

A SMOOTHER RIDE

Unlocking a green bus
revolution



FOREWORD

There was a time when all the buses in our urban areas were powered by diesel, producing harmful emissions as they noisily ferried passengers around our city regions.

Those times are changing.

Not only have buses become progressively cleaner as emissions standards have tightened, but over the last 15 years or so, we have witnessed the deployment of ultra-low and zero emission buses, helping to reduce emissions from the most used mode of public transport.

But this transition is not happening fast enough. Despite the best efforts of city regions - which are clear in their determination to meeting net zero targets - we face a huge decarbonisation gap when it comes to greening our bus fleets.

There are multiple challenges to overcome in manufacturing and deploying the thousands of zero emission buses – and installing their associated infrastructure - that we need if we are to achieve those ambitious targets.

This report breaks new ground by setting out the opportunity for Government of getting this right, which will not only help green our fleets but provide an economic boost to UK plc. The prize of more zero emissions buses on our streets is huge – not only from an environmental point of view, but also by supporting economic growth through new manufacturing jobs and increasing bus passenger numbers through modal shift from private car use.

Bus manufacturers and operators, and local authorities are coming together to accelerate the deployment of zero emission buses, we now need further support from Government to overcome the decarbonisation gap.

This report is the final instalment of a trio of papers on bus policy entitled 'A Smoother Ride'. It is a logical conclusion to a journey that has seen us first recommend improvements to existing bus legislation, then to examine the role of capital investment in making bus services more efficient, and now to explore how the benefits of zero emission buses can be realised and rolled out more rapidly. Together, these three reports have rightly put the bus front and centre of future public transport policy.

By working together in a collaborative way, across the sector and with Government, we can unlock not just a bus revolution but a green bus revolution, ensuring green prosperity for future generations.

Jason Prince, Director

Urban Transport Group

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About Urban Transport Group

The Urban Transport Group is the UK's network of transport authorities. Our vision is for city-regions, their towns and surrounding areas to be green, fair, healthy and prosperous places, with public transport and active travel options that provide access and opportunity for all.

urbantransportgroup.org

About EY

This report is supported by research carried out on a pro bono basis by EY on behalf of UTG. At EY, our purpose is building a better working world. The insights and services we provide help to create long-term value for clients, people and society, and to build trust in the capital markets.



About the author

Monta Drozdova is Policy and Research Advisor at the Urban Transport Group, primarily working on devolution, bus and light rail policy, and stakeholder engagement.



EXECUTIVE SUMMARY

Back green buses to deliver on Government's missions

Buses are the backbone of the country's transport network and key to enabling modal shift to sustainable, accessible and affordable public transport.

Among the Government's five policy missions¹ is to 'make Britain a clean energy superpower' with the aim of cheaper, zero-carbon electricity by 2030 and 'accelerating to net zero'.

At 26% of greenhouse gas emissions, transport remains the largest emitting sector in the UK. Within that, cars and taxis are the largest contributor to domestic emissions, at 57%. Buses account for only 3% of road transport emissions² but **Zero Emission Buses (ZEBs) have a crucial role to play in achieving modal shift away from polluting private vehicles.** Transport authorities will need to achieve very significant levels of modal shift to realise their overall targets to decarbonise their networks and achieve net zero.

Making it easier and more convenient for people to use the bus plays a key role in achieving strong and sustainable economic growth, another of the five policy missions set by the Government. The bus connects people and businesses to opportunities, reduces congestion and, in doing so, increases economic productivity.

In Metropolitan areas alone, **bus networks are estimated to generate over £2.5bn in economic benefits against public funding of £0.5bn.**³ Around half of these benefits are to bus users stemming from greater access to jobs, training and leisure opportunities.

Furthermore, **the UK's ZEB market and associated supply chains provide the opportunity for a sustainable and long term economic boost.** Similarly, grasping the opportunity to grow the domestic battery industry could not only boost the ZEBs supply chain, but crucially create jobs, grow the economy and increase resilience against geopolitical shocks.

Time to act to decarbonise buses

Our last report, *A Smoother Ride – Can capital investment deliver more efficient bus services?* explored the impact of capital investment in ZEBs, including on patronage growth. Having established the far-reaching benefits of investment in ZEBs, this report brings together evidence and insights from bus manufacturers, operators and transport authorities to set out what action must be taken to unlock an accelerated and sustainable pathway to ZEB delivery.

Our bus networks are in a time of significant change, with many metropolitan areas exploring franchising, the new Government promising reform, and the whole market seeking ways to reverse the trend of patronage decline. Meanwhile, over the course of the last 15 years, operators and authorities have been working towards decarbonising their fleets to achieve net zero commitments.

Though the upfront capital costs of a ZEB are high compared to their diesel equivalents, **ZEBs have lower maintenance costs, longer lifespans, and offer cost savings from increased fuel efficiency. They are also quiet and smooth in operation, offering an enhanced passenger experience, alongside noise reduction and air quality improvement. Travel surveys have**



Credit: National Express West Midlands / Shine Pix

found that passengers have a higher willingness to use a bus if it is electric.⁴

ZEB technologies have now reached a relative stage of maturity that is seeing deployment on bus networks across the country. However, **the task of decarbonising the UK's bus fleets is still significant, with only 4.3% of buses in England being zero emission.**⁵ Elected leaders, city regions, operators and manufacturers agree that bus fleets must be decarbonised, but is there the capacity and the right foundations in place to deliver on this ambition?

Whilst progress has been made over the last decade, in order to achieve the bus fleet decarbonisation targets set by city regions, **the delivery of ZEBs must be accelerated at pace.** Over **15,000 buses across our member areas still need to switch to zero emission operations** – equal to **on average 1,200 per year as a minimum to meet fleet decarbonisation targets.** Expanding the production rate to cover demand across England or even just meeting accelerated UTG member roadmaps would see the domestic supply chain exceed its historic maximum capacity.

Delivery of ZEBs, however, goes beyond the procurement of vehicles, and requires certainty of policy and funding as well as interventions around infrastructure such as grid capacity and charging infrastructure.

UTG members do not yet have the required secured funding to achieve their fleet decarbonisation plans. Currently there are no dedicated government funding streams for ZEBs delivery post 2025.

Meanwhile the task of electrifying depots is complex and requires considerable levels of investment, with lead times for adequate power supply identified as a key risk by authorities, operators and manufacturers alike. The scale of upgrade requirements in certain depot locations is constraining the ability to quickly increase the volume of ZEBs deployed. This could result in multi-million-pound bus fleets going unused whilst waiting for grid connections to be finalised.

