic manufacturer could serve as an indicator.
- *Help local authorities deliver on their transport ambitions:* LTAs are required to develop local transport plans and bus connectivity assessments. These set out local targets against which progress can be measured.

[9] Confederation of Passenger Transport: *The economic impact of local bus services:* 2024

4. Description of proposed intervention options and explanation of the logical change process whereby this achieves SMART objectives

Primary legislation will be required to deliver the preferred option. It is only by changing the law that we can deliver a reduction in the usage of new non-zero emission buses. This option will ensure that the Government can deliver its commitments around net-zero and increase the usage of zero-emission buses.

The proposed policy is designed to focus market development on bus manufacturing, and related sectors, to help achieve climate change commitments. In the absence of such policy, there is a risk that firms in other countries will benefit from this innovation to the detriment of those in the UK. Creating a prohibitive environment in the UK would therefore not achieve the policy objectives.

Overly prescriptive policies can negatively impact innovation by 'pigeonholing' the industry into a limited number of pathways that shut out other avenues of discovery. The central option has been drafted in an "outcome" based approach, prescribing what government expects the outcomes to be rather than how to achieve them.

This approach has been chosen to ensure the greatest flexibility and minimise other burdens for industry, whilst still ensuring there are sufficient precautions in place to mitigate any risks. By keeping the prescriptiveness to a minimum, the policy aims to not stifle innovation and potentially innovative changes to organisational methods and processes.

Officials have considered the potential impacts, with relation to innovation, throughout policy development, and have ensured the policy is:

- designed and reviewed with a clear understanding of how it can maximise the potential benefits of innovation; and
- is supported by robust evidence and analysis

This has been supported by use of futures tools and techniques, to gather intelligence and explore the different dynamics of change.

In the driver mapping exercise, the following factors, in addition to decarbonisation, were considered key to shaping the future business environment:

Growing the economy

Government wants the UK at the forefront of the design and manufacturing of zero emission vehicles. The size of the global opportunity is potentially significant: Bloomberg New Energy Finance estimate the cumulative value of zero emission vehicle sales across all segments could hit $9 trillion dollars by 2030 and $63 trillion by 2050[10].

The UK is well placed to seize these new opportunities as home to the manufacture of a range of zero emission buses, across England, Scotland and Northern Ireland, one of the fastest selling electric vehicle markets in Europe, all supported by a world-class R&D ecosystem and supply chain.

[10] Bloomberg New Energy Finance: *New Energy Outlook*: 2024

Improving air quality

Over recent decades, UK air quality has significantly improved thanks to action at all levels. The UK has commitments to reduce annual emissions of air pollutants by a percentage of 2005 levels, set in the National Emission Ceilings Regulations (2018). These are known as emission reduction commitments (ERC).

As noted above, per DEFRA statistics, transport contributes a substantial portion of these air pollutants to the UK's domestic total:

- 30% of nitrogen oxides
- 18% of PM2.5 emissions
- 16% of PM10 emissions

Investing in clean air and taking action to tackle poor air quality are key priorities.

According to DfT analysis, each zero-emission bus saves around 67 tonnes of CO_2 and 23kg of NO_X a year, relative to a diesel alternative, supporting healthier communities and reducing the burden on the NHS.

Improving energy security

Since 2013/14, the UK has become a net importer of oil. Imports of road transport fuels have also increased over the last decade, in particular to meet the growth in demand for diesel. In 2023, the UK remained a net importer of petroleum products by 11.5 million tonnes[11].

Zero emission vehicles can help reduce the UK's reliance on oil, and exposure to the volatility of global markets. The transition to zero emission vehicles could partly replace our reliance on imported oil with largely UK generated energy sources, helping to improve the UK's long-term energy security.

This will also likely stimulate the domestic energy services, e.g. frequency response, and flexibility services, and energy storage industries, in addition to generation and distribution.

Lowering costs for operators and passengers

Today zero emission vehicles, like battery electric buses, already have substantially lower fuel and maintenance costs compared to conventional vehicles. More energy efficient vehicles and operations can significantly drive down the costs of operating bus services.

Additionally, the Energy Saving Trust estimate that efficient driving alone could save 5-10% of annual fuel bills - for heavier vehicles, like buses, improving the overall efficiency of operations can have significant costs savings as well as overall emissions reduction benefits[12].

The development of the policy of reducing the use of new non zero emission buses has been informed by two public consultations. In March 2021, the Department held a light-touch consultation on the appropriateness of restricting sale of diesel buses, which

[11] Department for Energy Security and Net Zero: *Digest of UK Energy Statistics*: 2024
[12] Energy Saving Trust: *Advising fuel efficient driving techniques for your fleet*: 2016

informed a second consultation, held in March 2022, on restricting sale of new, non-zero emission buses from a date between 2025 and 2032.

Officials also examined critical uncertainties – drivers which are more important for the policy area, but which have an uncertain outcome, to understand whether implementing a policy in a certain way could ‘lock’ the Government or wider sector ‘in’ or ‘out’ of certain pathways.

A common insight that emerged from previous Government consultations on this topic is the considerable uncertainty that industry has around the vision and policy direction for zero emission buses in the UK. Also mentioned elsewhere in this document is uncertainty relating to technology change and fears of obsolescence for first movers.

The proposed policy will not remove incentives toward further innovation on internal combustion engines as, through retrofitting and the second-hand market, opportunities will remain.

This certainty will also encourage innovation toward overcoming some barriers that exist in the zero-emission bus space, for example further development of battery light weighting and more efficient motors.

Government is supporting innovation across the sector, for example in vehicle-to-grid technologies, where battery electric vehicles may be used to supply electricity back to the grid at times of high energy demand to glean wider energy system benefits.

5. Summary of long-list and alternatives

Options that were considered have been summarised in the below table. The Green Book's options framework and filter process was used to assess the long list of options and create the short list by considering how each met the objectives.

Option	Objectives		
	Deliver a decarbonised bus fleet	Ensure the UK remains a leader in bus manufacturing	Help local authorities deliver on their local transport ambitions
Do nothing	1 – Very low: In the absence of intervention, analysis indicates the bus sector will not comply with necessary carbon reduction targets	1 – Very low As analysis indicates the bus sector will purchase zero emission buses at a much-reduced rate in a do-nothing scenario, lack of demand is unlikely to spur innovations and economies of scale	1 – Very low No further intervention provides little assurance to the ability of local authorities to meet their own decarbonisation or zero emission bus targets.
End the sale of new, non-zero emission buses from a given date	1 - Very low Due to implementation issues (see below the table for more information) this option is unable to meet the objectives	1 – Very low Due to implementation issues this option is unable to meet the objectives	1 – Very low Due to implementation issues this option is unable to meet the objectives
Restrict the usage of new, non-zero emission buses on local bus services from no earlier than a given date	4 – High As the measure targets a large proportion of the total bus fleet in England it will require the necessary decarbonisation in line with requirements, while enabling the local authorities and operators the time to plan investment and fleet strategies to meet the date.	4 – High This would provide a clear direction of travel to the bus industry and allow manufacturers to adjust product planning and assembly lines, in turn improving efficiencies and reducing costs, as well as building confidence and certainty for the market.	5 – Very high As the measure would exclude franchised areas, it allows for areas who have decided to take local control of their bus services to make a decision in line with their needs and objectives, for example moving faster. For other areas, it provides assurances that their bus fleets will not be left behind in the transition to zero emissions.

Targeted investment and interventions, i.e. grant funding programmes, investment in supply chain, etc.	3 – Medium This would depend on the scale of the financial intervention, but would likely not guarantee the decarbonisation of the fleet and there may be value for money concerns	5 – Very high Depending on the targeted nature of the funding, i.e. support for manufacturers to transition to zero emission at scale, or further funding for buses and infrastructure to local authorities	3 – Medium Unless funding were available on a scale to match every local authority's ambitions, there would ultimately be winners and losers

Other alternative options to legislation were considered but deemed not suitable to deliver the change required because of the need to meet legally binding carbon budget targets and achieve net-zero. While officials evaluated non-regulatory models, they were deemed ineffective:

- **Industry Self-Regulation (ISR):** Although ISR can complement government policies and benefit both industry and consumers, its effectiveness depends on factors like the strength of commitments, industry coverage, adherence to commitments, and consequences for non-compliance.
- **Co-regulation:** This involves government and industry collaboration, where the industry enforces a code of practice developed with government input. It offers benefits similar to ISR but also shares its limitations.

This is due to the failure of previous non-regulatory approaches to reducing vehicle emissions, which is covered in more detail in the evidence base, in section 13.

Per the table, regulatory options were considered for both a total restriction of sales of new, non-zero emission buses across the UK, as well as the preferred option of reducing the usage of new, non-zero emission buses on local bus routes in England outside London and franchised services. As was mentioned previously, two public consultations have been held on the principle of reducing buses based on emissions which informed policy development.

As such, it was considered appropriate to pursue a shortlist of dates for reducing usage on registered bus services:

Buses are defined as Class I and II, M2 and M3 buses, i.e. those with a capacity exceeding 22 passengers, in addition to the driver, as defined in Article 4 of Regulation (EU) 2018/858, as that regulation has effect in domestic law, or, as the case may be, as it has effect in EU law from time to time and by virtue of the Windsor Framework.

A local bus route is defined as a service which uses public service vehicles (PSVs) to carry passengers who pay separate fares where passengers must be able to disembark within 15 miles of the place from where they boarded the bus, per section 2 of the Transport Act 1985. This excludes London and franchised services.

Reducing the usage of new, non-zero emission buses on bus services is a well understood means to achieve emissions reduction from the bus sector. Countries like the Netherlands have utilised such policies to achieve the stated objective – section 13 of the evidence base has further detail on international examples.

This measure will send a clear message to manufacturers and operators about the Government's intention to achieve an all ZE local bus fleet.

6. Description of shortlisted policy options carried forward

Three policy options have been considered for reducing the usage of new non-zero emission buses on English local bus routes (excluding London and franchised services). New buses registered on local bus services beyond the year specified for each option would be required to be zero emission at the tailpipe. Operators would still be able run existing non-zero emission buses after the date.

Option 0 – Do Nothing – This option is present to establish a baseline, as to what would happen if there were no intervention.

Option 1 – Restrict the usage of non-zero emission buses on English local bus routes from 2030.

Option 2 – Restrict the usage of non-zero emission buses on English local bus routes from 2032.

Option 3 – Restrict the usage of non-zero emission buses on English local bus routes from 2035.

The Department's Greener bus model has been used to determine the impacts generated by each of the policy options. The impacts being captured by the model reflect the change to the England bus fleet excluding London and franchised services as a result of the policy options. Impacts cover the key monetised costs and benefits to businesses, government and society. These are the reduction in carbon dioxide, nitrogen oxides (NOx) and particulate matter (PM2.5) emissions, additional capital costs to purchase new zero emission buses, capital cost incurred for battery replacements, incremental maintenance cost of the bus fleet, capital costs associated with supporting infrastructure, maintenance costs associated with supporting infrastructure, incremental operating costs from fuel and electricity used, changes in Bus Service Operators Grant (BSOG) payment and changes in fuel duty revenue/costs.

For each of the above impacts the model calculates the annual cost or benefit generated, in each year from the first year the end of use policy is implemented, which varies depending on the policy option, up until 2066. This accounts for impacts generated from expected differences in bus purchases, compared to the do-nothing scenario, made between the first year of each respective option and 2050. Given each bus is assumed to have an operational life of 17 years, the appraisal period extends to 2066 to include all costs and benefits that would occur from the additional zero emission buses delivered by 2050. Each additional zero emission bus will only generate costs and benefits during the assumed 17-year operational life.

An overview of the methodology for each monetised cost and benefit is outlined in the evidence base. This includes details of the key assumptions and parameters used. These parameters and assumptions often vary over time to account for external factors. Costs and benefits for each year will depend on the parameters and assumptions used in a given year and the estimated difference in the bus fleet, or changes to the buses, between the do-nothing and do something options.

The central, and for the purposes of this IA, preferred, option is option 2 (2032). Option 1 (2030) is considered a more ambitious way forward, and option 3 (2035) is considered less ambitious.

A small and micro business assessment (SaMBA) is available in the evidence base. It assesses that the measure does not disproportionately affect such businesses due to the manner in which the measure is to be implemented (i.e. only on full size buses operating on local bus services), and due to the market dynamics (i.e. tendency for SMBs to use the second-hand market, which remains unaffected).

