Charging forward

How electric bus fleets can energise the UK's cities

Foreword

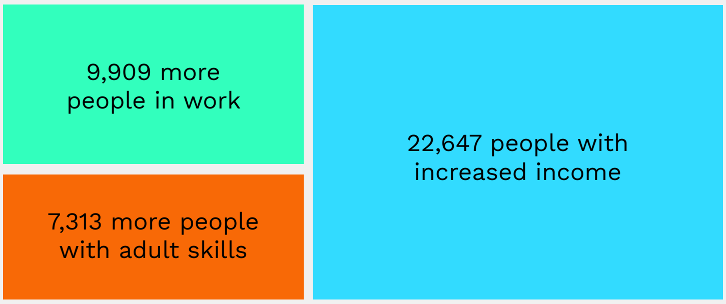
This report presents our research into the total cost of ownership for diesel and electric buses. It shows that electric buses can have lower lifetime costs, bringing important economic and environmental benefits to communities across Britain. While we recognise the Labour Government's commitment to bus franchising, it is too early to predict how this will affect the rollout of zero-emission buses. Instead, this report offers a policy framework to speed up bus electrification in our towns and cities, helping to clean up our communities and make bus systems more cost-effective, under any delivery model.

Public transport is a vital part of the UK economy and the country's journey towards a greener future. Buses are at the heart of this system, powering 3.7 billion journeys a year – one billion more than the railways, which only account for 2% of all passenger journeys, albeit over longer distances.[1] They achieve this despite rail taking up 60% of public transport spending, and four times as much government policy attention.[2] Buses are lifelines connecting people to employment, education and local services. They make our neighbourhoods vibrant and productive, while electric buses clean up our communities by saving thousands of tonnes of carbon emissions and pollution each year.[3]

However, significant hurdles need to be overcome to spread the benefits of bus electrification across the UK. Among these are the long-term decline in passenger footfall on buses, and a growing divorce between energy and transport policy. These barriers undermine the economic case for electrification. Through consultation with leaders in the bus industry, we have identified innovative, cost-effective policy pathways that will remove these barriers, accelerating electrification and cleaning up our air.

This starts with ensuring that electricity policy is made with electric transport in mind and does not penalise buses for their energy usage. We also show how redesigning public subsidies will allow them to be deployed more effectively and equitably. Finally, we explore how to transform passenger experience to get people back on buses again. These system-level responses will help transform perceptions of buses as old, overlooked and outmoded. Instead, they will be seen as the heartbeat of a new, clean, and dynamic urban transport network.

A 10% increase in bus connectivity would drive improvements for thousands in the UK.



Source: University of Leeds

In cities such as Coventry, Glasgow, Oxford, Newport and London, electric buses are already bringing about a new era of electric public transportation. These early successes have given us a glimpse of what is possible. We know that electric buses are good for the environment and public health due to reduced carbon emissions and pollution. In this report, we demonstrate that electric buses have also crossed a threshold and can also be cheaper than new diesel buses when evaluated on a total cost of ownership basis. This offers potential for significant cost savings for bus operators and local authorities.

As we charge towards a future powered by clean energy, we need a plan for electric buses. This report can serve as a catalyst for collaboration and innovation, helping policymakers, industry leaders, and communities work together towards a cleaner and more cost-effective transport system.

Steven Meersman,
Zenobē Founder Director
October 2024

Executive summary

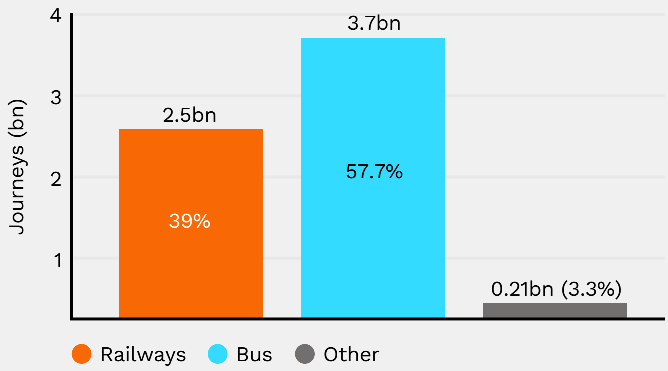
This report shows that bus electrification offers lifetime cost savings for local authorities and bus operators, while also reducing emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), and particulate matter (PM2.5). We summarise new modelling demonstrating the key economic benefits include lower fuel and maintenance costs, making electric buses not only more cost efficient than their diesel/hybrid equivalents but also more durable.

So why, despite progress, is the transition not moving faster? As we argue, the challenge of accelerating bus electrification at scale is not the price of electric vehicles, but rather overcoming barriers that undermine the potential cost savings. The transition is hindered by unfair network charges that discourage electrification, inconsistent grants such as the Zero Emission Bus Regional Areas (ZEBRA) scheme and the former Ultra Low Emission Bus (ULEB) grant for hybrid and zero-emission models, along with declining passenger numbers. To accelerate the transition to electric buses, we need to create greater certainty for operators and local authorities regarding energy costs, the design of government subsidies, and revenue streams.

Drawing on the perspectives of industry experts and policymakers, this report highlights the potential for a quicker transition away from diesel buses, well ahead of the UK government's proposed end-of-sales date in 2032. An accelerated transition to electric buses would renew our public transport networks, reduce air pollution in our communities, and reduce costs for operators, local authorities, and the government.

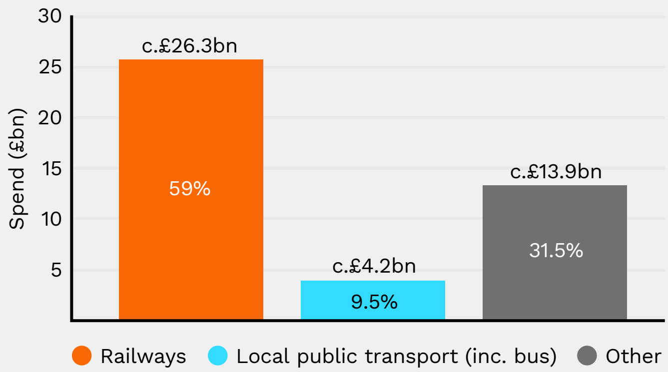
Buses deliver the highest share of passenger journeys per year, but receive the least investment

Passenger journeys per year in the UK (2023)



Source: www.gov.uk

Public transport spend in the UK (2023)



Source: www.gov.uk

Zenobē / National Express depot, Coventry
See full case study on p.17.