Currently there is no clarity over the end sale date for diesel buses, furthermore, the sector lacks a comprehensive policy regarding electric vehicle infrastructure that would support the speedy and affordable installation of necessary charging infrastructure for ZEBs. **Manufacturers have strongly stated that clarity on the discontinuation of diesel buses would provide certainty and confidence to stakeholders, unlocking effective planning and commensurate investment in the right infrastructure.** Clarity on policy would also be advantageous to franchising authorities in forming their fleet strategy, as well as to non-franchising Local Transport Authorities, giving them assurance on timescales of decarbonisation plans.

There is the need for government to provide a clear and holistic pathway to unlocking a green bus revolution, to build confidence in the supply chain and among potential investors.

Cross sector change needed to unlock a green bus revolution

This report explores a set of recommendations that will unlock the delivery of ZEBs to support the cross-sector goal of decarbonisation. These include:

- Providing policy and funding certainty alongside wider pro-bus policy measures to speed up journeys and grow patronage
- Providing a long-term stable funding stream for ZEB procurement and infrastructure provision, also boosting confidence for private sector investment
- Increasing ZEB procurement pipeline visibility to give confidence and enable long term planning and capacity increases
- Boosting manufacturing and delivery capacity and support for the development of local supply chain for batteries
- Exploring viable vehicle, charging and safety specifications to drive efficiencies and achieve economies of scale
- Addressing grid capacity issues and creating a nationally consistent and streamlined process for installing charging and refuelling infrastructure at depots
- Providing support for the latest ZEB innovations, including hydrogen vehicles and repowering of diesel vehicles

There is political agreement amongst decision makers and growing confidence in the sector to deliver. If we are to grasp the opportunity that ZEBs present to decarbonise transport, improve air quality, increase bus patronage and grow the UK economy, action must be taken to accelerate their delivery now.

INTRODUCTION

This report is the third and final instalment of our 'A Smoother Ride' series of papers on bus policy.

The first report in partnership with LGA looked at changes that could be made to the Bus Services Act 2017 to empower local transport authorities to deliver better bus services for the people and places they serve. The second analysed whether capital investment in bus - including ZEBs - can be used to make bus services more efficient, thereby boosting patronage and reducing operating costs, enabling networks and revenue to grow.

This report completes the series, exploring how the benefits of ZEBs can be realised and rolled out more rapidly. It looks at the local and national policy reforms, funding arrangements and manufacturing capacity needed to unlock the delivery of ZEBs and fulfil fleet decarbonisation goals.

Methodology

This report is supported by research carried out on a pro bono basis by EY on behalf of UTG.

In early 2024, EY undertook a piece of work, interviewing UTG members and ZEB manufacturers to understand the capacity of the supply chain to support the transition to ZEBs. The topics discussed included manufacturing and delivery capacity and associated constraints; standardisation of specification and potential efficiencies; best practices in production and delivery; cost trends and parity of ZEBs versus diesel buses; and domestic supply chain sustainability.

The results of this piece of work were further supplemented by UTG's own analysis of current ZEB requirements across its member areas based on latest Department for Transport statistics, as well as interviews and questionnaires undertaken by UTG with our member authorities, The Confederation of Passenger Transport (CPT) (representing the UK bus and coach industry) and UK Infrastructure Bank (UKIB). For the purposes of this report, Principal Members of UTG were surveyed and interviewed - Merseytravel, Nexus, South Yorkshire Mayoral Combined Authority, Transport for Greater Manchester, Transport for London, Transport for West Midlands and West Yorkshire Combined Authority.

A Zero Emission Bus is defined as:⁶

- *no combustion engine(s) on-board (including diesel heaters);*
- *no regulated emissions from the tailpipe(s);*
- *achieves a 50% well-to-wheel (WTW) greenhouse gas saving compared to a conventional Euro VI diesel*

There are two main types of ZEBs: battery electric and hydrogen fuel-cell.

POLICY ENVIRONMENT

Before exploring city region plans for net zero bus fleets, and manufacturers' capacity to deliver, it is important to first consider the surrounding policy environment for the transition to ZEBs.

In the transition to net zero transport, manufacturers, operators and authorities have all stressed the importance of clear government policy to build confidence in the supply chain and among potential investors.

In 2021, the previous UK Government published its Transport Decarbonisation Plan as part of the UK's ambition to reach its net zero target by 2050. The plan saw commitments to consult on phase out dates for the sale of new diesel cars, alongside pledges for further investment in sustainable travel.

The ban on new diesel and petrol car sales was pushed back from 2030 to 2035, whilst the cut-off date for sales of new diesel buses is yet to be decided on, despite two consultations on the matter.

Manufacturers have strongly stated that clarity on the discontinuation of diesel buses would provide certainty and confidence to stakeholders, unlocking effective planning and commensurate investment in the right infrastructure. Clarity on policy would also be advantageous to franchising authorities (who are looking to purchase fleet) in forming their fleet strategy, as well as to non-franchising LTAs to give them assurance on timescales of decarbonisation plans.

Recommendations:

- Government should provide certainty on the end of sale date for new, non-zero emission buses, to give confidence to manufacturers and empower operators to develop and bring forward plans to decarbonise their fleets.
- The end of sale date must be proportional and be accompanied by a long-term and sustained funding settlement to support the ongoing procurement of ZEBs and comprehensive plan to address charging and infrastructure needs.



In parallel, for an end sale date to be feasible, many other policy components need to be in place, not least ensuring that the grid and infrastructure has the capacity to cope with an influx of electric vehicles. The former government's electric vehicle infrastructure strategy published in March 2022 does not address the needs of buses or other Heavy Duty Vehicles (HDVs).

Recommendations:

- Set a target to mandate the provision of ZEB charging infrastructure in the context of expectations for vehicle delivery.
- Deliver a national charging and hydrogen refuelling infrastructure strategy for buses and other Heavy Duty Vehicles covering both depots and public locations. Such a strategy should recognise the integral role of local and regional authorities, who should be given greater control over the planning of power infrastructure and associated planning tools, supported by adequate upskilling and funding.

Buses account for only 3% of road transport emissions,⁷ but ZEBs have a crucial role to play in achieving modal shift away from polluting private vehicles. Transport authorities will need to achieve very significant levels of modal shift to realise their overall targets to decarbonise their networks and achieve net zero.