7. Regulatory scorecard for preferred option

Part A: Overall and stakeholder impacts

(1) Overall impacts on total welfare		**Directional rating** **Note: Below are examples only**
Description of overall expected impact	The net present social value (benefits minus costs), across the appraisal period, indicates that the intervention will result in a positive contribution to society of c. £749m[13] The costs to business reflect that, over the lifetime of the policy, operational savings for bus operators would be expected to outweigh the additional capital cost of zero emission buses. The primary benefit and objective of the policy, which drives the positive NPSV, is carbon reduction. This is followed by large net savings in operating costs.	**Positive** **Based on all impacts (incl. non-monetised)**
Monetised impacts	Total c. £749m NPSV (c. £669m for less ambitious scenario, c. £800m for more ambitious scenario) The monetised impacts are covered in more detail in the expected impacts to businesses, households and on wider government priorities.	**Positive** **Based on likely £NPSV**
Non-monetised impacts	There are a range of non-monetised impacts as a result of the intervention, the majority of which are considered benefits. See the expected impacts on businesses and impacts on households' section for more detail.	**Positive**
Any significant or adverse distributional impacts?	No significant adverse or distributional impacts are found as a result of this intervention - see the expected impacts on businesses and households for more specific details.	**Neutral**

(2) Expected impacts on businesses		
Description of overall	Zero-emission buses have higher upfront costs, due to currently relatively higher prices for batteries or fuel cells, relative to combustion engines, and new infrastructure needs. However, their lower operating costs often make them more	**Positive**

[13] All monetised values presented in the scorecard are for the 2032 central way forward unless otherwise stated. Later sections of the IA present the monetised values for all shortlisted policy options and scenarios assessed.

business impact	cost-efficient over time, giving significant operating cost savings for businesses over the appraisal period. All bus operators in England, excluding those that cover London and franchised areas, may be impacted by this measure. Due to uncertainty in the number of places that are likely to franchise, the central scenario assumes the measure will affect operators in 59 LTAs, 63 LTAs in the high scenario and 43 LTAs in the low scenario[14].	
Monetised impacts	Business NPV c. £314m Approx net financial benefit to business EANDCB c. £15m of which admin costs are £0 [15] **Additional vehicle capital costs** - additional costs incurred to purchase a zero-emission bus compared to an equivalent non-zero emission bus. Includes mid-life cost such as battery replacements. C. -£700m over the full appraisal period **New charging and refuelling infrastructure costs** - New zero-emission buses will require charging & refuelling infrastructure. Includes cost incurred to connect to the grid and substation upgrades. C. -207m over the full appraisal period **Net savings in maintenance cost** - Zero emission buses can have lower maintenance costs, due to fewer mechanical components relative to non-zero emission alternatives. C. £398m over the full appraisal period. **Infrastructure maintenance cost** - Charging and refuelling infrastructure will need maintenance to keep in operation, cost of maintenance expected to be higher than infrastructure used for non-zero emission buses. C. -£47m over the full appraisal period. **Net savings in operating cost (incl. fuel duty and BSOG)** - Zero emission buses can have a lower per km operating cost than non-zero emission buses. The cost of electricity per km for electric buses is lower than cost of diesel per km for diesel buses. This includes change in VAT, Duty, and the Bus Service Operator Grant (BSOG). C. £870m over the full appraisal period.	**Positive** **Based on likely business £NPV**
Non-monetised impacts	**Higher upfront capital costs -** Bus operators may incur costs as a result of leasing/credit mechanisms – though this depends on business structure and may not be the case for all businesses. **Short-run vehicle capability constraints** - In the short-term technology constraints may mean a zero-emission bus cannot cover the same distance per day as a non-zero emission bus, for instance due to limited battery capacity. In these cases, a	**Neutral**

[14] Franchising assumptions are explained in greater detail in section 15.
[15] Calculated by the Present Value of Net Costs to Businesses (the £314m) and dividing it by the annuity rate over the time period of 35 years (as appraisal period lasts until 2066). See the guidance for further detail.

	higher number of zero emission buses would be needed to cover the same level of service as the current non-zero emission fleet being used. **Additional Depots space** – Upgrading depots to accommodate the infrastructure required to refuel and recharge new zero-emission buses, reducing the space to park buses when not in use. This could result in operators needing to increase the size of depots to keep the same bus capacity. **Efficiency gains from limiting production lines** - This will allow manufacturers to focus solely on zero-emission solutions at an earlier date. This can broaden the range of zero-emission vehicles available to operators which will increase competition, promote innovation and potentially reduce vehicle costs. **Skills in industry boosted sooner** as technical maintenance staff will be required to be trained. **Increased patronage** - switching to zero-emission buses can potentially increase bus patronage which would benefit operators. Zero-emission buses are quieter, more comfortable, and have no exhaust fumes, making the experience more pleasant and attractive for riders. Health and environmental benefits may also encourage more people to opt for public transit over personal vehicles. Increased awareness of sustainability and cleaner air in urban areas can make public transportation a more appealing choice for eco-conscious travellers. .	
Any significant or adverse distributional impacts?	No – a small and micro business assessment has been carried out (see evidence base) and finds that, due to the way the Government has scoped the policy, there should be no significant or adverse distributional assessments	**Neutral**

(3) Expected impacts on households		
Description of overall household impact	Households and individuals are expected to benefit from improvements in journey quality and reduction in noise pollution. Households will benefit from the reduction in Greenhouse Gas (GHG) and air quality emissions.	**Positive**
Monetised impacts	The household NPV is equal to the environmental monetised impacts, which totals c. £1,156m.	**Positive** **Based on likely household £NPV**

Non-monetised impacts	**Improved journey quality from smoother and quieter buses** - Zero-emission buses vibrate less and are quieter than non-zero emission buses. This could be associated with an improvement in journey quality for passengers **Reduction in noise pollution** – zero emission buses run more quietly than diesel buses. As a result, there may be additional benefits generated associated with reduced traffic noise. Reduced traffic noise has been associated with increased health and wellbeing. The benefit generated will depend on whether the road in question is busy or not. Benefits are unlikely to be significant on very busy roads. Nonetheless, they could deliver material benefits for roads with low traffic flows. In all cases, the proposed changes are highly likely to be audible leading to an increased quality and acceptability of soundscape and consequently an associated increase in well-being. Increases to wellbeing are hard to monetise, so have not been included in our model for the purposes of making an initial assessment on this policy. Given this analysis estimates there would be a net saving to operators, it could be expected that these savings will be passed on to passengers in the form of **lower fares and/or higher service levels.** However, due to a lack of competition and given operators' tendency to put a high weight on short term impacts, the transfer of this benefit to passengers may take time to be realised or operators may at least in part used to increase profit margins.	**Positive**
Any significant or adverse distributional impacts?	An equality analysis was conducted, ensuring compliance with the Public Sector Equality Duty (PSED). Research indicates that socially disadvantaged groups, including people from some minority ethnic groups, and some disabled people are disproportionately affected by air pollution, which the transition to zero emission buses aims to mitigate. There will also be positive health and well-being benefits for others too.	**Positive**

Part B: Impacts on wider government priorities

Category	Description of impact	Directional rating
Business environment: **Does the measure impact on the ease of doing business in the UK?**	This assessment concludes that the proposed policy is unlikely to negatively impact competition in the UK market, due to its outcomes-based approach, which specifies expected results rather than how to achieve them.	**Neutral**

International Considerations: **Does the measure support international trade and investment?**	By limiting the approach to local bus services in England, the Government has scoped this policy to potentially mitigate any negative impact. Moreover, this policy also opens opportunities for greater investment and trade than currently exists.	**Uncertain**
Natural capital and Decarbonisation: **Does the measure support commitments to improve the environment and decarbonise?**	Reduction in costs from Greenhouse gas, Nitrogen oxide and Particulate Matter emissions that would otherwise be omitted by non-zero emission buses of c. £1,156m. There may be reductions in Greenhouse gas, Nitrogen oxide and Particulate Matter emissions resulting from any mode shift from car to bus, due to the introduction of zero emission buses. (non-monetised impact) Reduction in noise pollution (non-monetised impact) Reduction in upstream carbon emissions associated with diesel production, such as refining and distribution to depots (non-monetised impact)	**Supports**

8. Monitoring and evaluation of preferred option

A post-implementation review is not required for this primary legislative measure. The approach to evaluating this legislation will be considered as part of a wider monitoring and evaluation plan for the Bus Services Bill. As the policy will not be in effect until 2030 at the earliest, a comprehensive evaluation will not be feasible before then, however monitoring and evaluation activities will begin prior to this time.

Scope of monitoring and evaluation

The evaluation approach and activities will be refined and agreed as the policy moves towards Secondary Legislation stage. This intervention will be evaluated as part of wider evaluation of other measures in the Bus Services Bill. Development of monitoring and evaluation plans for individual measures will be aligned to co-ordinate evaluation activities – particularly collection of new evidence – to ensure efficient use of resources and minimise stakeholder burden.

The evaluation will consider research questions relating to process, outputs, outcomes and impacts which will be refined as the policy and monitoring and evaluation plan are developed. An initial list from which evaluation questions could be drawn are outlined below.

Process evaluation e.g.

1. What worked well, and what could be improved, regarding how the policy was developed, consulted on and communicated to LTAs/operators?

2. Have the design principles been implemented as intended? What were the barriers to this and how can they be overcome?
3. How did LTAs/operators respond to the policy and plan to meet the end date? What were the challenges and how were they overcome? How did this differ across LTA/operators?

Impact evaluation e.g.

1. What impact has the policy had on the number of zero emission and combustion engines being purchased and in operation?
2. What impact has the policy had on mileage of zero emission and diesel buses?
3. Has the policy increased the pace of the transition to zero emission buses?
4. What are the enablers and barriers to the transition to zero emission buses? For example, infrastructure provision, vehicle reliability, purchase cost.
5. What wider or unintended impacts has the policy had on LTAs, operators and businesses?

Monitoring and evaluation approach

As much as possible, we intend to utilise existing data sources for the evaluation of this measure. However, we anticipate collection of some new evidence will be required to assess the outcomes and assumptions in the causal pathways of the theory of change and, where feasible, will be aligned with evidence collection for other measures in the bill. The final evaluation scope will be further refined to ensure activities are proportionate but could include:

- Scoping work – to review the initial theory of change, refine the research questions and confirm the evaluation approach.
- Process evaluation- to provide evidence on how the implementation mechanisms and contextual factors impact on successful delivery of the policy intervention (or not).
- Impact evaluation – will be undertaken to measure intended outcomes and assess the extent to which the policy achieved its objectives.

The scoping phase and full monitoring and evaluation plan will identify the optimal impact evaluation approach; however, it is expected that the following may be used as evidence sources:

- Current surveys to collect wider views on attitudes e.g. National Travel Survey / National Highway and transport Network survey
- Existing data collections and statistics e.g. bus fuel type and consumption
- Online survey of LTA staff and operators
- Qualitative interviews with LTA staff, transport operators, manufacturers and other stakeholders
- Review of existing data and documents on policy design and development, for example the Greener Bus Tool and materials used to communicate the policy
- Wider qualitative and quantitative data collection opportunities conducted as part of the monitoring and evaluation of the Bus Services Bill. This may include a variety of research methods including surveys, interviews or focus groups with LTAs, bus

operators and/or bus passengers, and analysis of monitoring data including bus patronage and passenger satisfaction.

Inputs/Objectives

__Legislation__
Use of new, non-zero emission buses is restricted on English local bus routes from 2030

__Policy Design__
Outcome based approach to policy design to ensure flexibility and minimise burdens for industry

__Objectives__
To support efforts to reduce GHG emissions from transport, specifically in the bus sector, to net-zero by 2050

Introduce zero emission buses at scale

Build UK competitiveness in bus manufacturing

Support local transport authorities to deliver on their ambitions

Outputs

Greater certainty within the bus industry around the vision and policy direction for zero emission buses in England

Increased pace of roll out and number of zero emission buses

Increased zero emission bus milage

Reduction in older, more polluting vehicles

Reduction in ICE bus usage

Outcomes

__Environmental, Health and Wellbeing Outcomes*__
Reduction in carbon and other GHG emissions, air pollutants including NOX and particulate matter

Improved national air quality

Reduction in noise pollution

__Economic Outcomes__
Increased investment in zero emission bus manufacturing

Increased innovation

Job creation through scaling up of UK manufacturing of zero emission buses

__Operational Outcomes*__
Lower fuel and maintenance costs

Reduced operating costs of bus services

__Passenger Experience Outcomes__
Improved journey quality from smoother and quieter buses*

Increased bus patronage

Impacts

Contribution to the UK meeting its GHG reduction targets

Public health improvements and reduction in health and social care costs of air pollution

Reduction in UK's reliance on oil and exposure to the volatility of global markets

Developing domestic industry's ability to export globally

Increased use of UK generated energy sources, helping to improve the UK's long-term energy security

Investment in the UK

Expansion in high value UK manufacturing

* The Low Emission Bus Scheme provided funding to 13 projects to purchase buses using four Low Emission Bus technologies: battery electric, diesel hybrid, compressed natural gas and hydrogen fuel cell. The monitoring of the scheme found:

- The battery electric buses used up to 70% less energy than diesel, reducing GHG by up to 70%. Fully renewable electricity would reduce emissions by up to 100%.
- Compared to the diesel baseline, battery electric single deck buses were 59-78% cheaper to run and the double deck buses were 64-66% cheaper.
- Operators reported that customers liked the vehicles, and that they were popular with drivers due to being simpler, quieter and smoother to drive

9. Minimising administrative and compliance costs for preferred option

It is proposed that the Traffic Commissioners for Great Britain, liaising with the Driver and Vehicle Standards, would enforce the measure through their existing mechanisms. The Office of the Traffic Commissioner (OTC) is responsible for overseeing and issuing of service operators' registration. Enforcement is carried out by the Driver and Vehicle Standards Agency (DVSA). If the restriction were breached, we would intend that the OTC can apply sanctions set out in section 155 of the Transport Act 2000 as appropriate. This can be a maximum fine of up to £550 per bus in the operators' fleet, however this can be amended through secondary legislation.

Declaration

Department:

Department for Transport

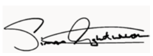
Contact details for enquiries:

Buses.Bill@DfT.gov.uk

Minister responsible:

Simon Lightwood, Minister for Local Transport

I have read the Impact Assessment, and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.

Signed: 

Date: 16th December 2024

10. Summary: Analysis and evidence

For Final Stage Impact Assessment, please finalise these sections including the full evidence base.