To address uncertainty, we propose three key policy reforms:

1

Stop hitting low carbon bus depots with punitive charges

Few areas demonstrate the misalignment of clean energy and transport policy more than residual network charges. Recently reformed, such charges accidentally penalise electric bus depots recharging overnight. Exempting electric bus depots would realign energy and transport policy and create a favourable business case for electrification, similar to exemptions provided for storage assets and energy intensive industries (EIIs).

2

Shift government support from diesel buses to electric buses

We must streamline funding schemes to reward electric bus adoption. Increasing the Bus Service Operators Grant (BSOG) – and devolved equivalents – for electric buses and simultaneously decreasing it for newer diesel models will propel a switch to cleaner transport. Supported by a longer term commitment for a higher BSOG rate for zero emission buses rather than providing capital grants for charging infrastructure and the upfront bus capital cost.

3

Speed up buses

Reversing the decline in bus usage requires collaborative efforts between transport authorities and industry to enhance service delivery. Bus improvements, improved ticketing systems, and increased bus priority measures are pivotal to this.

Although the costs of electrification have historically been high, they are now falling. Our proposed reforms will give local authorities and bus operators more confidence to switch to electric at scale and speed, paving the way for a cleaner, more sustainable future in public transportation.

1 The case for making the switch

The UK is Europe's largest EV bus market.[4] Significant investment into electric buses from innovative green financing sources has already seen cities like Oxford, Coventry, Glasgow and Newport transform their public transport systems, delivering cleaner air and brighter city and town centres.

The blueprint for a full electric bus rollout exists and is already a reality in pockets of the UK. It could be happening faster and benefiting more of us.

Over their 15-year lifespan, electric buses yield a net saving of £120k when compared to diesel buses

Zenobē / National Express, Yardley Wood

Financial savings

While electric buses have a higher upfront cost (up to £300k more than diesel counterparts), their lower running costs provide material financial benefits. The investment in electric buses is recouped within eight years due to substantial savings in fuel and maintenance costs. Over their 15-year lifespan, electric buses are expected to yield a net saving of £120,000 when compared to diesel buses.

Climate benefits

Electrifying bus fleets would lead to cleaner air and significant reductions in greenhouse gas emissions in our cities and towns. England could avoid over 13 million tonnes of CO_2 emissions, while Wales could avoid 0.9 million tonnes, and Scotland could avoid 2.5 million tonnes (see Annex 1 for methodology).

Cleaning up our communities

Electrifying bus fleets would result in substantial reductions in particulate matter (PM2.5) and nitrogen oxide (NOx) emissions, which are associated with chronic disease, premature death, and excess costs to the NHS. A full transition in England would cut 67 tonnes of PM2.5 and 4400 tonnes of NOx over a 26-year period (see Annex 1 for methodology).

Local impact

Electrifying bus fleets presents an opportunity to save money for both government and operators. Substantial savings in maintenance and fuel costs are predicted for cities like Manchester and Liverpool, as well as smaller cities like Derby and Hull, which can be reinvested into improving services.

Back on the buses

With the right policy framework, and governments, local authorities and operators working together, the passenger experience can be substantially improved through priority measures that reduce congestion and speed up buses, improve bus reliability, increase passenger numbers and solidify the future of the industry.

Boost local supply chains

Boosting the UK's electric bus market can turbocharge its battery industry through the innovative use of second life batteries in charging infrastructure, creating a homegrown and sustainable circular economy.

2 The tipping point for electric

Zenobē / Cardiff Bus Depot, Cardiff
Completed 2021. Zenobē provided 15-year "as-a-service" support for depot electrification, charging infrastructure and battery maintenance for 36 buses.

The Government has committed to introducing an end date for the sale of new non-zero emission buses, suggesting 2032 as the latest date.[5] While this de facto ban will help drive behavioural change, it will not automatically force diesel buses off the road. Diesel buses bought in 2032 will still be able to operate indefinitely, indicating that we may still have a large fossil fuel-powered bus fleet throughout the 2030s and into the 2040s.

However, our research and modelling indicate that putting new diesel buses on the road would be an expensive mistake both for operators and local authorities. Below, we set out two scenarios that show the falling cost of electric buses. Both demonstrate there are significant savings for operators and local authorities choosing to electrify their fleets.

Scenario 1: buying electric fleets with cash

When purchased with cash on day one, diesel buses are initially cheaper than electric buses. However, within eight years electric buses overtake diesel due to lower fuel costs and the lower maintenance cost. Over a 15-year period, operators could expect the Net Present Value (NPV) of fleet costs – a measurement of cash inflows and outflows – to be £160,000 lower.

However, it is worth noting this option is often infeasible for operators and local authorities as upfront costs and capital expenditure remain high. The right leasing arrangements – enabled through intelligent private and/or public financing – can also deliver costs saving from day one, while reducing capex and enabling a greater number of electric buses to be rolled out.