Switching to ZEBs alone will not be sufficient to achieve this shift. As such, efforts must be made to support local authorities to implement policies that seek to grow patronage and speed up journeys. Ensuring reliable bus journey times is a key driver for patronage and passenger satisfaction.

As explored in the previous *A Smoother Ride* report,⁸ investment in ZEBs alone could deliver an additional 46 million trips and 33 million vehicle kilometres a year, assuming that the anticipated operational savings from ZEBs are reinvested into service improvements (which is not guaranteed in commercial markets).

The boost to patronage and mileage is higher still when investment in ZEBs forms part of a package of interventions. Combining investment in ZEBs with bus priority schemes and maintaining enhanced revenue funding beyond the current cut off of April 2025, could add an additional 126 million trips and 88 million vehicle kilometres a year by 2035/36, in comparison to where we predict the market would be otherwise under a 'do nothing' scenario'.

Recommendation:

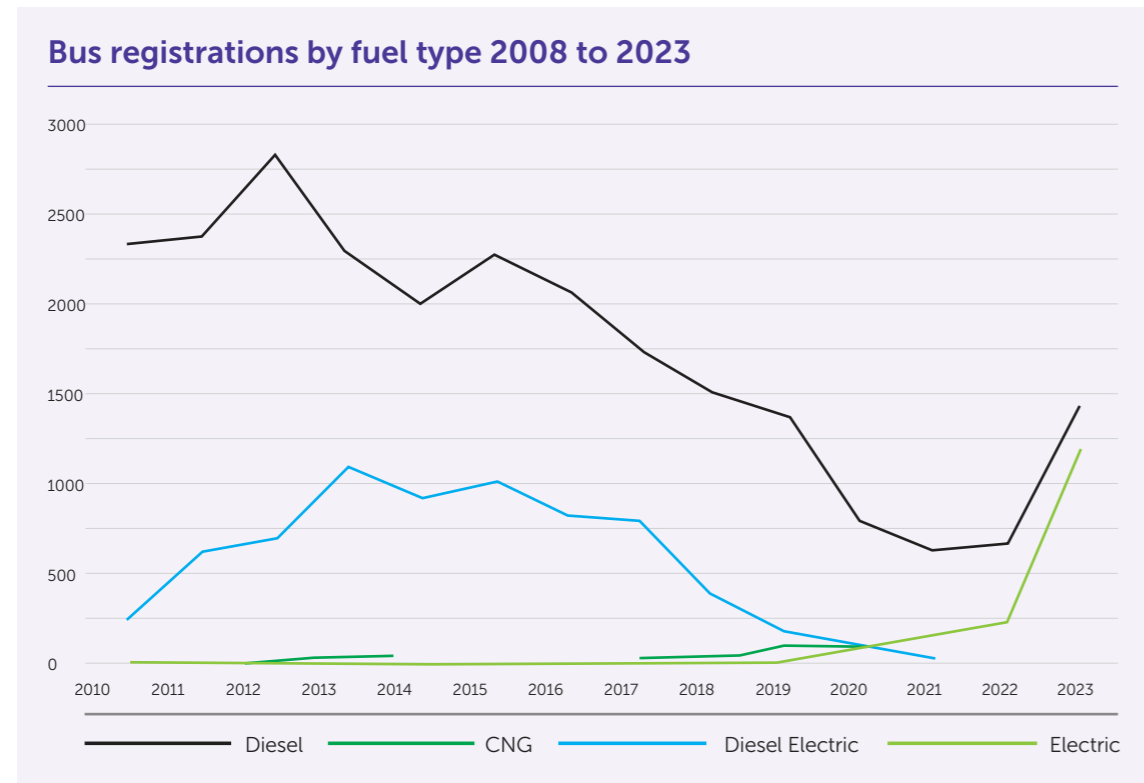
- The government must advocate for modal shift away from private cars, championing pro bus policies and bus priority measures as part of a broader narrative to promote public transport and active travel as a means to helping achieve net zero and economic growth.

Progress on ZEB rollout so far

The speed of ZEB roll out has increased over the last decade. With the support of government funding, UK operators have been deploying zero emission buses for around 15 years, the majority being battery electric and, less frequently, hydrogen fuel cell.

In 2023, electric or hydrogen buses accounted for 45% of new single and double decker bus registrations in the UK – almost treble the new car market share. The UK is now considered to be Europe’s biggest ZEB market by volume.⁹

The boost in registered vehicle numbers, set out in the graph below, must, however, be caveated by the impact of the Covid-19 pandemic on the UK’s bus networks, manufacturing and supply chains. The significant recent uptick is partly down to ‘catch up’ from the pandemic, although the trend has continued, with 322 zero emission models entering service in the first quarter of 2024, up 22.9% on quarter one last year.¹⁰ Electric bus registrations are now catching up with diesel registrations.



The table used is from SMMT 2024 report Next stop Net Zero the-route to a decarbonised UK bus market

Whilst this progress is welcomed, the ambitious targets for bus fleet decarbonisation set out by transport authorities across the country, will require an acceleration in the delivery and roll out of ZEBs.

GREEN FLEET ROADMAP

According to the latest available DfT Bus Statistics,¹¹ by the end of March 2023 around:

- 30,200 buses were in operation across England, 16,500 of which were in the English Metropolitan areas and in London
- 1,200 of these were ZEBs, of which:
 - 1,000 were ZEBs operating in London;
 - Over 200 were ZEBs operating in the Metropolitan areas;
- A further 100 ZEBs were operating elsewhere in England.

	London	English metropolitan areas (outside London)	Total England (inc London and Met areas)
Total fleet size	8,800	7,700	30,200
Number of ZEBs as of April 2023	1,000	215	1,300
% Electric	11.1%	2.5%	4.2%
% Hydrogen	0.2%	0.3%	0.1%
% ZEB total	11.4%	2.8%	4.3%

This leaves an estimated 29,000 buses in England still needing to switch to to zero emission operation to achieve a fully zero emission fleet. Of these, around 15,000 ZEBs are required in London and the Metropolitan areas alone.