Price base year:	2024
PV base year:	2024

	1. More ambitious central way forward (2030)	**2. Central way forward (2032)**	**3. Less ambitious central way forward (2035)**
Net present social value The NPSV consists of benefits to operators in terms of reduced maintenance and operating costs, which outweigh costs relating to higher upfront purchase price. There are also largescale benefits to society through reduced carbon emissions and improved air quality.	Central Scenario: £800m High Scenario: £833m Low Scenario: £667m	Central Scenario: £749m High Scenario: £779m Low Scenario: £624m	Central Scenario: £669m High Scenario: £696m Low Scenario: £558m
Public sector financial costs Public sector financial costs consist of reduced fuel duty taken from the shift to zero emission vehicles and increased spend through the Bus Service Operators Grant.	Central Scenario: -£856m High Scenario: -£892m Low Scenario: -£714m	Central Scenario: -£722m High Scenario: -£752m Low Scenario: -£602m	Central Scenario: -£567m High Scenario: -£590m Low Scenario: -£472m

Significant un-quantified benefits and costs Un-monetised impacts, also covered in the scorecard, cover: • improved journey quality from smoother and quieter buses • reduction in noise pollution created by non-zero emission buses • reduction in upstream carbon emissions associated with diesel production, such as refining and distribution to depots • costs as a result of leasing/credit mechanisms due to higher upfront capital costs • costs due to short-run vehicle capacity constraints, as well as increased depot size. • Efficiency/skill gain, as well as increased patronage.	**Greater benefits but greater costs –** This option will have the highest un-quantified costs. Costs due to short-run vehicle capacity constraints will be at their highest. There will be less time to develop infrastructure strategies/upgrades, risking less adequate infrastructure delivery to support ZEBs due to lead times. Benefits will be realised quickest. Under this intervention, the benefits associated with noise pollution and carbon emissions such as the improvements in health/wellbeing and lower fares are greater. Greatest benefits to operators of higher patronage under this option.	**Balanced benefit vs costs -** Under the central way forward, there is a good balance between benefits realised quickly, and lower costs. The costs due to short-run vehicle capacity constraints will be lower as technology (battery capacity) improves and ZEBs will be able to cover more distance. More time to develop and implement strategies for infrastructure upgrades, potentially lowering costs further. As the use of non ZEBs are reduced, the benefits associated with noise pollution and carbon emissions will be realised. E.g. greater health and wellbeing, or savings potentially being passed down to consumers as lower fares. Potentially higher patronage as a result of improved journey quality will also benefit operators relatively quickly.	**Smallest costs but smallest benefits -** This option has the smallest un-quantified costs. For example, the higher costs due to short-run vehicle capacity constraints will be at their lowest. There will be the most time to develop and implement strategies for infrastructure upgrades, lowering costs further. The benefits will also be realised slowest, though still high. Under this intervention, the benefits associated with noise pollution and carbon emissions such as the improvements in health/wellbeing and lower fares will take longer to be realised and thus be lower. Lowest benefits to operators over the appraisal period of higher patronage under this option.

Further detail on scale is available in the evidence base.			

Key risks	Analysis assumes static fleet size and a constant annual turnover of buses. There is uncertainty in the extent zero emission bus vehicle costs will fall overtime. Analysis assumes all zero emission and non-zero emission buses are electric and diesel respectively, other powertrains are available and could change the impacts. To mitigate uncertain life-time costs, based on evidence, vehicle and infrastructure contingency uplifts have been applied (3.4% and 13.2%, respectively). The public sector discount rate (3.5%) has been used to calculate costs and benefits and estimate the TCO. While this is the standard TAG discount rate, the private sector has a significantly higher discount rate/required rate of return. There is a risk that the legislation will make investment in ZEBs unviable for bus companies. This would result in a hiatus in investment in new buses, and a deterioration in the quality of service for bus users.
Results of sensitivity analysis	Sensitivity analysis was carried out on the potential geographical scope of the measure by estimating the size of the fleet that would be subject to regulation i.e. England outside London excluding franchised areas. The analysis excludes franchised LTAs and Mayoral Combined Authorities (MCAs), or those expected to be franchised by 2030. The central, high and low scenarios assume 15, 31 and 11 local transport authorities will franchise respectively. Therefore, their estimated fleet size as a proportion of England outside London total bus fleet has been removed from outputs. There is a key assumption in place that these franchised authorities will franchise **75% of their bus network and therefore bus fleet**. Sensitivity analysis will be carried out on this assumption at secondary legislation stage, once the policy has been refined further and we have sought more evidence on the likely proportion of networks to be franchised, e.g. we could run scenarios including 100% and 50% of the network. If we were to assume that an authority franchises 100% of their fleet, then this would exclude more buses and have a smaller impact. On the other hand, if they were to franchise 50% of their fleet, then this would mean more buses are affected, and there would be a greater impact.

Evidence base

11. Problem under consideration, with business as usual, and rationale for intervention

Climate change is the most pressing policy challenge of our time. We need to limit global temperature increases to well below 2°C. The Paris Agreement of the United Nations Framework Convention on Climate Change, to which the UK is a signatory, aims at "*holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change*".

To contribute to this the UK has committed to net zero its contribution to climate change by 2050. The Climate Change Act 2008, as amended, imposes a duty on the Government to ensure that the net UK carbon account for 2050 is at least 100% lower than the 1990 baseline (i.e. net zero emissions).

Transport is the largest contributor to UK domestic greenhouse gas (GHG) emissions, contributing 28% of UK domestic emissions in 2021[16]. Prior to the pandemic, transport emissions were rising, with 2018 emissions only 3% lower than in 1990[17]. The UK transport network supports people and goods to travel around the country. All transport modes must decarbonise to meet our economy wide net zero commitment.

Additionally, the Government has a long-term strategy to improve air quality across the country and to bring areas where air pollution has breached the legal limits back into compliance.

The Climate Change Act 2008 requires the UK Government to set legally-binding 'carbon budgets' which act as stepping stones towards the 2050 target. A carbon budget is a cap on the amount of greenhouse gases emitted in the UK over a five-year period.

The trajectory of emissions reductions indicate additional policies will be required to meet the reductions required by the fifth (2028-2032) and sixth (2033-37) carbon budgets.

Furthermore, the UK has committed to reduce emissions in 2030 by 68% compared to 1990 levels, as its Nationally Determined Contribution (NDC) to the Paris Agreement. It is the first UK target set in line with Net Zero. It is therefore important we look to utilise all opportunities to decarbonise transport where possible.

There are around 30,154 buses in England: only 4% are zero emission buses[18], so faster, deeper, and unprecedented action is needed to decarbonise at scale.

A key factor will be ensuring these ambitions do not make bus services more expensive to operate overall, otherwise fares could rise, or services could be reduced – potentially leading to greater overall carbon emissions if more journeys are made by car.

Rationale for intervention

[16] Department for Transport: *Transport and environment statistics:* 2023
[17] Department for Transport: *Decarbonising transport, setting the challenge:* 2020
[18] Department for Transport: *Annual bus statistics: year ending March 2023*: 2024

There is a need for government intervention to address market failure resulting from the use of internal combustion engine buses. Market failures occur when the market has not and cannot, in itself, be expected to deliver an efficient social optimal outcome. The associated cost to society of contributing to climate change and degrading air quality are not taken into account when these vehicles are operated and purchasing decisions on vehicles are made.

Achieving net-zero involves overcoming a series of market failures. Perhaps the most significant of these is the negative externality driving climate change: those who emit greenhouse gases generally do not face the full costs of their actions, leading to increasing concentrations of greenhouse gases in the atmosphere, above the level that would be seen if those emitting greenhouse gases faced the full costs.

The most important market failure to address is the negative externality associated with the emission of greenhouse gases, but there are many others holding back the transition to net zero, including inertia, a lack of information, and bounded rationality. The market failures interact in complex ways within, and across sectors.

- Inertia: Bus operators may hesitate to shift from diesel buses due to established infrastructure, investment, and familiarity with existing systems. This resistance to change, or "inertia," slows the adoption of zero-emission buses, even if these are better for public health and the environment.
- Lack of Information: Decision-makers and the public may not fully understand the long-term benefits or total cost savings of zero-emission buses, such as reduced health expenses, lower maintenance costs, or improved air quality. Without this information, they may undervalue the switch to cleaner buses.
- Bounded Rationality: Individuals and organisations often make decisions with limited cognitive resources or short-term perspectives. Faced with the higher upfront costs of zero-emission buses, operators may focus on immediate expenses rather than long-term savings and benefits. This myopic view prevents rational choices that would otherwise favour zero-emission options over diesel.

These factors create a market that undervalues zero-emission buses and continues to favour diesel, despite broader societal benefits from cleaner transportation.

The Stern Review[19], in addition to a wide array of other literature, makes the case that the externalities relating to climate change are fundamentally different from other externalities. Climate change is:

- global in both impact and causes;
- the impacts are long-term and persistent, and;
- uncertainties and risks of impacts are high.

There is also a serious risk of major, irreversible change to the planet, with non-marginal economic effects. The externalities of this are so large that there is no meaningful approach to internalise the costs

The development of technology will be important for meeting the net zero target, keeping costs down and maximising the potential economic benefits. Much of the finance required can come from the private sector, but the risks and uncertainties associated with novel

[19] HM Treasury: *The Economics of Climate Change: The Stern Review*: 2006

technologies can hold this back. A clear policy framework setting out the Government's approach can help address these uncertainties.

Buses and coaches represented just under 3% of domestic transport GHG emissions, in 2021, emitting 3 $MtCO_2e$. The main source of emissions from this sector are the fuels used for propulsion.

While there have been significant innovations and improvements in engine efficiency, and resultant reductions in GHG and air quality emissions, the fundamental principles under which non-zero emission buses operate are incompatible with UK Government and international targets to reduce GHG emissions to zero.

The need to limit global warming to well below 2°C and to pursue efforts to limiting to 1.5°C means the UK Government is committed to moving as far, and as fast, as possible.

Setting a date from which usage of new non-zero emission buses would be restricted will provide assurance and a clear direction of travel, not only for the bus sector but also for related industries which are critical for the transition, such as the infrastructure and energy sectors.

This will allow manufacturers to adjust product planning and assembly lines by a set date, in turn improving efficiencies and reducing costs, as well as building confidence and certainty for the market.

Policy and regulation have a role in correcting this market failure. In placing restrictions on either those who produce the vehicles, or the emissions themselves, they can offset the negative effects of these externalities and ensure that they are accounted for.

Government is best placed to intervene to help drive innovation and provide the impetus for operators to procure only zero emission buses. This would act to curb the amount of GHGs, and other air pollutants emitted, and reduce the negative impacts on wider society.

Non-regulatory options, such as industry-led self-regulation, were considered during policy formulation stages, but were not taken forward based on experience of the initial voluntary approach adopted for reducing CO_2 emissions from cars and vans which failed to deliver reductions. For example, European car manufacturers promised to voluntarily reduce average CO_2 emissions of new cars to 140g/km by 2008, starting in 1995, when average CO_2 emissions were 186g/km. By 2005 it was clear that the manufacturers would not meet that voluntary commitment and in a mandatory regulation was adopted that set a CO_2 target of 130g/km by 2015.

In the light vehicle segment, policies which focus on driving down emissions have been in place for decades. For example, UK Government has set Vehicle Excise Duty (VED) by CO_2 emissions bands since 2000, with the EU introducing tailpipe CO_2 emissions targets for cars and vans in 2009.

By contrast, the bus market is not subject to fleetwide tailpipe CO_2 targets, with manufacturers only required to report on emissions. Tax policy for buses also diverges from that for cars and vans, with both registration and annual tax based on passenger capacity, rather than on an emissions basis.

Thus far, buses, and other heavier vehicles, have benefited from policies designed to decarbonise fuels, such as the Renewable Transport Fuel Objective (RTFO), and several rounds of funding to encourage uptake of low, ultra-low and zero emission buses. However, these polices are not designed to meet the totality of the challenge of reducing the UK's carbon emissions from buses.

12. Policy objective

This measure sits within the broader framework of the Bus Services Bill and aims to improve bus services across the country. Per section 3, the objectives for the policy are linked to a broader framework that seeks to deliver on both the Government's commitment for bus reform and to enable decarbonisation in line with the statutory carbon reduction targets set forth by the Climate Change Act 2008.

The three policy objectives are to:

- Deliver a decarbonised bus fleet, in line with net zero targets
- Ensure the UK remains a leader in zero emission bus manufacturing
- Help local authorities deliver on their transport ambitions

Further detail on these is available in section 3.

Considering the objectives described above, in reviewing options for responding to the issues identified, there are four main critical success factors underpinning our selection.

1. Any solution must put the bus sector on a pathway for compliance with the Climate Change Act 2008 and the Carbon Budgets set out under this legislation.
    a. The measures we use to decarbonise transport will also deliver the vast wider benefits available during this change, improving air quality, noise, and health.

2. Any solution must foster the market conditions required to support the transition of UK automotive manufacturing to zero emissions.
    a. This is a huge industrial opportunity to increase economic growth and future prosperity, to invest in new jobs across our country.
    b. Failure to do this in the short term could lead to dependence on imports for zero emission buses, with the loss of important investment.

3. Any solution should not jeopardise existing bus services
    a. Buses can improve productivity more widely, for instance by reducing congestion which affects all road users. Buses can also be key to reducing inequality; users are disproportionately from less advantaged social groups and places[20]. Improved services will strengthen communities, sustain town centres, and connect disabled and isolated people.

4. Any solution should ensure value for money
    a. We must set the right incentives for the bus industry if we are to achieve our future emissions reductions commitments.

[20] National Travel Survey 2023: nts0705.ods

13. Description of options considered

Section 5 set out the longlist of options and how the shortlist was produced from the longlist options in line with the Green Book's options framework and filter process.

To summarise, given the need to ensure compliance with legally binding carbon budget targets, and the overall impetus to achieve net-zero emissions, non-regulatory options were not considered appropriate to be brought forward to this stage.

In the course of policy development, officials considered the following non-regulatory models, but their efficacy meant such approaches were not applicable:

- **Industry-led "self-regulation" (ISR)** - ISR can be an advantageous complement to government policies, but it also poses a number of challenges. At the same time, ISR can potentially provide important benefits to both industry and consumers; their success in doing so depends on a number of factors, including:
  - the strength of the commitments made by participants;
  - the industry coverage of the ISR;
  - the extent to which participants adhere to the commitments; and
  - the consequences of not adhering to the commitments.
- **Co-regulation** - Also known as enforced self-regulation, this is an intermediate step between state-imposed and self-regulation. It involves some degree of explicit government involvement, beyond a stated government objective. For example, an industry may work with government to develop a code of practice. Enforcement would be by the industry or a professional organisation and accredited by government. Examples of such regulation are recognised codes, approved codes and standards and accreditation where government has been actively involved in the process. The advantages and disadvantages are similar to those of self-regulatory approaches.