Zenobē / Cardiff Bus Depot, Cardiff

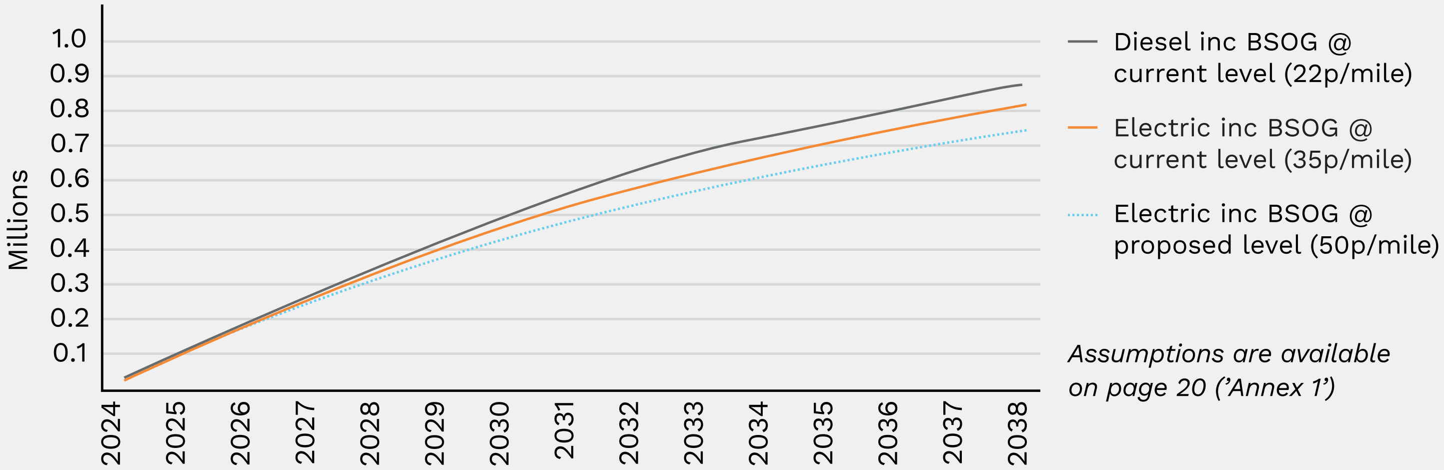
Scenario 2: purchasing through lease arrangement

Many buses are not purchased with cash upfront – they are leased on a form of financing arrangement. The higher “lease” (monthly) cost of an electric bus versus a diesel bus can be offset with the lower running and maintenance costs from day one of the bus purchase. Our modelling shows we have reached the tipping point for leasing electric vehicles. Our analysis shows this arrangement can be around £50,000 cheaper than diesel with Zenobē’s financing offering over an electric bus' lifetime. This is assuming public subsidies such as BSOG for both diesel and electric are kept at current levels.

These savings can be bolstered by the policies we recommend in section 3, including reformed public subsidies, which will make the commercial benefits of electrification clearer and more reliable. Increasing BSOG for electric vehicles to 50p/mile while removing intermittent ZEBRA capital cost funding, for example, could deliver an NPV saving of £120,000.

This financial reality presents an opportunity for operators, local authorities and national governments to unite and support changes to allow delivery at speed and scale.

If leased but supported by consistent subsidy, electric buses can be £120k cheaper than diesel over their lifetime



Assumptions are available on page 20 (’Annex 1’)

Towns and cities are set to benefit equally

We have modelled the cost savings and public health benefits of electrification in 6 cities - Southampton, Plymouth, Hull, Manchester Combined Authority, Liverpool Combined Authority, and Derby. These have been identified based on their low electric bus count.

To ensure we are considering the UK's disparate city populations and landscapes, our model looks at the largest urban areas (e.g., Manchester and Liverpool) as well as the smaller ones (e.g., Derby and Hull).

Our modelling found that operators in larger UK cities can save up to £340 million in reduced maintenance and fuel costs due to the lower lifetime cost of electric versus diesel buses. This is equivalent to the lifetime cost of 256 electric buses.

Separately, the switch to electric could also avoid over 1 $MTCO_2e$ greenhouse gas emissions while cutting polluting NOx by 376 tonnes over 26 years. That's the equivalent of taking around 955,000 cars off the road (see Annex 1 for methodology).

In smaller cities, our model predicts operators would save up to £47 million in fuel and maintenance costs over 26 years, which is the equivalent to almost 35 electric buses.[6] These cities would also see carbon emissions cut by between 104-150 $ktCO_2e$ and NOx by up to 40 tonnes, representing a further 95,000-137,000 cars off the roads (see Annex 1 for methodology).

Larger UK cities can save up to £340m in reduced maintenance and fuel costs

Zenobē / Cardiff Bus Depot, Cardiff

3 How we charge forward

Our analysis and conversations with industry show that the adoption of electric buses hinges less on ownership costs, and more on achieving certainty that these savings won't be undermined by high energy costs, intermittent government subsidies and declining passenger footfall.

In this section, we explain these barriers in more depth and set out three cost-effective policy pathways to remove them.

a) Stop hitting low carbon bus depots with punitive network charges

Energy and transport policy have long been divorced and need to be better aligned. Electric buses are being penalised for high energy usage due to outdated regulations that do not recognise their lower impact on grid reinforcement. Below, we argue that in order to remove unfair and inaccurate costs, electric bus depots should be exempt from residual electricity network charges. Alternatively, they could be officially classified as an energy intensive industry (EII).

Background on the Targeted Charging Review (TCR)

Prior to 2023, peak electricity transmission network charges for high energy consumers were applied between 17:00-19:00 from November to February, identified as the "TRIAD" periods. During these times, transmission costs were at their highest due to increased demand on the grid. Energy suppliers in turn issued "TRIAD warnings" to customers signalling that they should shift consumption and report lower peak usage, allowing them to save significant money on bills.