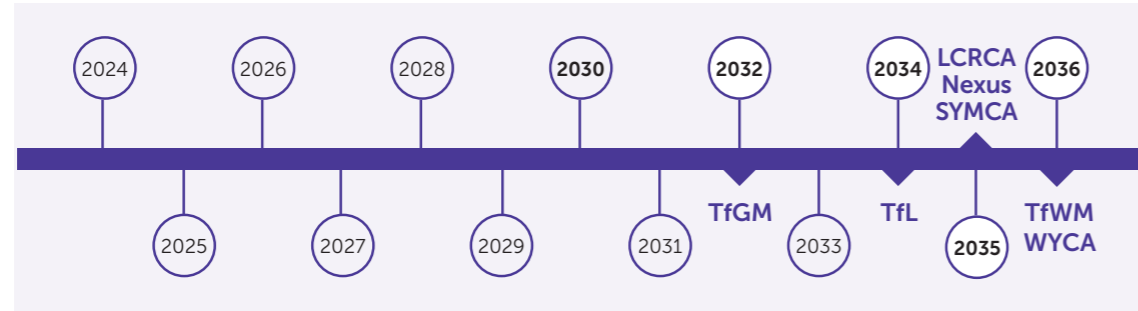
	London	English metropolitan areas (outside London)	Total England (inc London and Met areas)
Number of buses left to switch to ZEB	7,800	7,485	28,900

Since this data set was released, estimates suggest around 900 extra ZEBs have been delivered in London and the English metropolitan areas (the majority of these in London). On top of this, an order of around 1,000 more ZEBs has been made for London but is yet to be delivered at the time of writing. Across franchise operators in GM, a significant number of ZEBs will be deployed over the course of the next two years.

It is also important to note, however, that not all of the ZEB requirement may need to be fulfilled by entirely new vehicles. Many of the existing diesels in the fleet are relatively new and could be candidates for ‘repowering’ – converting them to electric running – explored later in the report.

The scale of the challenge

All of UTG’s seven Members have committed to becoming Net Zero, and therefore operating a fully ZEB fleet, **by 2036 at the latest**, as summarised in the timeline below.



Member target dates remain open to changes. For example., TfL plan to accelerate their roadmap by four years to 2030, if funding becomes available. The majority of UTG members plan to adopt either a fully or predominantly electric fleet. Liverpool City Region Combined Authority (LCRCA) is the only member pursuing a partly hydrogen fleet. Although until issues encountered in the initial hydrogen bus trail are addressed, battery Electric Buses will be the preferred vehicle type for Liverpool.

It is also important to acknowledge that the majority of large bus operators have their own zero emission targets in place.

- **First Bus** committed to not purchasing any new diesel buses beyond December 2022 and are committed to operating a zero emission bus fleet by 2035
- **National Express** have a target to operate zero emission buses only by 2030
- **Go Ahead and Stagecoach** have committed to zero emission bus only fleets by 2035.

It is expected that smaller bus operators will need more support to transition to ZEBs and remain competitive as the wider sector decarbonises. Private operator plans will support the nationwide switch towards ZEBs, with operators and transport authorities on the whole engaging jointly to deliver on their zero emission targets.

The decarbonisation gap

With over 15,000 buses yet to be decarbonised in London and the Metropolitan areas alone, to achieve our member targets for zero emission fleets by 2036, would require around 1,200 ZEBs to be delivered per year across these areas. However, as some of our members have earlier targets, ranging from 2030 to 2035, this could mean delivering up to 1,400 new ZEBs per year.

Whilst delivery of ZEBs seems to have accelerated over the last year, it is not yet at a sufficient rate to meet our member’s decarbonisation goals. Therefore, delivery of ZEBs is likely to lag behind the necessary average in the initial years, with a higher number needing to follow in the latter years once capacity is increased, putting even more pressure on manufacturers, operators and authorities.

However, if we are to truly revolutionise the delivery of ZEBs to the market, it is **imperative that a whole industry approach is taken to achieve decarbonisation targets. This is why it is important that the new government works with the bus and manufacturing sectors**, urgently providing policy stability and support in securing the required funding for ZEBs which in turn will help maximise the benefits of a UK based ZEBs manufacturing economy.

Procurement of ZEBs

The responsibility to procure the bus fleet and associated infrastructure varies between UTG members and has implications for the extent to which they have been able to progress towards their net zero targets.

In London, operators are responsible for procuring ZEBs which must meet the enhanced standards set by Transport for London (TfL). All buses across the capital are now ultra-low emission and more than a thousand are zero emission. Similarly, franchising in Greater Manchester is enabling Transport for Greater Manchester (TfGM) to specify standards for the vehicles serving its routes, with operators responsible for procuring these.

Transport for Greater Manchester

In Greater Manchester, under the new franchised model, TfGM specifies which services are required to be operated using ZEBs and operators provide the required fleet to specifications.

Under franchising, TfGM now either owns or leases the strategic depots and has overall responsibility for depot electrification and the roadmap for electrification.

Operators are free to either own or lease vehicles, provided that they can comply with the requirements of the franchised contracts.

To facilitate the transition to franchising, TfGM directly procured a proportion of the fleet required for Day 1 operations across a number of franchises. In particular, it procured 100 ZEBs to be used across first two tranches of contracts from day 1 of operations. Operators are in the process of procuring more ZEBs that will be deployed across all three tranches.

TfGM has procured ZEBs via a Crown Commercial Service framework, citing advantages in reducing the overall burden on the public sector to run a full procurement process, but it does mean that choice is limited to the manufacturers on the framework. Although the list is relatively comprehensive, there are some ZEB manufacturers in the UK market that are not on this framework.

In areas operating under a deregulated model, private operators largely independently procure and decide the composition and specification of their fleet.

However, with all UTG Members now exploring or actively pursuing a franchised model, they will have a new level of control over fleet composition and specification to reach net zero, but questions remain as to whether available funding can support their ambitions.

FUNDING

The majority of ZEBs in operation have been purchased with the support of government funding streams and have been taken up by the 'Big Five' bus operators (Arriva, FirstGroup, Go-Ahead, National Express, Stagecoach). **UTG members do not yet have the required secured funding to meet their committed Net Zero target fleet decarbonisation plans.**

Long term certainty of funding streams is key to ensuring ZEB delivery can be continued and accelerated. Piecemeal funding opportunities are not going to deliver the wholesale change committed to by transport authorities and central government.

This section explores the funding opportunities and challenges of ZEBs including costs, main funding streams and possible alternative financing approaches that could support the achievement of Net Zero roadmaps.

ZEB versus Diesel vehicle costs

A new electric bus costs around £450,000 for a double decker, whilst a new diesel costs around £250,000. These are high level averages, as there are potentially significant variations in pricing depending upon factors such as battery size as well as general specification.