In late 2006, the European Commission announced its intention to regulate the level of CO_2 from cars and vans sold in the EU, with the changes entering into force by 2008. This represented a significant shift from the previous model, implemented in 1998, which operated as a voluntary agreement. This illustrates the failure of non-regulatory approaches to reducing vehicle emissions.

From 1994 onwards, New Zealand's electricity market went through a period of industry reform, and the market at one point was self-regulated, but ultimately returned to a government-regulated model due to concerns around the ability of the prior model to meet targets.

Based on the above experiences and considerable policy development these models were not considered sufficient to achieve the policy objective.

As part of the policy development, officials considered international examples and whether there were learnings or best practices that could support the achievement of the UK Government's aims.

- The Dutch Government has set a date of 2025 for all new purchased buses to be zero emission at the tailpipe, backed by an administrative agreement between central and municipal governments, and 2030 for all buses to be emission free.

- Denmark's Climate and Air Plan sets a target for 100% of urban buses to be zero emission from 2025.

It was clear from international examples that Government intervening in the market to guarantee a shift to zero tailpipe emissions is a well understood and effective tool of driving down emissions from the road transport sector.

Thie central options also reflect the Independent Committee on Climate Change's advice on what is needed in order for the UK to end its contribution to climate change by 2050.

Furthermore, evidence commissioned from consultants at Ricardo by the Department for Transport is clear that zero emission vehicles have substantially lower greenhouse gas emissions than conventional internal combustion engine vehicles, even when taking into account the current generation mix of the electricity to charge these vehicles and battery production[21]. As we continue to decarbonise the electricity grid, they will become even cleaner.

14. Summary and preferred option with description of implementation plan

The central option is to legislate to reduce the usage of new, non-zero emission buses on local bus services through the Bus Services Bill. The Secretary of State would, through secondary legislation, be able to enact the Bill measure, however the primary legislation would limit the Government from commencing this any earlier than 2030. Delivering the secondary instrument will be informed by research and engagement with stakeholders.

The Transport Act 1985 provides that local bus services must be registered with the Traffic Commissioner for the relevant area. Section 6 sets out the registration requirement which aims to ensure the delivery of services to the proposed standard. This primary measure would apply to all bus services that are within the scope of the said legislation.

The Traffic Commissioner has powers to act against operators if services are not being operated as registered or the operator has failed to comply with the regulations relating to the prescribed information required. This has tended to mean not running the agreed services, or if services are repeatedly unreliable or subject to delay. These sanctions are set out in Section 155 of the Transport Act 2000.

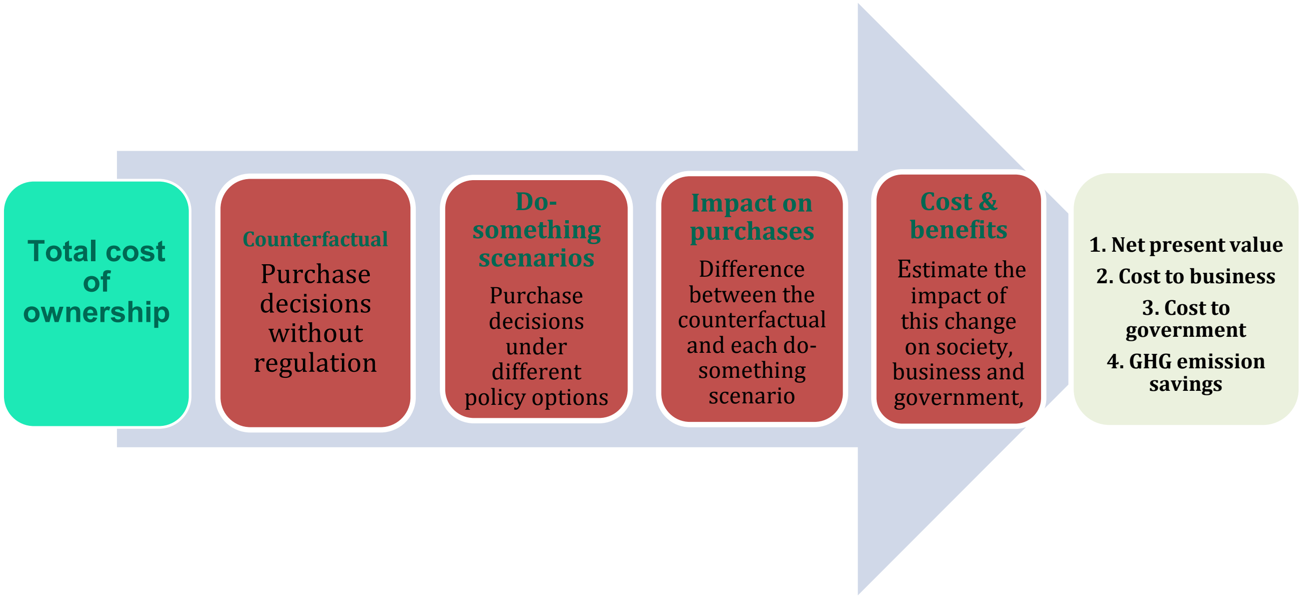
As this sits within an existing, understood framework, the Government considers it an appropriate, light-touch approach.

15. NPSV: monetised and non-monetised costs and benefits of each shortlist option

Costs and benefits to businesses, government and households have been calculated for each of the shortlisted options. The central option is for this measure to come into force from 2032. 2030 is considered a more ambitious way forward and 2035 is the less ambitious option to restrict the use of new non-zero emission buses on local bus services. For the benefit of this impact assessment a central option is stated, however the restriction of use date will not be set until secondary legislation is brought forward. Therefore, all policy options are presented equally within the analysis and the central scenario is being presented as the 'preferred' option.

[21] Ricardo: *Lifecycle analysis of UK road vehicles*: 2021

The diagram below summarises the approach to the analysis:



Total cost of ownership (TCO)

A major part of the decision to purchase a commercial vehicle depends on the expected total cost of ownership over the vehicle's lifetime. This includes: the capex cost of the vehicle including taxes and incentives, the cost of borrowing the capital to make the purchase, the residual value it is likely to retain for resale on the second-hand market, and the cost of refuelling and maintenance.

The TCO analysis was conducted using an existing bus total cost of ownership model, with updates reflecting the latest evidence. To estimate the number of additional ZEBs because of the intervention, it was necessary to determine the number of ZEBs that would be delivered in the counterfactual. This has been estimated using outputs of TCO analysis. For a range of use cases TCO analysis estimates when a new ZEB purchase may offer TCO parity with a diesel equivalent and hence could inform commercially viable for operators.

The costs and benefits of delivering zero-emission buses were monetised using the August 2024 DfT's Greener Bus Tool. The tool has been updated since the analysis was conducted for the pre-consultation impact assessment to incorporate the latest evidence on key inputs and methodologies in TAG.

TCO of diesel and zero emission buses will vary depending on a range of scheme specific and endogenous factors. Scheme specific factors include the use case of the bus (distance and intensity), make and model and infrastructure requirement. Endogenous factors include diesel/electricity cost forecasts and change in battery prices. This TCO analysis explores the implications of different vehicle distance and uses averages for other scheme specific factors. For endogenous factors, central case inputs are used such as the DESNZ diesel/electricity cost forecasts.

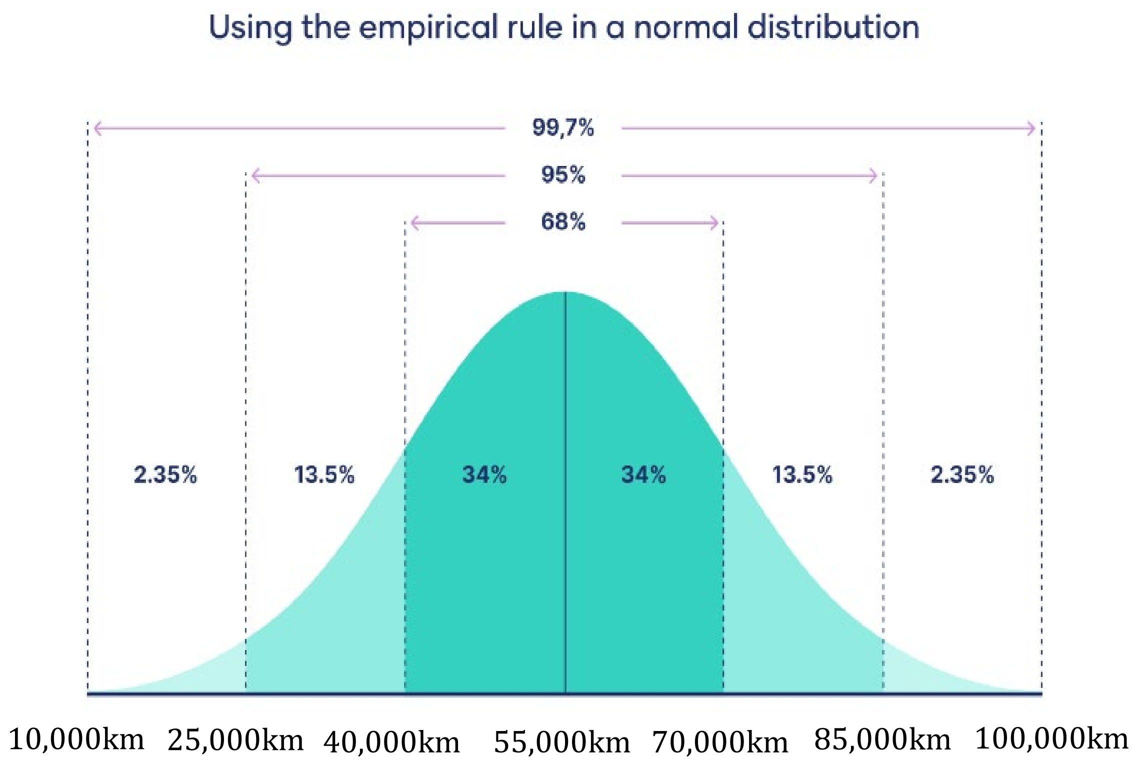
To estimate how the difference in TCO between electric and diesel buses may influence cost to business and how operators may make purchasing decisions without any intervention, costs need to be discounted. Discounting converts all costs into present values, by adjusting for operators' preference for now compared to the future. The extent of this preference is dependent on the discount rate, a higher discount rate implies a greater weight placed on costs and benefits that occur sooner than those that occur later.

Other factors may influence decision making such as operator commitments. TCO analysis reflects a standard operating model, different commercial models are likely to present a different picture on commercial viability e.g. leasing or franchising.

TCO analysis can be uncertain and sensitive to assumptions. Forecasting prices of batteries, electricity and diesel far into the future is challenging, as it depends on several factors outside of our control like global shocks.

The commercial viability of ZEBs will also vary by operator, as individual commercial organisations will take differing views on the discount rate, i.e. the extent to which they value money today more than money in the future. The cash savings from running an electric rather than a diesel bus come from future operating costs, but they need to be weighed against the higher capital outlay.

Annual vehicle kilometers (kms) is a key determinant of when TCO parity between a diesel and electric bus is reached. In absence of vehicle level data on milage we have assumed the distribution of buses by vehicle distance is normally distributed.



The empirical rule in a normal distribution enables the proportion of a distribution to be allocated to different ranges, as per the graph. For instance, 13.5% of buses would have an annual vehicle distance of between 70,000km and 85,000km, 2.35% between 85,000kms and 100,000kms and 0.15% more than 100,000kms, when 55,000km is the average annual distance.

This enables the following assumptions:

- 50% of buses cover more than and 50% less than the national average vehicle distance of c.55,000km per year

- Almost 100% of buses travel between 10,000km and 100,000km per year. (+/- 3 standard distributions)
- The empirical rule can be used to define % of total fleet between the ranges shown

Counterfactual / bus fleet forecasting

A fleet forecasting model is then used to project the makeup of the bus fleet in England outside of London, by emissions standards, up to 2050.

Key inputs include:

- Bus statistics
- ZEBRA 1, ZEBRA 2 and All-Electric-Bus-City (AEBC) deliveries.
- Assumptions on buses decommissioned and the % of ZEBs bought.

The high-level steps to reach the output forecast are:

1. **Establish a baseline**
    - Establish the size and makeup of the bus fleet using 2023 bus statistics.
2. **Set key assumptions.**
    - Key assumptions determine the forecast. These include the life expectancy of buses (17 years on average), the % of bus sales which are ZEBs in each year from the TCO analysis and the assumptions that bus fleet size remains constant.
    - Accounts for governments pre-existing funding commitments for ZEB buses.
3. **Calculate changes to bus fleet.**
    - Calculates how many diesel buses and ZEBs are purchased and decommissioned each year based on the average life expectancy and total fleet size needed.
        - Counterfactual analysis to understand the baseline fleet forecast of buses and new bus purchases
        - Do something scenarios assuming that once the new end of use of new non-diesel buses is set i.e. 2030, 2032 and 2035, all new buses purchased are zero emission.
        - Half of new ZEB buses are assumed to be single decker and the other half double decker.

Accounting for franchising

The outputs from the fleet forecasting analysis are for all of England outside London. However, franchised areas are not in scope of this measure. Franchised areas have been accounted for through percentage reductions on both the counterfactual and do something fleet size outputs for each policy year and scenario. Low, central and high scenarios have been run on the proportion of LTAs expected to franchise following the opening of franchising through the Bus Services Bill.