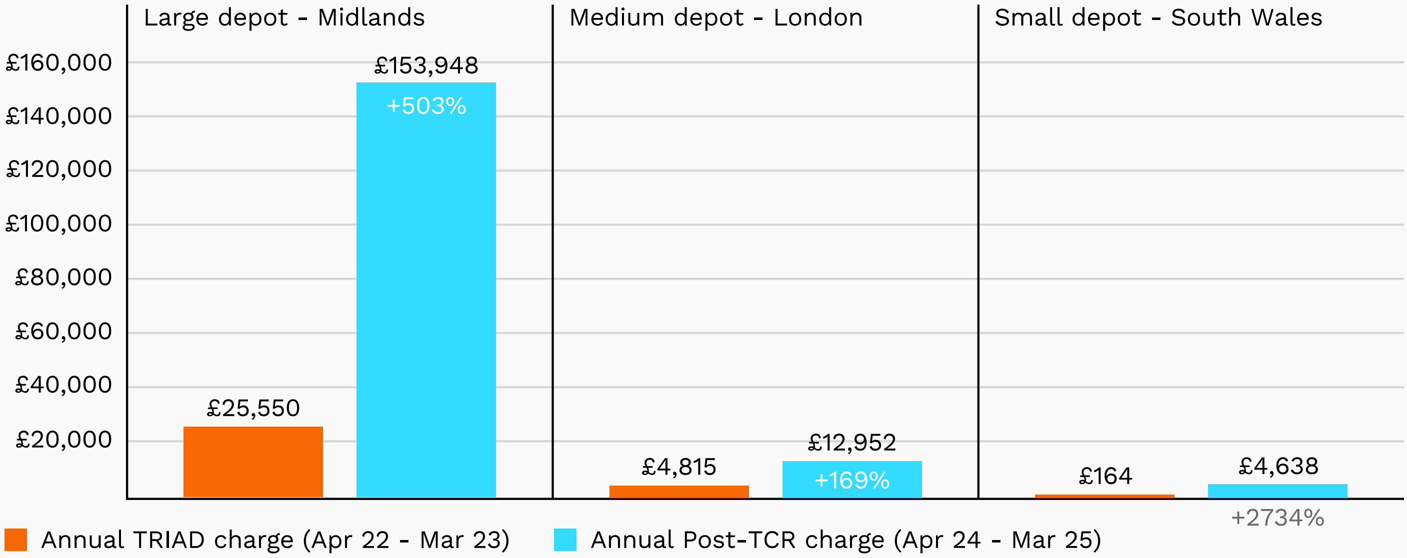
However, this led to concerns around the distribution of residual costs. Businesses able to shift consumption outside of TRIAD periods could minimise costs, resulting in the redistribution of expenses to smaller businesses and consumers without this flexibility. To address this, Ofgem implemented changes arising from the Targeted Charging Review (TCR) in 2023, which linked residual transmission network charges for high energy consumers to grid connection capacity. Exemptions were applied to energy storage assets as they provided services that relieve stress on network capacity.

However, electric bus depots were an unintended casualty of this reform and face these new charges, despite not using power during peak hours (most charge overnight as they are on the road in the day). Because of the load requirements to charge all bus depots overnight, there is a need for a large meter with a high connection agreement. These charges appear on operator bills in different ways: they can be a separate line item or built into either the fixed charges or unit rates. Unlike some high energy consumers, electric bus depots did not avoid peak consumption periods to "game" the system but for legitimate economic and logistical reasons. Indeed, much like energy storage assets, many electric bus depots provide responsive smart charging solutions for the grid.

> Under the TCR framework, **costs have spiked by c.£705k** over the lifespan of a 15-year vehicle contract

Zenobē / National Express depot, Coventry

Some residual charges for e-bus depots have spiked by upwards of 500% as they are now based on grid connection capacity - a static metric which doesn't account for time or flexibility of use.



Assumptions are listed on page 21 ('Annex 3')

Solutions

a) Exempt electric bus operators from residual charges: Several bus operators have reported that, since the change in electricity transmission charges, a large chunk of their government subsidies is taken up by the increase in transmission costs. Rather than going to government, this money flows into the hands of private Distribution Network Operators (DNOs) who collect the charges. In some cases, their energy bills have increased by tens of thousands per year. Analysing data across various sites reveals a startling trend: under the new TCR framework, costs associated have spiked by an average of £705,051.55 over the lifespan of a 15-year vehicle contract. In the Midlands, electricity charges at one of our large depots (see graph above) increased by almost £130,000 last year.[7]

This vast increase severely undermines the economic viability of electric buses, counteracting the advantages of lower running costs. It is a clear example of a lack of coordinated thinking between DfT and DESNZ on electric bus policy. Given that electric bus depots, like storage assets, are a unique case when it comes to large network connections, they should be exempted from residual network charges.

b) Reclassify electric bus depot operation as an Energy Intensive Industry (EII): EIIs such as steel, chemicals, paper and glass require large amounts of power. Compared to other countries, the UK used to impose significantly higher costs on these industries due to ambitious grid decarbonisation targets that meant they had to pay more through schemes such as Contracts for Difference (CfD), the Renewables Obligation (RO) and Feed-in-Tariffs (FIT). Rightly, however, to make the UK's EIIs competitive with counterparts and prevent carbon leakage, the Government has exempted EIIs from 85% of the cost of the CfD and RO schemes and full exemption from the indirect costs of FITs. The reduction in this revenue was made up for by increasing charges for other consumers, such as non-EII businesses, so government did not lose money in the process.

Despite being more energy intensive than some EIIs, bus depots are not included as part of this classification. As such, they receive a double charge from both TCR and the renewable levies – despite being critical clean infrastructure. Our analysis of data centres as illustrative EIIs, compared to electric bus depots showed that the latter faced an average 2050% rise in annual costs under the post-TCR regime, whereas the former saw average reductions of 62%. We even found that industrial factories who were penalised for load shifting saw lower cost increases than electric bus depots (see Annex 3 for full data). Therefore, in addition to, exempting depots from TCR charges or instead of doing this – if simpler for government to implement – we recommend reclassifying them as EIIs so that the savings from the renewable levies offset residual charges.

b) Shift government support from diesel buses to electric buses

Introduced in 2021 following the introduction of the National Bus Strategy (NBS), ZEBRA and ScotZEB are periodic grant funding competitions to which local transport authorities (LTA) apply in partnership with bus operators, making the case for how they can deliver zero-emission buses and accompanying infrastructure at scale and least cost.

While these schemes have contributed to the UK's electric bus boom, with the UK on track to meet the NBS' target of 4,000 zero-emission buses outside London by the end of 2024, the intermittent "feast and famine" nature of these subsidies – combined with uncertainty about future rounds – means bus operators and manufacturers cannot plan for the long term, compromising the investment case for electric. The grants mean electric bus demand develops in peaks and troughs, producing manufacturing bottlenecks and delays, which will in the long run become a vicious cycle as LTAs and operators are forced to replace buses in one go.

In addition, their competitive nature means rollout has been geographically uneven and skewed towards major cities and operators. Operators and local authorities expend a great deal of effort over these applications – often at short notice and paying thousands on external consultants for help.

As well as being a time and resource sink across the board, this process advantages those with greater budgets and expertise to draw upon, while incurring significant losses for smaller operators and authorities when bids are unsuccessful.