Though the upfront capital costs of a ZEB are high, whole-life costs should be the primary focus when assessing cost of ZEBs versus diesel vehicles. ZEBs have **lower maintenance costs, longer lifespan**, and cost savings from **increased fuel efficiency** compensate for the higher up front cost. ZEBs are expected to have a lifespan of maximum 20 years, with a mid-life interior refurb, and likely battery change, compared to diesel vehicles which have a lifespan of 12 to 15 years.¹² However at this stage the **whole life cost difference remains unclear, meaning that this uncertainty coupled with the higher upfront cost has represented a barrier to operators greening their fleet.**

Manufacturers broadly agreed that upfront capital costs of ZEBs versus diesel will remain significantly different for some time but mentioned that advances in technology, the evolving maturity of the ZEB market, the national drive towards net-zero and lower supply of diesel buses will reduce this difference over time.

One manufacturer suggested that the battery bus market is already adequately established, and the main changes in costs are now likely to be driven by improvements in battery technology. Furthermore, one manufacturer **anticipates the price of battery ZEBs to fall** year on year between now and 2030 to **around 50%** of current prices as a result of improvement in battery technology and supply chain efficiencies.

Funding streams

The main funding streams supporting the procurement of ZEBs are as follows:

- **Zero Emission Bus Regional Areas (ZEBRA) scheme offering £400m in two phases** (2021-2023 and 2023-2025). The ZEBRA grant covers up to 75% of the cost increase from a diesel to a zero emission vehicle and infrastructure. ZEBRA is a competitive grant scheme and future funding is not guaranteed. This lack of certainty makes it difficult to produce a fully costed proposal to transition to an 100% electric fleet. The scheme's lengthy grant application process and short-term application windows have meant that only the biggest operators with the most resources are successful. TfL has not been eligible to enter this funding competition.
- **Ultra Low Emission Bus Scheme (ULEB)** - A competitive £48m scheme available to local authorities and bus operators in England and Wales to help purchase Ultra-Low Emission Buses (ULEBs) and supporting infrastructure from 2018 - 2021.
- **City Region Sustainable Transport Settlements (CRSTS) and Transforming Cities Fund (TCF)** - several members have used their multi year transport settlements to support the roll out of ZEBs. This includes TfGM, who used CRSTS to purchase the first 50 ZEBs for their franchised services.
- **Transport authority funding** - in the case of London, this has been generated primarily from fares as well as subsidy payments to the authority. Since 2021, all new buses entering TfL's fleet have been zero emission, with all funding after 2019 coming from TfL's network funding.
- **The bus service operators grant (BSOG) Zero Emission Bus incentive** - Operators in England can apply for £0.22 /km for zero emission buses via BSOG. With reform of BSOG being currently considered, there is a need to ensure incentives to support ZEB roll out are retained.



The table below sets out the current funding for ZEBs and associated infrastructure secured through a number of funding sources by UTG members. Given, as explored above, not all vehicles are procured directly by authorities, further direct investment above this is expected to be provided by private operators.

Authority	ZEBRA (1 and 2)	CRSTS	TCF	ULEB	Authority	Other*
TfL	N/A	N/A	N/A	£7m	Total cost of bus network operation annually - £2.2bn**	£6m
TfGM	£35.7m	£115m		£5.4m		
TfWM	£28.7m			£2m		£60m
Nexus/North East CA	£7.39m	TBC		£1.66m		£16.3m
LCRCA	£10.4m	£90m	£10.5		£18.3m (LCRCA contribution to electric Zebra 2 fleet)	
SYMCA	£8.4m	£4m				
WYCA	£30.3m	£21m	£4m	£0.6m		

**As the cost of buses and infrastructure are included in the total cost to operate a London bus route – TfL do not split this out or share publicly. The annual cost of the entire bus network is around £2.2bn.

*Other funding relates to Office for Low Emissions Vehicles (OLEV) grant, Greater Birmingham and Solihull Local Enterprise Partnership (GBSLEP) funding, Joint Initiative for hydrogen Vehicles across Europe (JIVE), Coventry Electric Bus City and Levelling Up Fund.

The biggest dedicated funding streams for ZEB delivery have been competitive and short term. This approach to funding and lack of visibility of a long-term strategy for government funding ZEBs, make it difficult for operators and local authorities to effectively plan for long term investment. This also results in fluctuations in order levels which is not conducive to delivering a sustainable supply chain. Competitive bidding rounds are time and resource intensive for both operators and local authorities and rely heavily on local authorities having the necessary capacity and capability.

Currently no further ZEBRA rounds or other funding has been announced to support the purchase of ZEBs. Whilst operators have expressed confidence that they would still continue to invest in decarbonising their fleets, **without commitment to longer term funding, the pace of the transition would slow down significantly.**

Recommendations:

- Set out plans for a longer-term stable funding stream for ZEB procurement, in order to avoid the current boom/bust approach and give confidence to private investors. Extend these funding opportunities to all areas with capacity to deliver.
- Make available an innovation fund for trial projects and evaluating new technologies in live settings.

Potential alternative funding approaches

UTG members have suggested a variety of alternative funding approaches that could be explored, including:

- **Alternative green infrastructure funding schemes or bonds:** The authority issues bonds publicly or privately to raise funding that is used to purchase ZEBs.
- **Concessional loan:** The operator obtains a loan from a public sector financing institution, that is often provided with slightly more favourable lending conditions (compared to commercial loans), such as UKIB and Green Growth Bank. Concessional loans can also be used as part of blended financing and lessor financing whereby manufacturers take out loans to acquire batteries or buses which are then leased out to operators.¹³
- **Operating Lease:** The operator leases the buses from the owner (e.g. manufacturers, private investors, energy providers etc.), and pays for rent, taxes, and insurance. Ownership of the assets sits with the leasing company and there is often the ability for the asset to be handed back to the lessor after a period of time.¹⁴
- **Finance lease:** The authority/operator procures ZEBs which are financed by a financial institution and pays a regular lease payment over the period of the lease. The authority/operator takes on the material risks and benefits of ownership. Similar to an operating lease, the difference is the expectation of the operator purchasing the asset at the end of the lease term.
- **Component leases:** The operator purchases the vehicle but leases the most expensive part of the vehicle, for example electric batteries, hydrogen fuel cells or even charging infrastructure.
- **Bus-as-a-service financing:** An integrated financing package, providing all assets to the operator via a service model, where the operator pays a fee for the availability and use of the asset, on a per mile basis.