The proportion of LTAs expected to franchise is highly uncertain. To exclude franchised areas from this analysis it has been necessary to make assumptions on the proportion and years by which we expect areas to franchise by. The model that LTAs take when franchising is likely to differ, whether that be full franchising as in Manchester and London or only partial franchising of bus networks. A standard 75% assumption has been made for the proportion of the bus network and therefore bus fleet that we expect franchising LTAs to franchise within their networks. Therefore 25% of bus fleets for franchised areas have still been included within the analysis as the measure will apply at network level. So within franchised LTA, if they do not franchise their whole network then the non-franchised services would still come under scope of the measure.

It was not deemed proportionate to do sensitivity testing around the 75% of franchised LTA networks being out of scope at this stage. However, any increase in the proportion of networks that franchise would decrease the size of the bus fleet in scope of the measure and therefore decrease the direct benefits. Alternatively, if more LTAs partially franchise less than 75% of their network then the direct impact and therefore NPV would increase. Sensitivity analysis on this assumption will be conducted at secondary legislation stage once we have engaged further with stakeholders and refined the policy.

Assumptions around the proportion and timing of franchising for LTAs is consistent with other Bus Bill impact assessments. The number of LTAs expected to franchise is calculated by extrapolating the share of LTAs that expressed interest in franchising to all eligible LTAs. This results in an estimate that 25 LTAs would franchise. Expecting this to be an overestimate as LTAs indicated they would struggle to franchise without additional funding, which is subject to Spending Reviews, we use this as a high scenario. 1/3 of this is taken as the central scenario, and 1/6 as the low scenario. We know that Manchester is currently undertaking franchising, and 6 MCAs have either already begun, completed their franchising assessments or have expressed strong interest in franchising. Therefore, total franchising numbers are calculated by summing number of LTAs expected to franchise, LTAs that have already begun producing franchising assessments, and LTAs that are already franchised (excluding London).

For the purpose of this analysis, all LTAs who franchise are assumed to do so by 2030. The larger the number of LTAs that franchise the less buses in scope of this measure. Therefore, the scenario assuming more franchising is the low scenario, and the high scenario assumes lower franchising levels and in turn a larger bus fleet in scope. 1/5 of franchising LTAs are expected to franchise each year from 2026-2030, with LTAs currently planning to franchise who have undergone or completed their franchising assessment i.e. some MCAs, being franchised by 2026.

	Total
LTA's which will be franchised by 2030 in Central scenario	15
LTA's which will be franchised by 2030 in High scenario	11
LTA's which will be franchised by 2030 in Low scenario	31

Number of new franchises by year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Sum**
Central Scenario	0	0	8	1	2	2	2	15
High Scenario	0	0	7	1	1	1	1	11
Low Scenario	0	0	11	5	5	5	5	31

There is a lack of readily available data on bus fleet sizes by LTAs. Therefore, it has been necessary to make an assumption on the bus fleet sizes of LTAs to be removed from the analysis. One simplified approach would be to take the total bus fleet in England outside London[22] and divide this by the total number of LTAs. I.e. 21,365 / 74. However, many of the LTAs expected to franchise and beginning the process are larger MCAs which will have bus fleets much greater than the average LTA. Therefore, this approach is likely to underestimate the size and proportion of franchising fleets that should be removed from the fleet forecasting outputs.

Bus statistics table BUS06b has values for both England outside London's bus fleet and English metropolitan areas in 2023. The Metropolitan areas value includes Greater Manchester, Merseyside, South Yorkshire, Tyne and Wear, West Midlands and West Yorkshire. All these areas are expected to franchise and are all MCAs other than Tyne and Wear which is in North East Combined Authority (NECA) and Merseyside which is in the Liverpool City Region Combined Authority (LCRCA). To ensure the whole geography of all 6 MCAs was accounted for in fleet numbers, we needed to account for Halton, County Durham and Northumberland bus fleets. We calculated their proportion of the bus network using Table BUS02c_km total vehicle kilometres and uplifted the English metropolitan bus fleet numbers by this same proportion assuming that % of vehicle kilometres is equal to proportion of bus fleet.

All other LTAs bus fleets are calculated by:

(England outside London bus fleet – uplifted English Metropolitan area bus fleet)/ 68 [23].

I.e. (21,365 – 8,351) / 68 = 191 buses per remaining LTA or 0.9% of the bus fleet

The 6 metropolitan MCAs are assumed to franchise in 2026. Their proportion of the bus fleet are removed from the counterfactual and output analysis in 2026. Then all other remaining franchising LTAs are assumed to have the calculated average fleet proportion value which is removed in line with the previous table splits of assumed franchising numbers by year up to 2030. When LTAs/MCAs fleet proportions are removed from the new bus fleet numbers, only 75% of their proportion of the bus fleet is removed because of the assumption on the proportion of franchising within networks previously explained.

The table below shows the outputs of the counterfactual and do something shortlisted analysis for the central scenarios of each shortlisted option. The high and low scenarios follow the same approach with the only difference being the number of buses in scope due to franchising. The counterfactual number of new ZEBs being replaced/purchased each year is sourced from the fleet franchising assumptions. This accounts for a high number of new ZEBs in the first years due to ZEBRA funding and the assumption of cost parity from the TCO analysis between ZEB and diesel buses from 2032.

The fleet franchising assumes that in the do-something analysis, following the introduction date of an end of use of new non-ZEB buses, all new buses purchased will be ZEBs. Therefore, the impacts of this policy for each option is taken from finding the difference between the do-something analysis and the counterfactual. As a simplified assumption for all new ZEB purchased in the do-something scenarios, it is assumed that half will be double decker, and the other half will be single decker.

[22] Bus statistics table BUS06b
[23] Assuming there are 74 LTAs in England outside London minus the 6 MCAs we have total fleet values for.

For all policy options, from 2035 onwards the outputs of the analysis and new ZEB fleet purchased each year remain constant. New bus purchased up to 2050 are analysed with the appraisal period going to 2066 as all new buses purchased up to 2050 are assumed to have a lifespan up to 2066.

	Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035[24]
Counterfactual new ZEBs each year		***845***	***902***	***638***	***211***	***243***	***274***	***303***	***337***	***372***	***406***	***406***	***406***
2030 - Central	**2030 Policy new ZEBs**	845	902	638	211	243	274	812	812	812	812	812	812
	Difference (2032 scenario - counterfactual)	0	0	0	0	0	0	510	475	441	406	406	406
	New ZEB Single Decker	0	0	0	0	0	0	255	238	220	203	203	203
	New ZEB Double Deck	0	0	0	0	0	0	255	237	221	203	203	203
2032 - Central	**2032 Policy new ZEBs**	845	902	638	211	243	274	303	337	812	812	812	812
	Difference (2032 scenario - counterfactual)	0	0	0	0	0	0	0	0	441	406	406	406
	New ZEB Single Decker	0	0	0	0	0	0	0	0	220	203	203	203
	New ZEB Double Deck	0	0	0	0	0	0	0	0	221	203	203	203
2035 - Central	**2035 Policy new ZEBs**	845	902	638	211	243	274	303	337	372	406	406	812
	Difference (2032 scenario - counterfactual)	0	0	0	0	0	0	0	0	0	0	0	406
	New ZEB Single Decker	0	0	0	0	0	0	0	0	0	0	0	203
	New ZEB Double Deck	0	0	0	0	0	0	0	0	0	0	0	203

[24] Values in 2036-2050 are the same as 2035 values.

Greener Bus Tool (GBT)

The above outputs, on the number of new single and double decker buses purchased because of the restriction, are then inputted into the greener bus tool. The GBT calculates the economic impacts, costs and benefits, of the purchasing of zero emission buses for each scenario. Central assumptions, presented in section 23, are inputted into the tool to calculate the net present value, cost to business, cost to government and GHG emission savings.

Shortlisted appraised options:

The central option is for this measure to come into force from 2032. 2030 is considered a more ambitious way forward and 2035 is the less ambitious appraised end of use date for new non-zero emission buses on local bus services.

As the policy measure excludes both London and franchised areas, low and high scenarios have been run on the proportion of the bus fleet expected to franchise following the opening up of franchising through the Bus Services Bill.

The below costs and benefit types have been monetised and summed to calculate the monetised net present value of each shortlisted option. Further information on how and why each impact will occur is explained in the following cost and benefit sections.

Stakeholders	Impacts
Impact on operators (businesses)	- Additional **capital cost** of buses and infrastructure - Change in **maintenance costs** - Change in **operating costs** - Change in **BSOG revenues**
Impact on Government	- Reduction in **tax revenues** - Change in **BSOG expenditure** - **Government grants** to fund ZEBs and infrastructure.
Environmental and social impacts (households)	- Reduction in associated costs from **GHG, NOX and PM emissions**

The table below summarises the quantitative results of the economic analysis of each option.

The first quantitative row presents the net value (benefits minus costs) of each option, across the appraisal period. It indicates that earlier intervention has a greater positive contribution to society, but that even with a 2035 end of use date the expected net present social value is positive and greater than £550m in all scenarios.

The second row presents the net cost to business. Minus numbers in this row indicate a net saving to business. This reflects that over the lifetime of the policy, operational savings for bus operators would be expected to outweigh the additional capital cost of ZEBs.

The third, fourth and fifth rows relate to the scale of carbon emissions that would be avoided by introducing an end of use date in each given year. This is the primary benefit of the policy, which drives the positive NPSV in the first row. It shows that the earlier we intervene in the market, the greater the reduction in carbon emissions.

The final quantitative row provides an indication of when we might expect to achieve a fully zero emission bus fleet, which is based on the 15–20-year life expectancy of a bus.

	Options for reducing the use of new non-zero emission buses								
Year - Scenario	2030 - Central	2030 - High	2030 - Low	2032 - Central	2032 - High	2032 - Low	2035 - Central	2035 - High	2035 - Low
Central estimate Net Present Social Value (NPSV) £m	800	833	667	749	779	624	669	696	558
Net cost to business (present value, £m)	-325	-338	-271	-314	-327	-262	-294	-306	-245
Total carbon savings (MtCo2e)	-6.9	-7.2	-5.8	-6.2	-6.4	-5.1	-5.2	-5.4	-4.3
Carbon savings in CB5 (MtCo2e) 2028-2032	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Carbon savings in CB6 (MtCo2e) 2033-2037	-0.6	-0.6	-0.5	-0.4	-0.4	-0.3	-0.1	-0.1	-0.1
Expected date of net zero fleet	2045-2050	2045-2050	2045 - 2050	2047-2052	2047-2052	2047 - 2052	2050-2055	2050-2055	2050 - 2055

A breakdown of monetised costs and benefits calculated for each business and household impact are presented in sections 16 and 18.

Uncertainties in assumptions are detailed further in section 23.

16. Costs and benefits to business calculations

Option 0 – Do Nothing

In the do-nothing scenario, the Government would not reduce the usage of new zero emission buses. When purchasing a new vehicle, operators would continue to have free choice of any powertrain available in the market. Choices of powertrain are expected to be largely driven by the respective total cost of ownership, which includes the purchase cost of vehicles and on-going costs to operate services.

In the absence of this policy, total cost of ownership analysis shows that in the national average central scenario, diesel and zero emission buses will not reach cost parity until 2032. This is assuming a discount rate of 3.5%, as per TAG, which is lower than many private bus operators own discount rates. This means the bus sector will not purchase zero emission buses independently at the rate needed to achieve the necessary carbon emissions reductions in line with UK Government and international targets.

The methodologies and assumptions used to determine the additional costs and benefits to business from intervention, as opposed to the do-minimum counterfactual, are detailed below.

Vehicle capital costs:

Vehicle capital costs differ by powertrain due to the differing component and manufacturing requirements. With equivalent specifications, zero emission buses currently have a higher purchase cost than a non-zero emission bus.

Powertrains considered as non-zero emission include diesel, hybrids (parallel or plug in) and biofuel buses, whereas powertrains considered as zero emission include battery electric and hydrogen buses. For the purposes of this analysis all non-zero emission buses are assumed to be Euro VI diesel buses and all zero-emission buses are assumed to be battery electric.

The purchase cost of both types of powertrains will vary on a case-by-case basis. The analysis uses evidence from Departmental funding schemes on the typical purchase cost. Zero emission technologies for buses are evolving and the costs in real prices are expected to fall overtime due to falling component costs such as batteries and economies of scale are realised.

Diesel Single deck bus cost	£209,549
Diesel Double deck bus cost	£277,033
Single deck electric bus (2024)	£407,062
Double deck electric bus (2024)	£489,104

The proportion of new buses purchased per year is assumed to be the same in the do nothing and all do-something scenarios[25]. The percentage of new buses purchased which are zero emission increases to 100% when the restriction is put in place.

Stakeholder advice indicates buses are expected to have an operational life of between 15 and 20 years. Given the spread of the age of buses in the current bus fleet in England, the variation in the number of new buses purchased per year is expected to be low. Consequently, it has been assumed on average buses will have an operational life of 17 years.

A battery replacement is assumed after 9 years and a vehicle contingency uplift of 3.4% is applied, based on evidence from Departmental funding schemes.

Battery size is assumed to be 351kWh, based on the average from the certification of zero emission buses through BSOG eligibility. Evidence from the Element Energy report[26], sets out a forecast for battery prices. It is assumed that the cost of vehicles will fall in line with

[25] The proportions of the bus fleet in scope is different in the low, central and high scenarios due to different assumptions on the scale of franchising.
[26] *Analysis to provide costs, efficiencies and roll-out trajectories for zero emission HGVs, buses and coaches,* commissioned by the Climate Change Committee,

expected changes in battery costs. This is a simplified assumption as we do not have evidence on how the other zero emission bus related components or manufacturing costs may change in the future, though is reflected by the decrease in prices in the zero-emission car and van market, following significant falls in batteries for light duty vehicle applications.

New charging and refuelling infrastructure costs:

Additional zero-emission buses will require installation of new infrastructure to refuel hydrogen buses or recharge battery electric buses. Battery electric buses will require charging points, additional cables and substation in the depots. Depending on location they may also require reinforcement to the grid to support high power chargers, additional grid connection and upgrades to a primary substation.