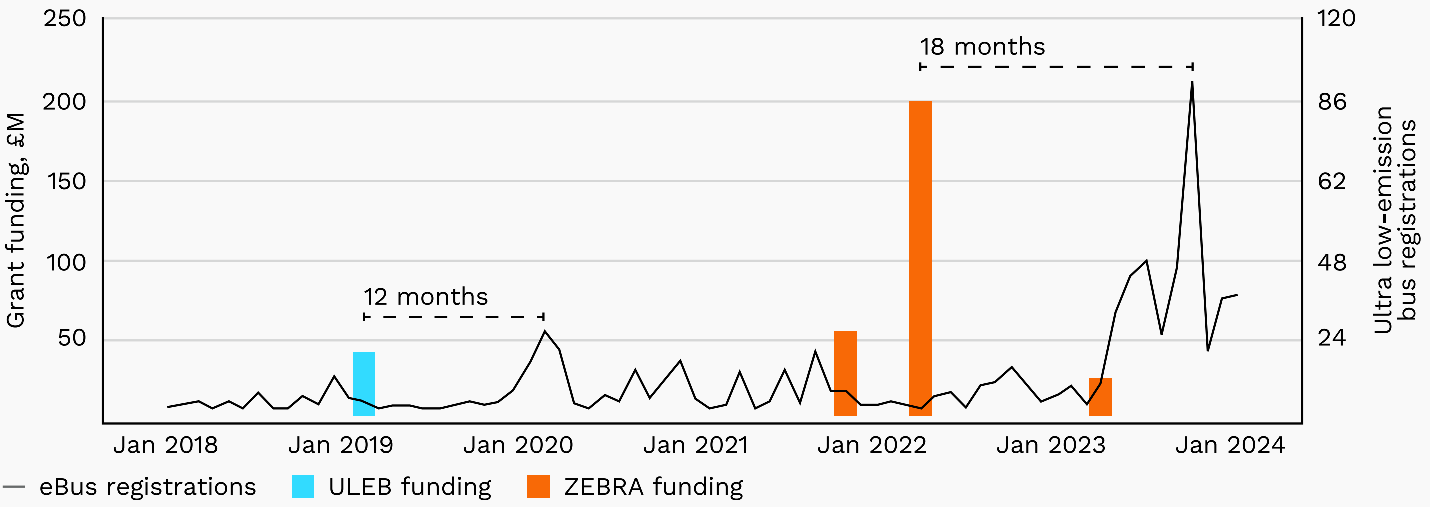
Solution

Rather than run another ZEBRA or ScotZEB round, the Government should instead focus on BSOG reform that drives the transition through reducing the residual value of existing diesel buses – and thereby making a rapid switchover more appealing. Devolved administrations in Wales and Scotland should do the same with the BSSG and the NSG respectively.

The Government currently spends about £200m per year on BSOG, split between support for electric buses and diesel buses. Government should look to increase the value of BSOG for electric buses to £0.50 per mile within a year while tapering the diesel BSOG for existing Euro 4, 5 and 6 models to zero by 2032, giving newly bought vehicles time to amortise residual value. Our analysis indicates that while electric BSOG rates will need to decline towards the end of this period in order to maintain spending at current levels, it will be adequate to drive diesel almost entirely out of the market beyond a few specific long-haul routes.

This would allow operators and manufacturers to make long-term business cases to deliver decarbonisation, giving scope to secure financing at reasonable terms.

Generous but intermittent subsidies create peaks and troughs in ultra low-emission bus rollout (England, outside London)



c) Speed up buses

In recent years, demand for bus journeys in the UK has been falling, even prior to the COVID-19 pandemic, with a 19% decrease in bus vehicle miles and a 39% drop in passenger journeys in Great Britain in the last decade. This is correlated with cuts in bus services in the same period, but also a clear fall in bus speeds since 2005, particularly in urban areas.[8]

As well as putting more buses onto roads, tackling congestion and speeding up bus journeys will get passengers back on buses. Congestion means operators need to put on more buses to maintain frequency with the same or lower number of passengers, eating into their bottom line. This puts pressure on operator profit, leading to fare increases and decreased consumer satisfaction.

To reverse this decline in passenger numbers, we need to:

a. Secure the long-term future of the BSIP system (and devolved equivalents)

b. Encourage local authorities to prioritise buses in road planning and improve general passenger experience

Securing the future of BSIPs

Since the 2021 National Bus Strategy (NBS), the Bus Service Improvement Plan (BSIP) has been the key measure to enable local authorities in England outside London to introduce bus improvement measures, alongside the £2 fare cap. Scotland has a similar scheme in the form of the Bus Partnership Fund while Wales has had the Bus Transition Fund.

The BSIP model requires local authorities to submit comprehensive yearly plans for bus service improvements in their area, which are then evaluated and awarded funding on a competitive basis. This includes improving bus frequency and reliability, ticketing, accessibility and passenger safety, among other measures.

We've seen a 38% drop in passenger journeys in Great Britain in the past decade

Zenobē / Cardiff Bus Depot, Cardiff

Zenobē / Nottingham City Transport, Nottingham

The plans made by local authorities have genuine potential to reverse the decline in bus patronage. However, two related issues continue to undermine BSIPs:

1. **An inconsistent and uncoordinated funding structure:** While local authorities will be expected to update BSIPs in 2025, the future beyond that is unclear and there remain large funding discrepancies between authorities.[9] According to the Campaign for Better Transport, while all 76 original applicants have now received some BSIP funding, 12 councils have over £50 per head, while 15 councils have received less than £6 per head.[10] Furthermore, the competitive nature of BSIP funding has undermined a cross-regional and collaborative approach to improving footfall, reducing the scope for learning.
2. **The lack of capacity and consistency in local authorities when designing BSIPs:** During the last Transport Committee review of the BSIPs, bus operators noted that smaller authorities struggled to come up with comprehensive and impactful BSIPs without the support of external consultancies. The result has been large variation in the quality of consultation and research processes to inform BSIPs, as well as the ease and consistency of reviewing their success. Indeed, representatives from West Sussex County Council noted that even the DfT group overseeing BSIPs was insufficiently resourced, leading to bottlenecks and implementation delays.[11]

To address these issues, government needs to:

a. Provide clarity about the future of BSIP funding beyond 2025 and restore funding imbalances. This means prioritising authorities who have received relatively little BSIP funding so far in future allocations. The same principles should apply in Scotland and Wales.

b. Set up a Bus Service Improvement Taskforce made up of operators, local authority representatives and passenger groups to share learning and best practices as BSIPs are rolled out. This will help address inequality of capacity and expertise.