Finance lease: Rock Road leasing scheme

In 2024, Rock Rail, the UK Infrastructure Bank and Aviva formed a partnership to provide a new funding platform for zero emission bus financier 'Rock Road'. The partnership committed an initial £100m to fund up to 250 zero emission buses and associated infrastructure.¹⁵

Through this partnership, 60 battery-electric buses were leased to The Go-Ahead Group and deployed on routes throughout London.

Despite this welcome partnership, third party financing has been comparatively small scale up to now, but expectation is that once private investors have more confidence on return and scale, more private investment will become available.

Component lease: Zenobē – battery leasing

Zenobē, an EV fleet and grid-scale battery storage specialist, headquartered in the UK, has developed a long-term debt framework for electric bus fleets. The platform provides financing and managed service offers, including a battery management service that removes battery risk for operators by splitting the ownership of an electric bus between the transport company, which owns the body of the vehicle, and Zenobe, which will own the battery which powers it.¹⁶

Zenobē now supports over 75 bus depots around the world including Transdev Blazefield's Harrogate depot where it will finance 39 fully electric vehicles, including a 15-year battery management service. Earlier this year, the fleet electrification specialist announced the financing of 24 batteries on board Nottingham City Transport's newly acquired fleet of fully electric single deck buses. Both projects utilised Zenobē's financing structure to enhance their Zero Emission Bus Regional Areas (ZEBRA) allocations.

Recommendation:

- Government should lead on expanding alternative financing option expertise sharing across transport authorities and enabling authorities to access the most appropriate mechanisms.

Whilst members and operators are open to exploring alternative financing methods, **long term certainty of funding streams is key to ensuring ZEB delivery can be continued and accelerated.**

ZEBs provide good growth potential and together with strong patronage through other policy measures to support mode shift, present an attractive business case. **Government investment has been proven to leverage private sector investment, with the recent ZEBRA funding scheme attracting around £1.20 of private investment for every £1 of central government investment,** according to CPT.¹⁷

Based on this, **CPT estimate that around £200m of government investment a year over the next five years could leverage in sufficient private investment in new vehicles to achieve a zero-emission fleet by the middle of the next decade.**

Given, however, the various operating and financing models available and being used by transport authorities and operators, **a whole industry approach must be taken to delivering a long term funding solution,** that would enable manufacturing to be accelerated and private investment to be leveraged.

Capital investment in the delivery of the vehicles alone is not enough to ensure that the benefits of ZEBs are realised. Crucially and urgently, the bus industry and transport authorities need long-term revenue funding certainty for service delivery, particularly with ongoing post pandemic patronage recovery efforts. Increased government revenue support during and post-Covid-19 has been vital in sustaining essential bus networks. However, **a number of key sources of bus revenue funding are set to end in April 2025 or remain unconfirmed, namely, BSOG+, BSIP and BSIP+ placing bus services at severe risk.**

Overall certainty and long-term support for bus is crucial in growing patronage. **An increase in passenger numbers will help deliver a sustainable business model and enable more operators to invest in zero emission buses.**

Recommendations:

- Government should help facilitate a whole industry approach to delivering a long-term funding solution.
- Provide long-term certainty of overall bus revenue funding, addressing the funding cliff edge facing authorities and operators in 2025.
- In the case of BSOG reform, continue BSOG uplift for ZEBs, with the rate reviewed regularly to ensure it considers any increases in hydrogen and electricity costs as the demand increases.



MANUFACTURING AND DELIVERY CAPACITY

Supporting UK manufacturing would help to ensure the transition to ZEBs bolsters domestic green jobs and economic growth.

The UK's main bus manufacturers, Alexander Dennis, Switch Mobility (formerly Optare) and Wrightbus, employ over 3,500 people¹⁸ and had manufactured 23% of the ZEBs on UK's roads by the end of 2023.

The UK ZEB market and associated supply chains provide the opportunity for a sustainable and long-term, green, economic boost. Currently only 31% of ZEBs across the UK have been procured from UK based companies. These manufacturers also fulfil international orders and, therefore, require certainty in the likely level of UK demand.

Procurement processes recognise the positive social impact on the UK economy, creating and supporting local jobs across various manufacturing sectors across the supply chain, including in battery production, as explored further in the report.

As part of our research, two UK-based bus manufacturers were interviewed by EY along with two UK importers of buses built elsewhere.

Manufacturing capacity differed across the interviewed manufacturers, ranging from approximately 1,100 –3,000 per year for smaller manufacturers to 36,000 –45,000 vehicles per year for larger foreign based manufacturers.

For the purposes of this research, an assumption was made that, to meet specified net zero targets, around **1,200 ZEBs would need to be delivered in UTG member areas per annum.**

The research undertaken by EY with manufacturers indicated that **the industry does not have material manufacturing capacity constraints.** From the discussions and current roadmap analysis, **the UK supply chain could meet the UTG member requirements for decarbonising their fleets. Manufacturers would, however, need certainty of forecast numbers to be able to invest in the required resource and capacity to deliver this.**

All manufacturers mentioned a capability to step up manufacturing if required, by increasing manufacturing shifts, as they have the labour capacity and expertise to do so.

However, expanding the production rate to cover demand across England or accelerating the UTG member vehicle requirements would see the domestic supply chain exceed its historic maximum capacity, and the international supply chain would need to support in this scenario.

Due to the nature of current procurement of vehicles and time limited, short-term funding, orders are often made irregularly and in small volumes. Manufacturers have highlighted this as something that pushes up prices.

Manufacturers have indicated there should be **enough volume regionally to benefit from volume discount benefits at the local authority level,** with operators being able to benefit from a joined-up approach at an authority level.



Credit: Alexander Dennis

Recommendation:

- The Department for Transport, working with manufacturers, operators and transport authorities, should explore opportunities for encouraging operators and authorities make bulk orders across regions to achieve cost savings.

Operators have reported that they are, overall, confident in the supply of vehicles, with the lead time for orders decreasing to around eight or nine months (down from over 12 months) due to increased manufacturing capacity and new companies entering the market. Despite this, operators have experienced some issues with delivery of ZEBs due to IT issues and industrial action, and others have advised of battery shortages which have impacted delivery dates.

Manufacturers highlighted various ways the supply chain should be supported to further strengthen it and bring down the cost of vehicles. These included **early engagement, planning and sustainable funding as critical to a smooth rollout, alongside joined-up forward planning to ensure authorities and operators can place bids at preferred manufacturers.**

The government has committed to establishing a new industrial strategy, with the aim of helping specific industries contribute to economic growth and the green transition. ZEB manufacturing and roll out can play a role in enabling green growth, alongside accelerating the journey to net zero.