Cost incurred for new infrastructure will vary on a case-by-case basis, depending on location and technology used and size of fleet. The analysis of cost incurred uses an estimate on the typical infrastructure cost per battery electric bus. This cost is assumed to occur for every bus purchased over the appraisal period. The analysis uses evidence from Departmental funding schemes on the average infrastructure cost per bus:

Infrastructure cost per bus (incl. charger)	£70,861
Charger cost (excluding depot works)	£35,470

From 2035 the infrastructure cost is assumed to only encompass the charger cost, as a result of network connections and other infrastructure costs likely having been incurred prior to 2035.

Infrastructure maintenance costs:

New infrastructure installed to support the additional zero emission buses in do something scenarios will require maintenance in order to keep in operational use, creating additional costs to operators. The analysis uses evidence from Departmental funding schemes which indicates that the annual maintenance rate is 1.88% of the capital cost of infrastructure.

Vehicle maintenance costs:

Both zero emission and non-zero emission buses will require maintenance in order to keep vehicles operational. Electric vehicles have fewer moving parts compared to diesel buses and are expected to have lower maintenance costs than diesel vehicles. The total scale of maintenance cost savings per bus depends on the estimated average annual vehicle distance per bus. This is assumed to be the national average of 55,703 km per year[27] in all scenarios. Based on departmental evidence, maintenance cost per km for diesel buses are assumed to be £0.23 compared to £0.13 for the zero-emission fleet.

Annual vehicle maintenance costs per diesel and electric bus are calculated by multiplying the estimated total maintenance cost per km by estimated annual average vehicle distance. The benefit generated for the additional zero emission buses has been calculated by subtracting the estimated total vehicle maintenance cost of additional zero emission buses from the total vehicle maintenance cost that would be incurred if these are otherwise diesel buses.

[27] Bus statistics - GOV.UK

Lower operating costs:

Non-zero emission buses and zero emission buses use different fuels, and these fuels have different unit costs per km. The costs vary in terms of the resource cost, duty paid, and bus service operator grant (BSOG) payment received. Analysis focuses on electric and diesel buses; operating costs will differ with other powertrains (such as hybrids and hydrogen buses). Resource and duty (where applicable) costs per litre of diesel and kWh of electricity can be found in the Department's Transport Analysis Guidance Databook[28] and forecasts can be found in the Department for Energy Security and Net Zero *Energy and emissions projections: 2022 to 2040* publication[29].

Evidence from certified tests conducted on both conventional and zero emission buses for the Department's Bus Service Operators Grant is provided for the average UK bus route:

SD Diesel fuel consumption (l/100km)	31
DD Diesel fuel consumption (l/100km)	36
SD Electricity consumption (kWh/100km)	125
DD Electricity consumption (kWh/100km)	126
SD Diesel fuel consumption (l/100km)	31
DD Diesel fuel consumption (l/100km)	36
SD Electricity consumption (kWh/100km)	125
DD Electricity consumption (kWh/100km)	126

This results in electric buses being cheaper to run per km than their diesel equivalent. The benefit to operators is the difference between the fuel and electricity consumption.

Total fuel related operating cost are calculated assuming the average vehicle distance remains constant at average as of 2023 calculated to be 55,703km per bus per year.

Annual operating costs per diesel and electric bus are calculated by multiplying the estimated total cost per km outlined by estimated annual average vehicle distance. The benefit generated for the additional zero emission buses has been calculated by subtracting the estimated total operating cost of additional zero emission buses from the total operating cost that would be incurred if these are otherwise diesel buses.

Total operator (business) costs:

The overall cost increases and reductions to operators from this measure for each shortlisted scenario are presented below. All costs are presented in present discounted values. All shortlisted options are expected to have a positive overall impact for businesses due to the large net savings in operating and maintenance costs. Larger benefits are realised the earlier the measure is introduced for the central case.

[28] TAG data book - GOV.UK
[29] Energy and emissions projections: 2022 to 2040 - GOV.UK

(PV,£m)	2030 - Central	2030 - High	2030 - Low	2032 - Central	2032 - High	2032 - Low	2035 - Central	2035 - High	2035 - Low
Additional vehicle capital costs	-841	-877	-701	-700	-729	-584	-542	-565	-452
New charging and refuelling infrastructure costs	-270	-281	-225	-207	-216	-173	-135	-140	-112
Net savings in vehicle maintenance cost	469	488	391	398	414	332	315	328	263
Infrastructure maintenance cost	-60	-63	-50	-47	-49	-39	-31	-32	-26
Net savings in operating costs (includes duty and BSOG)	1028	1070	857	870	906	726	686	715	572
Total impact on operators (PV,£m)	**325**	**338**	**271**	**314**	**327**	**262**	**294**	**306**	**245**

Indirect & non-monetised impacts

The NPSV analysis does not account for any behavioural changes that may arise as a result of the intervention. It also assumes that there are no perverse impacts from the intervention. There is a risk that in the short-term operators respond to the higher capital costs they will incur from purchasing ZEBs by raising fares or reducing service levels. This would negatively impact bus passengers and could potentially cause modal shift to other, more polluting modes such as cars.

Operators may also continue to operate existing diesel buses for longer than the assumed average life expectancy, which would adversely impact the availability of diesel buses in the second-hand bus market but save operators money in the short run. There may also be a surge in diesel bus purchases prior to a proposed end date. It is highly uncertain how operator behaviour will change following the intervention and consequently the impact this would have on the NPSV is unknown.

The risk that some ZEBs purchased create a cost to business is expected to be mitigated by operators having a commercial incentive to make optimal decisions on what services to first introduce ZEBs, particularly regarding introducing them on routes where the TCO is more favourable. This will minimise or avoid a cost to business at a TCO basis.

Manufacturers are not expected to incur any additional costs because of the intervention, given they will have sufficient time to transition to only producing ZEBs for the majority of the English market. ZEB models have already been in development and any transition costs will be passed on to bus operators as part of the capital costs for ZEBs.

There is a risk of higher upfront capital costs to operators. Bus operators may incur costs as a result of leasing/credit mechanisms – though this depends on business structure and may not be the case for all businesses.

In the short-term technology constraints may mean a zero-emission bus cannot cover the same distance per day as a non-zero emission bus, for instance due to limited battery capacity. In these cases, a higher number of zero emission buses could be needed to cover the same level of service as the current non-zero emission fleet being used which would come at an additional cost to operators.

Zero emission buses often require more depots space for charging than diesel alternatives. Upgrading depots to accommodate the infrastructure required to refuel and recharge new zero-emission buses, reducing the space to park buses when not in use. This could result in operators needing to increase the size of depots to keep the same bus capacity which would come at a cost to operators.

There are also potential benefits of increased patronage which would benefit operators through higher revenue and profits. Zero-emission buses are quieter, more comfortable, and have no exhaust fumes, making the experience more pleasant and attractive for riders. Health and environmental benefits may also encourage more people to opt for public transit over personal vehicles. Increased awareness of sustainability and cleaner air in urban areas can make public transportation a more appealing choice for eco-conscious travellers. The scale to which this measure could encourage mode shift to buses is uncertain, but any mode shift or additional trips made by bus would represent a positive impact to both operators and households.

17. Impact on medium, small and micro businesses

It can be argued that the implementation of the policy being proposed would place barriers to entry on the industry. However, it would not be appropriate to provide exemptions to SMBs from any final regulation, due to the need to mitigate the environmental, legal and international relations risks outlined in the problem under consideration. If we exclude SMBs we may fail to achieve the policy objectives. The objective is to restrict the usage of new non-zero emission buses on local bus routes, relating to wider government aims of achieving net zero greenhouse gas (GHG) emissions. For this measure to have most impact it is essential that a consistent approach is applied to improve the environmental impacts of the bus fleet across the country and to promote a unified approach to decarbonising the bus network within individual local bus networks. An exemption would not meet the policy objectives; therefore, it has not been deemed suitable.

An extensive range of options were reviewed and refined throughout the policy development process. The proposed policy is designed to enable the market to develop, whilst ensuring international and domestic climate targets are met.

The “big 5” operators (Stagecoach, FirstGroup, Arriva, Go-Ahead, and National Express) make up around ~80% of the English bus market, outside of London. The remaining 20% consists of, typically, smaller operators – however very few, if any, would be considered micro businesses. While most bus operating companies are private, some are operated as community based or not for profit entities, or as local authority arms-length bodies.

Rather than a full public service vehicle operator’s (PSV ‘O’) licence, organisations which provide transport on a not-for-profit basis can apply for permits under Section 19 and Section 22 of the Transport Act 1985. These operators are far more likely to be SMB than full PSV operators. The majority of such SMBs are unlikely to operate local bus services, mitigating against the impact of the policy on this group.

The amount of sectoral GHG emissions generated from SMBs is small, though it may be disproportionately large, relative to their market share. This is due to reliance on cascaded, older vehicles. As a result, SMB operators are likely to have higher average, per vehicle CO_2 emissions, relative to larger operators who are more easily able to purchase newer buses. Thus, the proposed policies focus only on new non-zero emission buses will mitigate some of the direct effects on SMBs.

Moreover, the intention is for this policy to apply to full sized buses, i.e. Class I and II vehicles, belonging to vehicle categories M2 and M3. As a result, only S19 large operators are likely to be impacted, less than 1% of the not-for-profit sector.

A search of specific S19 large operator permits suggests that, of the approximately 60 operators with such a license, 60% are local authorities. Most other institutions are educational, likely operating closed school services, which would not be affected. This illustrates further that the measure has been designed to mitigate any impact on SMBs.

However, it is important to keep in mind that SMBs will be disproportionately affected by climate change[30]. Therefore, the implications relating to SMBs of any action taken to mitigate climate change must be viewed through this lens.

As outlined, due to the existing market structure, the burden will mainly be borne by larger operators who represent the overwhelming majority of new bus purchases and have largely set voluntary commitments relating to decarbonisation. In all scenarios, there will be some agents for whom the effect of an earlier end of use date might be disproportionately negative.

We would not expect costs to be disproportionally weighted toward SMBs, given the likely impact only on S19 large operators and reliance on the second-hand market for vehicles. Therefore, there are unlikely to be direct effects. We would expect the larger fleets, who represent a high proportion of new vehicle purchases, to continue to turnover vehicles and ensure a steady flow of vehicles to the second-hand market, over time.

18. Costs and benefits to households' calculations

Some monetised environmental benefits have been quantified for this measure which would present a benefit to society. This includes the reduced operational greenhouse gases (GHG) emissions and improvements to air quality from a reduction in NOx and PM emissions. Electric buses will replace services that would have otherwise been made with diesel buses, leading to a net saving in carbon emissions and removal of Nox and PM emissions from diesel combustion engines.

	2030 - Central	2030 - High	2030 - Low	2032 - Central	2032 - High	2032 - Low	2035 - Central	2035 - High	2035 - Low
Reduction in carbon emissions (PV,£m)	1,302	1,356	1,085	1,131	1,178	943	921	959	768
Improved air quality (Nox and PM) (PV,£m)	29	30	24	25	26	21	21	22	17
Total environmental and societal impact (PV,£m)	1,331	1,386	1,110	1,156	1,204	964	942	981	785

[30] Holger Hendrichs, Timo Busch: *Carbon management as a strategic challenge for SMEs*: 2012

Further impacts to households are indirect and unmonetised. They consist of:

- improved journey quality from smoother and quieter buses
- reduction in noise pollution created by non-zero emission buses

Zero emission buses contribute to improving air quality (monetised above) and are also much quieter, with lower vibration levels for a more comfortable experience.

Zero emission buses can also help improve public health. Reduced air pollution from zero-emission buses can lower rates of respiratory and cardiovascular diseases, benefiting families, especially children and elderly members.

The Equality Impact Assessment, which has been prepared alongside this document sets out that there will be benefits to all communities, including those with protected characteristics who are disproportionately affected by poor air quality. It also sets out that the transition to zero emission vehicles could bring forward a step change in accessibility. Utilising the change in technology, and thus working practices, offers an opportunity to ameliorate some of the barriers and ensure that bus sector is more accessible for passengers and employees.

Given this analysis estimates there would be a net saving to operators in all cases, it could be expected that these savings will be passed on to passengers in the form of lower fares and/or higher service levels. However, due to a lack of competition and given operators' tendency to put a high weight on short term impacts, the transfer of this benefit to passengers may take time to be realised or operators may at least in part use it to increase their profit margin. The extent to which this benefit to households is realised is highly uncertain and likely to vary largely by operator but any service improvements or fare reductions would be very beneficial to bus users, especially low-income households.

19. Business environment

This proposed policy may act as a barrier to entry, as businesses will only enter the market if they think it is commercially viable given any additional cost this proposal might impose in the short term. There is a trade-off here between government intervention and ensuring healthy market competition.

This assessment concludes that the proposed policy is unlikely to have a negative impact on the level of competition in the UK market, given the "outcomes" based approach that has been taken when developing the policy. This prescribes the outcomes which government expects to see, rather than how to achieve them.

The measure, as proposed, will inevitably have impacts on the bus market. The intention is to restrict the usage of non-zero emission buses on local bus services, which may have unintended consequences (flagged in the risks section) which directly or indirectly could limit the number or range of suppliers, their ability to compete and the choices to end users. However, all existing manufacturers and operators have plans to move to zero emission technology in the coming years and all manufacturers are being treated equally through the policy's objectives.

The economic intuition behind SMBs being disproportionately affected by regulation is that some costs resulting from complying with regulation are fixed, i.e. they do not depend on the output of the business. Since larger businesses operate on a greater scale, such fixed costs are likely to be a smaller proportion of their overall costs. An identical increase in fixed costs in absolute terms will, therefore, translate into a larger relative increase in costs for SMBs.