Local authority measures

Whether they have adequate BSIP funding or not – and taking account of local conditions – local authorities should, at the least, look to include the following bus priority measures to speed up buses and improve passenger experience:

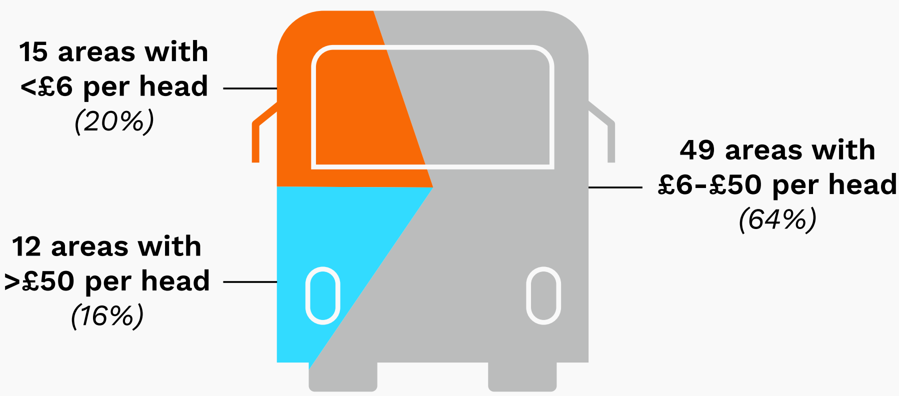
a. Priority bus lanes, allowing buses to move more quickly along congested roads. This could be further enhanced by increasing speed limits for buses in these lanes.

b. Priority signalling at traffic lights, allowing buses to get ahead of traffic.

c. Contactless and integrated ticketing across operators and transport systems, allowing passengers to get onto buses more efficiently.

d. Digital bus tracking, allowing passengers to plan journeys effectively and hold operators to account for poor service.

A clear imbalance between BSIP funding awards per head in different areas of the UK demonstrates the funding discrepancies and inconsistent improvements that drive low passenger numbers



Source: bettertransport.org.uk

The electric future, today

The electric bus should be a cornerstone of transformative public transport policy in the UK. Buses can, with the right support, be up to £120,000 cheaper over their lifetime compared to diesel. This will enable investment in better services while allowing our passengers to breathe cleaner air. By cutting emissions and operational costs, we have an opportunity to renew our public transport networks, connecting communities with economic opportunities while improving public health. But to achieve this, we need decisive action to overcome the barriers we have identified in this report.

While the UK is already electrifying buses at pace – as our indicative case studies below suggest – we cannot afford complacency. Significant hurdles – from declining passenger numbers, to inconsistent subsidies, to unfair energy costs – are putting further progress at risk. There is an urgent need to address these challenges and seize the opportunity to deliver cleaner and more cost-effective transport.

Buses remain the most used form of public transport, and their vital role means they must not be neglected. To rebuild the UK's bus industry and clean up our communities, we must charge towards the electric future.

To rebuild the UK's bus industry and clean up our communities, we must continue to charge towards the electric future.

Case studies

Three cities – Oxford, Coventry and Glasgow – are not the only success stories for the UK but are prime examples of how electrification can be achieved at speed and scale. They highlight the commercial, public health, and environmental benefits of this transition.

Oxford

While London has the greatest overall number of electric buses with over 1,000 in its fleet, other UK cities have made more progress in terms of the proportion of their fleets electrified.

Oxford, for example, has recently introduced 159 electric buses as part of a joint public-private partnership to make it a fully electric bus city. Once operational, only zero-emission buses will run through the city centre, with bus improvement measures from the council, such as central Oxford traffic filters and improved passenger information, ensuring swift and reliable journeys. Working with two major operators, Oxford Bus Company and Stagecoach, Zenobē has been at the heart of this transition, ensuring that both public and private funds have been used effectively by the operators.

The project was funded via a collaboration between Oxfordshire County Council and bus operators Oxford Bus Company, owned by The Go-Ahead Group and Stagecoach. The Council was awarded £32.8m from the government's Zero Emission Bus Regional Areas (ZEBRA) scheme and contributed £6m directly. Meanwhile bus operators, attracted by the council's commitment to boosting passenger footfall through service improvement measures, invested £43.7m.

Oxford East MP Anneliese Dodds visits Zenobē and Oxford Bus, November 2023.

Oxford Bus Company will deliver 104 electric buses into service and Stagecoach 55. Zenobē invested c.£18m to help Oxford Bus Company to finance and install 104 charging points, each offering 150kW of DC power, at its Cowley House depot and with Stagecoach to install 55 chargers at its Network Oxford site.

The charging hubs are powered by EDF Energy's Oxford Superhub network, providing enough electricity to charge all 159 buses, enough for each bus to drive up to 200 miles per day.

The combined 159 buses powered at these depots will lead to a reduction of 6,500 tonnes of CO_2 emissions per year and up to 50% of NOx (nitrogen oxides) pollution in the most congested areas of Oxford, tackling climate change and improving air quality.

Zenobē has been at the heart of this transition, ensuring that both public and private funds have been used effectively by the operators.

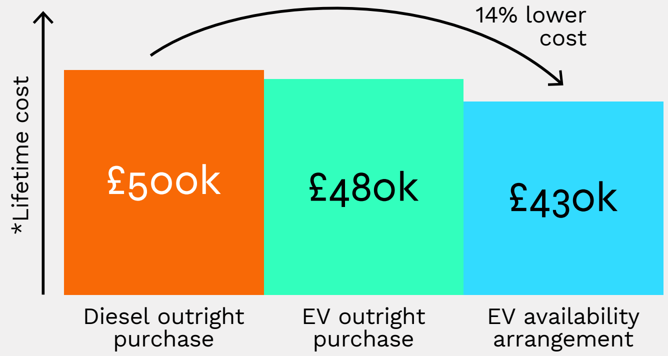
Coventry

Coventry is on course to be the UK's first "all-electric bus city" by 2025, thanks to a so-named subsidy from the UK government. It is another example of productive public-private collaboration and demonstrates the opportunity for electrification outside London.