Recommendations:

- Support the UK ZEB supply chain by giving confidence through long-term policy and funding to ensure local suppliers can continue to build capacity and support economic growth.
- Recognise the role that ZEBs and their associated supply chains could play in the future of UK manufacturing by considering the sector and the certainty it requires as part of the new National Industrial Strategy.
- The Department for Transport should work with operators to set out advice and share expertise across transport authorities on how the role of SMEs fits into the wider progress towards electrification, including fleet procurement, to address challenges SMEs face compared to larger operators.

Whilst authorities recognise that manufacturers seek clarity on the potential pipeline of demand, this can often be relatively difficult to provide as fleet strategies are in development and funding decisions not certain.

Bus franchising brings further challenges in this respect, as, inevitably, in taking over a network it is not possible to determine a roadmap to electrification with any degree of certainty until there is greater clarity over the key constraints.

TfGM, for example, now that it is nearing the completion of the implementation of franchising, is in a stronger position to map out its strategy to meet its ZEB targets as it is in possession of all the necessary business intelligence, including on matters such as the capacity to convert depots to electric operations.

Recommendation:

- Transport Authorities should publish annually updated ZEB procurement pipelines, once they have the clarity over their bus operation models, to keep manufacturers abreast of future requirements.

Battery supply

Critical to the production of ZEBs is a reliable supply of batteries. UTG members recently have observed improvements in battery technology, delivering greater mileage per charge. There are, however, risks to a rapid adoption of an evolving technology where a slower implementation might enable technology improvements to deliver greater value.

Some UK manufacturers have a reliance on batteries from Asia, which has led to issues due to post-Covid manufacturing constraints. This has seen some manufacturers look to develop European battery supply chains. **Manufacturers expressed concerns about the lack of realistic and appropriate scale of the automotive battery industry in the UK. They mentioned that better investment in the EU and UK in battery production is needed and would benefit the local and national economy.**



Credit: Alexander Dennis

The UK has not yet entered the battery production market in a significant way. The UK's approach to developing its battery industry has had negative consequences for the sector, driving original equipment manufacturers (OEMs) to look abroad for opportunities to produce batteries, impacting the confidence of the private sector and investors in the UK industry's future.¹⁹

The UK has one factory producing batteries at "giga" scale: a site run by the Chinese-owned AESC in Sunderland, which is capable of producing 2 gigawatt hours (GWh) of battery capacity a year, far short of what will ultimately be needed.

The demand in the UK to satisfy the need for batteries for private cars, commercial vehicles, heavy goods vehicles, buses, micromobility and grid storage is equivalent to five gigafactories with demand rising to ten gigafactories by 2040. This could see 35,000 people employed in gigafactories and 65,000 people in the battery supply chain if these were to be located in the UK.²⁰

Grasping the opportunity to grow domestic battery industry could not only boost the ZEBs supply chain, but crucially also create jobs, grow the economy and increase resilience against geopolitical shocks to the supply chain.

In order to unlock the scale of this opportunity, the delivery of the commitments made in the 2023 UK Battery Strategy²¹ is needed to give the industry clarity and direction, drive research, technology development and investment in growth throughout the supply chain.

We welcome the policy commitments made by the Labour party whilst in opposition in their Plan for the Automotive Sector, including the creation and financing of gigafactories; grid expansion and upgrade; and supply chain capacity increases.²² We urge the new government deliver these commitments at pace.

Recommendations:

- Deliver the vision and commitments made in the 2023 UK Battery Strategy to give confidence to ZEBs manufacturers, enable them to develop local supply chains and local skills, and boost confidence for private investment.
- Implement the recommendations set out in Labour's Plan for the Automotive Sector that will accelerate domestic battery production, develop domestic supply chains and increase grid capacity.

OPPORTUNITIES FOR STANDARDISATION AND EFFICIENCY

One way to make the best use of available manufacturing capacity would be to look for ways to standardise specifications to unlock efficiencies and bring down costs.

Most Local Transport Authorities (LTAs) have different specifications for their bus services and fleets, as well as different systems to accommodate, including for ticketing and vehicle location.

This means that larger bulk ordering is often impractical. However, through interviews with manufacturers, operators and authorities, it has become clear that **there is both scope as well as willingness to share knowledge and seek to achieve specifications that aim for more commonality, particularly on charging and safety.**

Manufacturers, in particular, have expressed positive views around standardisation and the efficiencies and cost savings to be gained. From an engineering and supply side perspective, manufacturers highlight **common specifications leaving them less exposed to parts shortages and making manufacturing more efficient.** Standardisation could **benefit the full supply chain,** as parties could operate on common ground and know what to expect and forecast. This could **increase purchasing power and bring about cost savings to benefit stakeholders involved.**

However, given the current nature of the UK market, which sees different operators - and even the same operators in different regions - **requiring an element of bespoke design, manufacturers have to remain flexible to accommodate varied specification preferences.**

That said, charging and safety standards could represent a helpful jumping off point for greater standardisation and therefore savings.

Safety standardisation

TfL has adopted a Vision Zero target for zero deaths or serious injuries on London's roads by 2041, and for buses an additional target for no one killed in, or by, a London bus by 2030. As part of the goal to achieve Vision Zero, TfL sets safety requirements for new buses entering the fleet to improve bus vehicle safety, both ahead of, and in addition to, regulatory requirements through the Bus Safety Standard (BSS).

Features installed on the buses include Intelligent Speed Assistance technology which limits buses to the posted speed limit, Camera Monitoring Systems that replace wing mirrors to reduce blind spots, occupant friendly interiors to improve passenger safety, and an Acoustic Vehicle Alerting System (AVAS) for quiet-running vehicles to ensure the bus is audible to road users outside the bus. The requirements for AVAS in London, for example, have exceeded the UN regulations by introducing this requirement earlier and through a unique Urban Bus Sound to improve conspicuity. More recently, a responsive AVAS has been introduced, which adjusts the sound levels to the ambient environment to further improve acoustic conspicuity. The most recent requirements for 2024 include Advanced Emergency Braking and a new bus front-end design to reduce the impact in the event of collisions.²³

Currently there is a two-tier safety market – with franchised authorities being able to specify enhanced safety standards, whilst others are working to national minimum standards. Additional features see increased costs of vehicles and their maintenance. However, there is scope to learn from TfL's approach and explore if there any of these safety standards could be adopted across transport authorities, possibly through a higher national safety standard, that could further drive commonality and manufacturing efficiencies in vehicle procurement.