The indirect impacts on competition may be more apparent than any direct impact, at least in the short term. Currently zero emission buses, whether electric or hydrogen fuel cell, tend to be more expensive than those propelled by combustion powertrains. This is partly the result of high component costs, such as batteries and fuel cell stacks. These tend to be produced internationally, and their high cost may:

- significantly raise the costs of production for incumbent firms, causing them to exit the market;
- significantly raise the costs for new suppliers (including small businesses) relative to existing suppliers; and,
- raise the costs of some existing suppliers relative to other existing suppliers.

There may be fixed costs with the need to retool manufacturing facilities and upskill workers to process high voltage electrical components and pressurised hydrogen gas, for example. There are large, fixed costs associated with constructing a bus manufacturing facility, regardless of any additional regulatory requirements. This is also the case for vehicle operators, who face high costs in terms of the development and building of depots, procurement of vehicles, and other associated infrastructure necessary to enable vehicle operation. However, these cost elements are largely independent of the proposed policy, which may vary certain component elements of the total cost.

Existing bus manufacturers in the UK already produce zero emission models, these manufacturers may enjoy incumbency advantages, such as access to information, prequalification, and support for transition costs.

80% of urban buses operating domestically are made in the UK, with manufacturing based across the UK with Alexander Dennis based in Falkirk, Scotland; Wrightbus, based in Ballymena, Northern Ireland; and Switch Mobility, based in North Yorkshire, England.

For component suppliers of manufacturers, specifically those involved in powertrains, the proposed policy will likely have an impact. Though, as the proposed measure does not halt the production or use of such vehicles (or related components), manufacturers and their supply chain will still be able to sell their products where it is appropriate to do so.

The manner of the policy may, inadvertently, favour some suppliers over others. For example, those who have already integrated power electronics, batteries and fuel cells into manufacturing processes may have a competitive advantage relative to those who need to retool and reskill their manufacturing base and staff to a greater extent.

Inherently, the proposed measure will influence the characteristics of new buses which may be used on local bus services. However, despite this, the proposed policy will not directly:

- Limit the sales channels a supplier can use, or the geographic area a supplier may supply in; or
- Substantially restrict the ability of suppliers to advertise their products; or
- Limit the suppliers freedom to organise their own production processes or their choice of organisational form

The specification of certain standards, i.e. for zero tailpipe operation, may also increase suppliers' costs. Higher costs incurred by businesses could therefore translate into higher fares prices, and a reduction in the variety of services available. Given, on average, the cost of a battery or fuel cell stack far exceeds that for a combustion engine there is a likelihood of higher costs in the short term. However, zero emission buses have far lower operating costs meaning zero emission buses can often be more cost efficient when compared from a total cost of ownership perspective.

A major part of the decision to purchase a commercial vehicle depends on the expected total cost of ownership (TCO) over the vehicle's lifetime. This includes: the capex cost of the vehicle including taxes and incentives, the cost of borrowing the capital to make the purchase, the residual value it is likely to retain for resale on the second-hand market, and the cost of refuelling and maintenance. TCO calculations will remain the key component of vehicle purchasing decisions for zero-emission buses (as for Internal Combustion Engines (ICE)) and the competitiveness of the market (relative to ICE buses), on this basis, may ultimately determine the rate of uptake.

Government remains technology neutral, but we are not outcome neutral – to achieve legally binding carbon and air quality targets and reduce our contribution to climate change the bus sector must ultimately transition to zero emissions. This approach is less likely to harm innovation, since suppliers are able to tailor their products to the standard, compete over efficient modes and methods of production, and ultimately provide more choice for end users.

The proposed policy will not restrict the ability of suppliers to compete with each other by differentiating their products. Regardless of powertrain there are numerous other characteristics which bus manufacturers do and will continue to compete on.

In terms of fuel, although the current range of blended petroleum products and other combustible fuels will no longer be appropriate for zero emission buses, we anticipate competitive electricity tariffs and sources of hydrogen will be new arenas for price competition and product differentiation.

Policy or regulation can create a scenario where it is in suppliers' commercial interests to coordinate their activities in an anti-competitive manner, as flagged above. The move to zero emissions for the bus market will not eliminate the ability for suppliers and manufacturers to compete.

In fact, the move to full zero emissions may increase the competitiveness of the market – with a new, and potentially greater, array of choice for end users, for example on battery size, vehicle capability, design etc. There is still significant scope for product differentiation in the bus market, irrespective of any policy relating to powertrains. Separate from price, characteristics such as handling, ride etc. will remain important for operators, and a venue where manufacturers and suppliers will remain competitive.

The characteristics of the bus market, namely the current market condition as well as methods employed in manufacturing, mean that it would be unlikely that suppliers would lack an incentive to compete, particularly on price. This is as bus manufacturing is particularly labour intensive, especially relative to other automotive manufacturing sectors, such as for cars and vans, which tend to have a greater degree of automation.

The need for such significant change across the sector may also diminish any inherent advantage incumbent firms have, lowering the barriers to entry to the market and allowing for greater competition, and thus price decreases.

As buses are road vehicles, there is a baseline level of information that is publicly available through the DVLA's Vehicle Enquiry Service, in addition to the logbook. Fundamentally, the information that would be available to a purchaser now, will also be available, at least, as a result of the proposed policy.

In December 2020, government laid an SI before Parliament enabling the display of green number plates for zero emission vehicles, including buses. Green number plates provide a UK-wide mechanism which will enable people to spot and differentiate vehicles based on their environmental impact, help inform road-users and normalise the idea of clean vehicles on our roads. This all plays an important part in supporting the transition to zero emission vehicles, and easily enables passengers to understand the relative environmental impact of different bus services.

20. Trade implications

The potential impacts of the policy on UK trade and investment must be given against the counterfactual.

Option 0: Do nothing (the counterfactual) represents a continuation of the status quo. There will be no additional policies to enable greater use of non zero emission buses. As a result, the resulting uneven development of the UK zero emission bus industry will likely impact on UK trade and investment. This is evidenced by the fact that, currently, manufacturers must balance the production of zero emission models alongside conventional internal combustion engine models across an uncertain time horizon, limiting investment in plant and machinery. We expect this to continue without this policy.

In this counterfactual some small trade and investment effects may be seen:

- **Expenditure effects** – There are some expenditure effects without the proposed policy, as grant funding has already been disbursed, with further rounds already underway, including across the devolved administrations, which has incentivised domestic investment and foreign direct investment (FDI). The inward FDI flow resulting from expenditure effect is likely negligible compared to total UK annual inward FDI flows. The effects on goods and services imports and exports resulting from expenditure effects may be reasonably assumed to be negligible.

We believe there is an opportunity for the UK to grow its automotive and supporting technologies sector significantly. Such a major disruptive technology transition presents an opportunity for the UK's successful automotive sector to be at the forefront of new technologies. Any accelerated ambition should place us in a good position to capture part of this growing global market.

Any of the do something options may cause additional trade impacts not realised in the counterfactual scenario:

- **Leveraged effects** – Policy would provide certainty to the market and focus research and development efforts away from non-zero emission-based powertrains toward zero emission alternatives. In this case, we could expect domestic manufacturing to capture a growing portion of the international market. This could result in an increase in UK exports of zero emission buses, alongside increased exports of UK services, in the form of transport and energy consultancy services which count as mode 2 services exports, consumption abroad. The existence of a thriving UK market implies that infrastructure, specialist finance firms, consultants and other service providers, vehicle manufacturers and operators tied to the UK operate, these agents may import specialist components and machinery as part of their capital expenditure. This may also attract additional inward Foreign Direct Investment (FDI) to the UK.

  - The expected increase in the UK export of services would likely have a marginal positive impact on total UK goods and services exports; likewise, the expected flow of inward FDI to the UK resulting would likely have a marginal positive impact on the UK's inward FDI stock.
  - Ning and Wang[31] suggest that FDI relating to environmental projects tends to increase overall positive environmental knowledge externalities in a region, and also spills over to nearby regions, attenuating the absorption and diffusion of a variety of cross-sectoral knowledge.

- **Growth effects** – it is expected additional growth will be stimulated in the UK downstream automotive and advanced manufacturing and services segments as a result of the policy. It is likely the imports and exports and inward and outward FDI flows in this segment will experience additional growth.

The business environment section outlines the domestic bus manufacturing market. New entrants to the market could also offer further opportunities in the development of the UK's zero emission bus market.

Unlike the car market, which relies on large volumes and production automation to provide competitively priced products, the bus market is relatively low volume and relies far more on manual construction and finishing. These lower barriers to entry mean that it is possible for small-scale companies to potentially produce a price competitive product in the bus market. This presents trade and export opportunities for UK small and medium-sized enterprises (SMEs).

The Technical Barriers to Trade (TBT) Agreement defines measures prohibiting the manufacture, importation, marketing or use of products as technical barriers. By limiting the approach to local bus services in England, the Government has scoped this policy to potentially mitigate any impact.

However, this policy also opens opportunities for greater investment and trade than currently exists. The three largest UK bus manufacturers all make zero emission models, so there is existing potential to scale up, creating more jobs, alongside developing domestic industry's ability to export globally.

Government recognises that manufacturing zero emission buses in the UK has a positive multiplier effect, supporting UK jobs and growth and new export opportunities.

[31] Lutao Ning & Fan Wang: *Does FDI bring environmental knowledge spill overs:* 2018

The global zero-emission bus sector is still nascent. However, the overwhelming majority of the existing fleet (~90%) is based in China[32]. Despite this, there are still significant opportunities for UK manufacturing and services.

UK bus manufacturers are already enjoying export success around the world. Examples include Alexander Dennis electric buses ordered in Hong Kong and Wrightbus hydrogen buses ordered in Germany.

In order to continue attracting international investments and anchor high value manufacturing to the UK, government has committed to increase the productivity and competitiveness of the UK zero emission supply chain. There are still gaps in the UK supply chain meaning automotive manufacturers import components.

The Advanced Propulsion Centre predicts that optimised future electrified supply chains will be localised to ensure they are cost effective and competitive. It estimates that there are £24bn worth of opportunities for UK suppliers in batteries, electric machines, and power electronics in the coming years[33].

The UK also has considerable expertise in the design and manufacture of electric chargepoints. Ambitions and policies across modes mean the UK is in a strong position to attract investment in infrastructure. We can also lead development of emerging new chargepoint and energy business models, particularly through government supported work on smart charging and energy storage options.

The measure does not specifically seek to affect trade or investment, rather it is a consequence of achieving our stated objective. This will likely impact imports of conventionally powered buses into the UK, though we estimate approx. 20% are purchased from non-domestic manufacturers. The measure will not restrict the ability of domestic manufacturers to produce vehicles and components for export.

There is a well-established supply chain for the production and operation of conventional buses in the UK, with specialised firms producing engines and related components. These technologies will retain use cases.

In the very short term, there is a risk of reliance on imports of both components for, and fully finished, electric and hydrogen buses. By providing a clear direction of travel to the market, i.e. through this policy, we expect firms to adapt and invest appropriately to meet the challenge. Broader Government initiatives, like the Automotive Transformation Fund, Faraday Institute, Advanced Propulsion Centre, and others, are providing support for zero carbon propulsion technologies.

It is also important to consider investment in earlier stage component production infrastructure, for example for batteries. This would encompass cathode and anode production and precursor chemicals production facilities. This would reduce dependence on foreign suppliers.

Energy storage onto a bus is very challenging as most of the space is required for passengers. The challenge for buses varies significantly between different bus designs (double decker buses are more challenging as the energy storage cannot increase the height of the vehicle) but all buses face the challenge of ensuring the chassis is strong enough to hold the weight of the energy storage, a challenge which is less of a concern for

[32] Bloomberg New Energy Finance: *Electric buses in cities*: 2018
[33] APC Passenger car electrification report v16.indd

other vehicle types. Given UK expertise in double decker design and manufacturing, this could present further export opportunities.

The proposed measure will not include different requirements for domestic and foreign business. Both imported and domestically produced buses will be treated equally under the proposed measure, and there are no proposals to treat any particular countries differently to any other.

21. Environment: Natural capital impact and decarbonisation

The measure is expected to deliver the following environmental benefits:

Greenhouse Gas Emissions: Buses currently produce 3% of transport greenhouse gas emissions in the UK[34]. The policy aims to reduce these emissions by promoting the use of zero-emission buses.

Carbon Savings: The carbon saving as a result of a restriction on the use of new non zero emission buses on local bus routes from 2030 is -6.9 MtCo2e.

Air Quality: The transition to zero-emission buses is expected to prove air quality by reducing harmful pollutants emitted by diesel buses, including CO, NO_x and N_2O.

Geographical Impact: The direct environmental effects would apply only to bus services in England outside London and franchised areas though there may be some spillover effects.

The environmental outputs for the shortlisted options are presented below. The earlier the end of use of new diesel buses is brought in the larger the environmental benefits from this policy. The carbon savings in carbon budgets 5 and 6 are also shown.

Year - Scenario	**2030 - Central**	**2030 - High**	**2030 - Low**	**2032 - Central**	**2032 - High**	**2032 - Low**	**2035 - Central**	**2035 - High**	**2035 - Low**
Reduction in carbon emissions (PV,£m)	1,302	1,356	1,085	1,131	1,178	943	921	959	768
Improved air quality (Nox and PM) (PV,£m)	29	30	24	25	26	21	21	22	17
Total environmental and societal impact (PV,£m)	1,331	1,386	1,110	1,156	1,204	964	942	981	785
Total carbon savings (MtCo2e)	-6.9	-7.2	-5.8	-6.2	-6.4	-5.1	-5.2	-5.4	-4.3
Carbon savings in CB5 (MtCo2e) 2028-2032	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Carbon savings in CB6 (MtCo2e) 2033-2037	-0.6	-0.6	-0.5	-0.4	-0.4	-0.3	-0.1	-0.1	-0.1
Expected date of net zero fleet	2045-2050	2045-2050	2045-2050	2047-2052	2047-2052	2047-2052	2050-2055	2050-2055	2050-2055

Zero-emission buses, in addition to directly reducing harmful emissions, may indirectly further improve GHG emissions, air quality, habitat damage, congestion and noise by influencing a modal shift from single-occupant vehicles to public transport. Research

[34] Department for Transport: *Transport and Environment Statistics 2023*: 2023

commissioned by bus operator Stagecoach indicated that more than one million new passengers could be attracted to use the bus networks through the switch to zero emission buses[35].