Supported by a £50m grant from the Department for Transport since 2021, National Express in partnership with Transport for West Midlands (TfWM) and Zenobē have so far introduced 130 buses to Coventry.[12] This added to a previous ten operational since 2020, which had already prevented over 1,400 tonnes of carbon dioxide from entering the atmosphere.[13]

With an organisational goal of achieving a fully zero-emission bus fleet by 2030, National Express were able to build a business case for electrifying, reinforced by the certainty of the government target set in Coventry and solutions provided by Zenobē that reduced upfront and operating costs.

Zenobē developed an end-to-end solution for National Express including financing, batteries, chargers, and management software. In addition to the many environmental and economic benefits of Zenobē's end-to-end solution, this project also seamlessly utilised recycled bus battery cells in an onsite battery energy storage system – a UK first. Recycled bus power cells from Scandinavia that were no longer capable of being used on buses were repurposed into a stationary battery solution, powering electric vehicles. Zenobē's new application will allow the battery life to be extended by around 30%, resulting in less waste and lower replacement costs.



*Lifetime cash outflows for a double-decker bus in the UK, including the initial purchase outlay, any ongoing availability charges, and all running costs, including fuel, repairs, and maintenance. It excludes any grants or funding. All discounted back to present value.

Source: Full Year Results Presentation 2022 - (mobicogroup.com)

Zenobē's electric transport-as-a-service solution will deliver a 14% cost saving over the electric fleet's lifetime vs. diesel

Glasgow

McGill's Buses, based near Glasgow, has Scotland's largest proportion of zero-emission buses with 110 on the roads (one quarter of its overall fleet). Supported by both public subsidies such as ScotZEB and Zenobē's unique funding services, McGill's has delivered lower emissions and cleaner air through cost-effective electric buses. Its recent operations in Glasgow and around the West Scotland region, enabled by Zenobē, have been particularly noteworthy. In the most recent collaboration between the two businesses, Zenobē worked with McGill's to bring cleaner air to the communities served by its Greenock, Johnstone and Inchinnan depots, with 41 new electric buses.

Previously utilising Scottish Ultra Low Emission Bus funding (SULEB) funding for Johnstone, Inchinnan and Dundee depots, Zenobē once again worked with the operator, maximising £9 million of the newer ScotZEB fund to expand Johnstone and Inchinnan, and bring electric buses to Greenock for the first time.

Zenobē's unique funding services were ued to bring down the upfront costs of switching to electric. This enabled McGill's to maximise its use of government funding and ultimately purchase more electric vehicles, bringing cleaner transport to the roads of Scotland. This was achieved through full financing of the vehicle and charging infrastructure, as well as Zenobē's battery managed service.

Zenobē also used its strong-track record designing and building charging infrastructure to convert or expand the depots to match its electric fleet requirements, upgrading the grid connections and embedding future plans into depot designs.

In November 2023, McGill's announced that they had hit the milestone of 7 million zero-emission miles travelled by their electric fleet, saving 7,889 tonnes of CO2 from being released into the atmosphere. In comparison, it would take planting 788,917 trees in an area the size of 1,949 football pitches to remove the same amount.

Zenobē / McGill's depot, Johnstone

Zenobē financing and expertise has enabled McGill's to electrify over 100 buses across Scotland.

Annex 1

Methodology

We calculated these statistics using the following sources:

- Bus fleet sizes were estimated using 2023 bus mile data and the average miles per bus for English metropolitan areas, Wales, and Scotland, derived from DfT bus statistics.
- Average bus speeds for regions in England and Wales were derived from National Road Traffic Projections for 2025. In lieu of Scottish traffic projection data, the average bus speed in Wales was applied to Scotland.
- The DfT also provides information on the proportion of buses by year of manufacture for each metropolitan area status and country, from which we derived the average bus age and average number of buses replaced each year.
- Fuel savings and environmental impacts were calculated using Transport Appraisal Guidance (TAG) methods and datasets. Grams per km driven by a bus for each pollutant were taken from TAG Table A3.5, and CO_2 emissions per litre of fuel burnt were taken from TAG Table A3.3. The amount of fuel burnt is determined by the average fuel consumption for each case study area, which was derived from the average speed of buses and the annual distance travelled by a bus. These two variables were calculated respectively from regional traffic projections for 2025 and vehicle mileage and bus numbers and mileage data based on metropolitan area status and country, both published by the Department for Transport.
- Data provided by ZEMO on existing HFC and BEV bus stocks was used to derive the remaining fleet of diesel buses for each location. We use 2026 as the start year for the conversion of the remaining diesel bus fleet.
- Maintenance and fuel cost savings are net of capital expenditure. Both cost savings and avoided emissions figures correspond to the financing period covering all payments for new purchases of electric buses. This is 2026-2051 for English areas and Wales, and 2026-2048 for Scotland, as it takes fewer years to convert the Scottish bus fleet to electric, given the higher initial electric bus stock.
- BSOG is currently calculated at 22p per mile for diesel buses and 35p per mile for electric. Our calculations of the savings of increasing BSOG for electric also assumes the removal of the ZEBRA funding scheme (assumed at £129m every two years, in line with the ZEBRA Phase 2 funding round).

Annex 2

TCO modelling

Support figures that informed the economic modelling in section 2 and 3. Note that lease costs vary on a project-by-project basis depending on factors such as counterparty credit risk, lease period and more.

	Area	Value	Units	Rationale
Electric Asset	Vehicle Price	475,000	GBP	Internal Benchmark
	Charging Infrastructure Price Per Bus (Inc DNO)	60,000	GBP	Industry Standard
	Funding Tenor	180	Months	Industry Standard
Diesel Asset	Vehicle Price	250,000	GBP	Industry Standard
	Funding Tenor	120	Months	Industry Standard
	RV at End of Term	12,500	GBP	Industry Standard
	Monthly Fee	2,884	GBP	Calculation
Maintenance	Electric Maintenance	18,000	GBP	Calculation
	Diesel Premium	30.00%	%	Expert Interviews
	Diesel Maintenance	23,400	GBP	Expert Interviews
Energy	Energy Cost	Variable	GBP	DEZNEZ Data
	Diesel Cost	1.20	GBP	Bulk Diesel Price
	Electric vehicle consumption	1.2	kWh/km	Internal Benchmark
	Diesel vehicle MPG	6.0	miles/gallon	Expert Interviews
General	Discount Rate	7.0%	%	Industry Standard
	Inflation Rate	3.0%	%	Estimate
	Vehicle Mileage	50,000	Miles	Inhouse benchmarks

Annex 3

TCR costs

Support figures that informed the economic modelling in section 2 and 3.

Depot	**Large Depot**	**Medium Depot**	**Standard Depot**
No.s of Meters	2	2	1
Supply Type	HV	LV	HV
Location	8 - Midlands	12 - London	10 - South Wales
TRIADs			
02/12/2022 - 17:30*	249.1	33.7	1.4
15/12/2022 - 17:00*	229.5	36.2	1.3
17/01/2023 - 17:00*	191.5	43.5	1.5
TRIAD Ave Demand kW (all meters combined)	446.73	75.6	2.8
Triad Tariff*	£57.19	£63.69	£58.46
TRIAD Charge	£25,550.41	£4,814.80	£163.69
TCR			
Capacity kVa	6000	2500	1800
TCR Band	HV 4	LV 4	HV 1
TCR Charge £/meter/day**	£210.89	£17.74	£12.71
TCR Charge £/meter p.a.	£76,974.16	£6,476.20	£4,638.49
Total TCR charge per depot	£153,948.32	£12,952.40	£4,638.49
Increase £	£128,397.91	£8,137.60	£4,474.80
Increase %	502.53%	169.01%	2733.64%

* TRIAD periods and Charges taken from the last chargeable period of Apr-22 to Mar-23 published by National Grid

**TCR charges have been taken directly from the Apr-24 to Mar-25 rate book published by National Grid

Annex 4

TCR Costs – Industry Comparison

	Method	TRIADs (kW)	Capacity kVA	TRIADS £/kW	TCR £/Day	Difference	
	Year			22-23	23-24	£	%
South Wales comparison (1 * Band 1 HV Supply 1800kVa)	TNUoS rate			£58.46	£19.17		
	EV depot (normal operations)	2.8	1800	£139.14	£6,996.72	£6,857.58	4929%
	Industrial factory with load shifting (illustrative)	225	1800	£11,180.85	£6,996.72	-£4,184.13	-37%
	Data centre - load shifting not possible (illustrative)	1620	1800	£80,502.13	£6,996.72	-£73,505.41	-91%
Midlands comparison (2* band 4 HV Supplies 6000kVa)	TNUoS rate			£57.19	£300.49		
	EV depot (normal operations)	446.74	6000	£21,718.17	£219,360.40	£197,642.23	910%
	Industrial factory with load shifting (illustrative)	750	6000	£36,461.09	£219,360.40	£182,899.31	502%
	Data centre - load shifting not possible (illustrative)	5400	6000	£262,519.87	£219,360.40	-£43,159.47	-16%
London comparison (2*Band 4 LV Supplies 2500 kVa)	TNUoS rate			£63.69	£23.06		
	EV depot (normal operations)	75.6	1801	£4,092.58	£16,832.63	£12,740.05	311%
	Industrial factory with load shifting (illustrative)	225.13	1801	£12,187.33	£16,832.63	£4,645.30	38%
	Data centre - load shifting not possible (illustrative)	1621	1801	£87,752.22	£16,832.63	-£70,919.59	-81%

Note: Load shifting is based on an entity being able to drop to a baseload of 12.5% of full capacity for the duration of TRIAD warnings. This is not always achievable, with the ultimate goal being to drop to the absolute base load. Max demand is generally around 90% of available supply as good working practice is to allow 10% buffer for unforeseen circumstances.

Sources: National Grid ESO - TRIAD Dates and times; EDF Energy - General TRIAD Overview; Arenko Group - In depth TRIAD Timing.

Endnotes

1. In 2022, rail accounted for c.65bn passenger km versus c.25bn bus and coach passenger km. However, these are small numbers overall - a very large majority of passenger kms (86%) are travelled by cars, vans and taxis. See Transport Statistics Great Britain: 2022 Domestic Travel - GOV.UK (www.gov.uk).
2. Rail factsheet: 2023 - GOV.UK (www.gov.uk); rail - Policy papers and consultations - GOV.UK (www.gov.uk); bus - Policy papers and consultations - GOV.UK (www.gov.uk).
3. The benefits of buses for cities | Centre for Cities; London reaches major milestone with more than 1,000 zero emission buses - Transport for London (tfl.gov.uk); Oxford to roll out 159 electric buses within ZEBRA scheme - Sustainable Bus (sustainable-bus.com).
4. UK leadership of European electric bus market grows in 2023 - routeone (route-one.net)
5. Ending the sale of new, non-zero emission buses, coaches and minibuses - GOV.UK (www.gov.uk)
6. In England and Wales, it takes 11 years to convert an entire fleet to electric, based on the average replacement rate of buses. We examine the savings for the period covering the leasing arrangements of all electric buses bought to convert an entire fleet, assuming a 15 year leasing arrangement, so the total period is 26 years. See Annex 1 and 2 for full methodology.
7. See Annex 3 for a full table of TCR cost charges.
8. Bus Industry Costs in 2023 (cpt-uk.org)
9. Bus service improvement plan - GOV.UK (www.gov.uk)
10. 'Shocking' bus funding imbalance, says Campaign - Bus & Coach Buyer (busandcoachbuyer.com)
11. UK Parliament, Transport Committee, Implementation of the National Bus Strategy: Fourth Report of Session 2022-23, March 2023.
12. 130 electric buses on the roads of Coventry - Zenobē (zenobe.com)
13. First 130 buses ordered puts Coventry on road to becoming UK’s first all-electric bus city (wmca.org.uk)

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