There may be some increased impact on the built environment, with the potential need for civil works to upgrade bus depots and stations to deploy appropriate charging/refuelling infrastructure. The scale of any infrastructure related natural capital impacts will be highly contextual to the local environment. For example, the suitability of the existing electrical infrastructure will vary across the country – in some cases it may require reinforcement or additional capacity to allow for the installation of sufficient high-powered charging infrastructure, concentrated in bus depots, in others a lighter touch might be appropriate.

22. Other wider impacts

There are wider impacts to the Government from this policy which are presented below. These are the transfer payments such as the Bus Service Operator Grant (BSOG) and change in Duty. They have no impact on NPSVs, given they are economic transfers between government and operators which net to zero. Two changes in government revenue and transfer payments have been quantified:

1. Fuel duty revenue – A reduction in the amount of diesel used will reduce the amount of fuel duty revenue for HMT, this is recorded as a dis-benefit.

2. Reduction in BSOG expenditure reduces the BSOG RDEL cost incurred by DfT, which is captured as a cost to the broad transport budget. Diesel and electric buses receive different rates of BSOG resulting in a change in BSOG expenditure from government. Diesel buses receive 35p per litre of diesel used and electric buses receive 22p per km, the rate for electric buses was set on the basis of there being parity with diesel buses.

PV, £m	2030 - Central	2030 - High	2030 - Low	2032 - Central	2032 - High	2032 - Low	2035 - Central	2035 - High	2035 - Low
Change in fuel duty revenues (transfer)	-780	-812	-650	-659	-686	-549	-519	-540	-433
Change in government expenditure on BSOG payments (transfer)	-77	-80	-64	-63	-65	-52	-48	-50	-40
Total impact on Government (PV,£m)	-856	-892	-714	-722	-752	-602	-567	-590	-472

[35] Stagecoach: *Road map to zero: the transition to Zero Emission Buses, what it means for people, and the journey to get there*: 2022

23. Risks and assumptions

Key analytical risks:

A key risk of this analysis is that the date at which this policy is brought into force has not been set and will not be set until secondary legislation stage. To mitigate this, a range of likely shortlisted years; 2030, 2032 and 2035, have been assessed. However, there is a risk that none of these shortlisted options will be the final chosen option. Though it is highly likely that the end of use date will be between 2030-2035, therefore mitigating the risk. There will be the opportunity to conduct further detailed analysis at secondary legislation stage.

Analysis could have been expanded further by exploring the impacts of different assumptions other than the central case averages which have generally been used. This has not been deemed proportionate at this stage as the best current evidence base are used where available. Secondary legislation stage will give the opportunity to analyse the impact of changing assumptions on the NPSV further. As many of the assumptions are uncertain, and we largely present the central case analysis only, other than franchising scenarios, later sensitivity analysis could explore the implications of using different assumptions. E.g. what if electricity prices are higher than the DESNZ central case that has been used.

To account for the removal of franchised areas from this measure, it has been necessary to estimate the proportion of LTAs and therefore the size of their bus fleets that are expected to franchise. The methodology for this has been explained in section 15. There is high uncertainty in the extent to which franchising will spread across the country, and therefore the applicability of this measure. Scenario analysis has been conducted to illustrate the impacts. Where available, evidence from engagement with LTAs and national statistics have been used to calculate the proportion of the bus fleet we expect to franchise. High, central and low scenarios have been produced for each shortlisted option regarding franchising role out. This should be explored further once more is known on the portion of LTAs expected to franchise.

Analysis assumes all zero emission and non-zero emission buses are battery electric and diesel respectively, other powertrains are available and could change the impacts. Current evidence suggests that hydrogen buses are likely to offer lower value for money relative to electric buses due to higher capital and operating costs. There is a risk that the NPSV is currently overestimated as including hydrogen buses will likely lower the NPSV. Consultation responses suggested that in future, hydrogen buses are likely to account for 5-30% of the ZEB fleet. As a simplified assumption 50% of new ZEBs are assumed to be single decker and the other 50% double decker.

There is risk of behaviour changes from operators. We have assumed a compliance rate of 100%. However, operators may change the timing of new bus purchases to stock up on non-ZEBs before the end date. This risk is perceived to be low, given the capital cost requirements. Alternatively, operators could stretch the life of diesel buses beyond normal expectations, prolonging the carbon emission emitted by diesel buses. These risks are also greatest for earlier options. Both types of operator behaviour change could have a consequence on the expected NPSV.

Analysis assumes static fleet size and a constant annual turnover of buses. The NPSV results are based on national average figures for the annual vehicle distance travelled and the fuel / energy consumption of a bus. This does not consider variations in these variables that are likely to exist across different bus services in England. TCO and NPSV per bus will differ on a case-by-case/operator basis depending on factors such as where the ZEBs are delivered, the type of route they are delivered on and when.

Commercial electricity prices provided by DESNZ have been used as opposed to domestic electricity prices stated in TAG as these are more representative of bus operators' costs. Commercial electricity prices are lower than domestic prices so assume a lower running cost to operators. Should operators not benefit from commercial electricity prices their running costs will be higher, and this will increase electric bus TCO.

LTAs green commitments have not been included in counterfactual analysis. Four of the “Big 5” bus operators have stated commitments to have a zero-emission bus fleet by 2035 and several MCAs have fleet decarbonisation commitments. They have not been captured in the counterfactual as they are contingent on government funding and other support. There is therefore a risk that the estimated number of ZEBs delivered because of the intervention is overestimated, consequently overestimating the associated costs and benefits of the intervention and overstating the NPSV. To mitigate this risk, the analysis could be developed further at secondary legislation stage to establish an alternative counterfactual that assumes operators will meet their commitments. This will result in a wider NPSV range and may better reflect the uncertainty of ZEB purchases in the absence of the intervention.

The extent to which the purchase cost of ZEBs changes overtime is a key uncertainty. Zero emission technologies for buses are evolving and the costs in real prices are expected to fall overtime due to falling component costs such as batteries and economies of scale. There is limited data and evidence available to forecast the extent of this change. The analysis uses the central battery cost forecasts from a 2020 Element Energy report commissioned by the Climate Change Committee to estimate how electric bus vehicle and battery replacement costs may change overtime. It is assumed that the cost of vehicles will fall in line with expected changes in battery costs. This is a simplified assumption as we do not have evidence on how the other ZEB components or manufacturing costs may change in the future.

The analysis does not take into account wider changes that may directly affect the bus sector. Future policy changes such as the reform of BSOG have not been accounted for, which will affect the TCO of buses in the future. Changes in the level of bus service provision is also not accounted for as it is assumed that the average annual vehicle distance and size of the bus fleet, which are derived from national bus statistics, remain static over the appraisal period. This is due to the uncertainty of how bus service levels may change in the future and in which direction. It is unclear how the fleet size will change in response to changes in service levels as buses may be used more or less intensively. Due to these inherent uncertainties, the analysis assumes that service levels and the size of the bus fleet remains constant. The NPSV analysis does not account for any behavioural changes that may arise as a result of the intervention.

TCO specific risks:

TCO of diesel and zero emission buses will vary depending on a range of scheme specific and endogenous factors. Scheme specific factors include the use case of the bus (distance and intensity), make and model and infrastructure requirement. Endogenous factors include diesel/electricity cost forecasts and change in battery prices. This TCO analysis uses averages for scheme specific factors. For endogenous factors the central case inputs are used such as the DESNZ diesel/electricity cost forecasts.

To estimate how the difference in TCO between electric and diesel buses may influence cost to business and how operators may make purchasing decisions without any intervention, costs need to be discounted. Discounting converts all costs into present values, by adjusting for operators' preference for now compared to the future. The extent of this preference is dependent on the discount rate, a higher discount rate implies a greater weight placed on costs and benefits that occur sooner than those that occur later.

Government guidance estimates for society, the discount rate that should be used is 3.5%[36]. This rate has been used when determining the net present cost to business. Yet when making commercial decisions private sector organisations typically have higher discount rates, given consideration of the cost of raising capital, compensation for risk, and shorter time horizons. One of the big 5 operators used a 10% discount rate in their TCO analysis, hence discount rates over 3.5% may be a better representation of bus operators' time preferences. This means there is a risk that the legislation will make investment in ZEBs unviable for some bus companies, resulting in a hiatus in investment in new buses, and a deterioration in the quality of service for bus users.

Other factors may influence decision making such as operator commitments. TCO analysis reflects a standard operating model, different commercial models are likely to present a different picture on commercial viability e.g. leasing or franchising.

TCO analysis is highly uncertain and sensitive to assumptions. Forecasting prices of batteries, electricity and diesel far into the future is challenging, as it depends on several factors outside of our control like global shocks.

The commercial viability of ZEBs will also vary by operator, as individual commercial organisations will take differing views on the discount rate, i.e. the extent to which they value money today more than money in the future. The cash savings from running an electric rather than a diesel bus come from future operating costs, but they need to be weighed against the higher capital outlay.

In summary, in some cases the TCO of an electric bus is already an attractive investment proposition compared with diesel. However, even when making optimistic assumptions, there will be services that are challenging to decarbonise and where the TCO may not make private investment attractive.

[36] The Green Book (2022) - GOV.UK

As stated, to be able to conduct proportionate analysis, simplified assumptions were made. There are a range of variables that may impact TCO, the fleet forecast and therefore analytical outputs. There are likely behaviour change responses that are not reflected in this analysis, such as running diesel buses for longer and spikes in diesel purchases before an end of new use date. The GBT analysis assumes the national average vehicle distance.

Further core assumption used in the analysis and the sources are presented below.

Core Assumption	Value	Source
Diesel Single decker bus cost	£209,549	ZEBRA 2 average
Diesel Double decker bus cost	£277,033	ZEBRA 2 average
Single decker electric bus (2024)	£407,062	ZEBRA 2 average
Double decker electric bus (2024)	£489,104	ZEBRA 2 average
Infrastructure cost per bus	£70,861	ZEBRA 2 average
Charger cost (excluding depot works)	£35,470	ZEBRA value
Year infrastructure cost per bus falls (charger cost only)	2035	Unevidenced assumption
Battery size (kWh)	351	ZEMO test certificate average
SD Diesel fuel consumption (l/100km)	31	ZEMO test certificate average – UK average route
DD Diesel fuel consumption (l/100km)	36	ZEMO test certificate average – UK average route
SD Electricity consumption (kWh/100km)	125	ZEMO test certificate average – UK average route
DD Electricity consumption (kWh/100km)	126	ZEMO test certificate average – UK average route
SD Diesel fuel consumption (l/100km)	31	ZEMO test certificate average – UK average route
DD Diesel fuel consumption (l/100km)	36	ZEMO test certificate average – UK average route

SD Electricity consumption (kWh/100km)	125	ZEMO test certificate average – UK average route
DD Electricity consumption (kWh/100km)	126	ZEMO test certificate average – UK average route
Diesel fuel cost	Central	DESNZ forecast
Electricity cost	Central	DESNZ forecast
Battery replacement after	9 years	Assumption (vehicle mid-life)
Vehicle contingency uplift	3.4%	ZEBRA 2 average
Infrastructure contingency uplift	13.2%	ZEBRA 2 average
Average annual km	55,703	Annual bus statistics – England average 2023
Infrastructure maintenance cost	1.88%	ZEBRA 2 average
Vehicle life expectancy	17 years	Operator engagement
Proportion of franchising LTA's network that they will franchise	75%	Qualitative evidence from LTAs in the UTG report and best estimate
Appraisal period	2024 to 2066 (impact on bus purchases between now and 2050, with buses purchased in 2050 estimated to be decommissioned by 2066)	
Appraisal assumptions (GDP deflators, carbon values, air quality values etc.)	May 2024 TAG data book (current version)	

Policy risks

There are multiple options that may achieve carbon reductions close to the goal of net zero by 2050, but all with different trade-offs and risks.

In general, the earlier we bring the restriction on usage of new, non-zero emission buses on local bus routes, the greater the carbon savings, but the higher the risk that there might be adverse risks to the bus sector and additional costs to consumers and to the energy sector.

At a global level, in setting an earlier date for a restriction, there is a risk that the UK will simply displace carbon emissions savings of zero emission buses which would otherwise be sold elsewhere, rather than providing any new additional emissions savings in the absence of the proposed policy. This risk will only be realised if manufacturers, globally, do not accelerate zero emission vehicle production to meet demand

There is also a risk that bringing forward the restrictions could result in further negative impacts. These may include a smaller range of vehicle models to choose from (although we expect a vastly expanded range of zero emission bus models to be available on the market in subsequent years), higher upfront costs, and potentially fewer new buses available in the market altogether due to supply constraints. This could lead to fleet turnover slowing down, as operators may turn to the second-hand market for older conventionally powered vehicles rather than purchasing new zero emission models.

We anticipate that this policy will generate the required behaviour, however there is a risk that manufacturers may adopt different pricing strategies around an end of use date to maximise profits, and thus operators may retain internal combustion engine buses for longer than they currently do, both of which would slow carbon reduction and could lead to an increase in carbon emissions ahead of any restriction.

Reducing the usage of new conventionally powered buses from local bus services could increase the upfront cost of zero emission buses as it removes the ability for manufacturers to cross-subsidise by increasing the price of conventional vehicles within markets. Manufacturers could cross-subsidise across international markets, but this is at their discretion and often not attractive because of currency differences, so vehicle cost impacts are uncertain and unclear.