Charging standardisation

AC vs. DC Charging:

Alternating Current (AC) is used to distribute electricity to homes and businesses to power lights and appliances, while batteries – such as those used in ZEBs - require Direct Current (DC) to be charged. To charge vehicles, AC needs to be converted to DC either on-board the bus or in the charging unit.²⁴

Increasingly, larger bus industry groups are moving to DC charging, but for smaller coach and bus companies, AC may remain attractive, considering DC is more expensive (albeit safer and quicker to charge). **Manufacturers have highlighted that consensus around AC/DC charging would help set a clear direction and an industry standard, in order to speed up and simplify the roll out of vehicles.**

Overnight vs. Opportunity Charging:

Depot-based charging overnight mimics typical diesel bus operation and is **currently the most common strategy in the UK.** Vehicles charge continuously overnight before leaving the depot, typically not returning till the end of the scheduled service. 'Opportunity' charging deploys high-power chargers to provide rapid charging at regular intervals such as at the start/end of routes, or at bus stops/stations. Schedules may also allow 'top-up' charging using depot infrastructure for a short period mid-service.²⁵

As with AC versus DC charging, manufacturers said that consensus around overnight and opportunity charging would help set clear direction and industry standard. Whilst manufacturers remain flexible, the general view was that overnight charging seems to be where the UK is heading. Overnight charging systems require heavier battery packs, increasing the energy consumption of ZEBs, whilst opportunity charging systems require smaller on-board batteries.²⁶ Overnight charging can also support balancing the supply for renewable electricity, by providing off-peak demand for renewable power. Opportunity charging systems meanwhile, require higher infrastructure costs, related to the installation of high-powered chargers and the procurement of land in multiple locations throughout the city.

The infrastructure challenges with opportunity charging were highlighted by manufacturers, however, it was mentioned that presence of opportunity charging in the form of 'top up' chargers is likely to remain as a solution in certain areas of the UK.

Our members are individually leading the way in supporting standardisation in charging. TfGM, for example, is rolling out a single charging regime for their bus fleet to provide commonality and is exploring options to modify existing operator infrastructure that is currently using an alternative charging regime that TfGM has inherited. TfGM is rolling out DC and charging is predominantly depot based (rather than opportunity charging), although that does not necessarily mean all charging would be overnight. As electrification is rolled out, the costs/benefits of out-of-depot (i.e. opportunity charging) will be explored and may therefore be deployed in the future. It is expected that this high level commonality will provide ongoing flexibility, which is particularly relevant within a franchise network where TfGM may wish to redeploy fleet between depots to drive network-wide benefits.

Recommendation:

- Work with manufacturers, operators and authorities to obtain a clear direction on viable common charging and safety specifications to drive efficiencies and achieve economies of scale.



Credit: Alexander Dennis

DEPOT INFRASTRUCTURE AND GRID CONNECTIONS

Having procured and manufactured ZEBs, sufficient charging infrastructure must be in place to enable them to enter into service.

As the primary point of charging and hydrogen refuelling is likely to be in the depot, this requires significant investment to install the necessary infrastructure. Charging infrastructure required to support ZEB deployment is bringing together the energy and transport sector, which have historically had limited interaction. Different working practices and regulatory environments means infrastructure deployment can be the most challenging part of the vehicle deployment.

Depot infrastructure installation

Depot-based overnight charging is currently the most common approach in the UK. The cost of installing electric charging infrastructure at a depot is estimated to exceed £29,000 per bus.²⁷ The task of electrifying depots is complex and requires considerable levels of investment. This is particularly the case in depots that may require gantry systems - specifically with Victorian era depots. In addition, the lead time for adequate power supply has been identified as a key risk by authorities, operators and manufacturers alike. **The scale of upgrade requirements in certain depot locations is constraining the ability to quickly increase the volume of ZEBs deployed.**

Connecting to the grid and ensuring sufficient energy capacity at depot, or receiving certification for hydrogen infrastructure, in some cases is resulting in more delays than those associated with the delivery of the vehicles themselves.

Depot capacity is also an issue as the installation of charging infrastructure at depots requires significant space. This can lead to a reduction in vehicles that may be parked within the site of approximately 15%²⁸. Similarly, electrification of depots and fleets is likely to require upskilling of staff given the different maintenance needs of the infrastructure and vehicles.

Emerging safety risks in the roll out of ZEBs must also be addressed, for example, the lack of fire safety guidance at a national level around ZEBs parked at bus depots or underground. This lack of guidance could risk inhibiting the roll-out of ZEBs, as authorities and operators increasingly face risks without sufficient guidance in place.

Recommendations:

- Explore ways of simplifying and creating a nationally consistent process for installing charging and refuelling infrastructure at depots.
- Provide long term certainty over funding streams available for depot electrification to ensure infrastructure is in place and ready to serve accelerated vehicle procurement timelines.
- The Department for Transport to lead on providing further guidance and knowledge sharing around best practice on depot electrification.
- Working with transport authorities and operators, DfT to develop ZEB safety guidance, particularly addressing battery fire safety and vehicle safety at depots.

Depot grid connections and capacity

Grid connection has been highlighted as potentially the most challenging aspect of ZEB deployment, requiring coordination across multiple suppliers and the local Distribution Network Operator (DNO). Existing DNO connection processes have been set up for housing or renewable energy projects rather than more time and space constrained bus depot conversions.

The process for securing additional grid capacity at depots varies, depending on which DNO is responsible for the upgrade, however, the cost of connections and lead in time is significant, taking 12 to 24 months. **This could result in multi-million-pound bus fleets going unused whilst waiting for grid connections to be finalised.**

The logistical and financial implications of accessing the grid are also considerable, with one member reporting that a 2km dig across an urban area would be required to connect a particular depot to the grid, significantly increasing the costs and complexity of the project. Some depots may also be in unsuitable locations and need to move to a more appropriate place on the grid.

The Department for Energy Security and Net Zero and Ofgem released a Connections Action Plan in November 2023, which outlines measures DNOs will introduce to reduce the timescales involved in applying for grid connections. Whilst this is a welcome step and recognition of the challenges faced in the electrification of depots, more could be done. A way of accelerating the process of increasing electricity supplied to depots could be exploring how, working with Ofgem, bus depots could be moved higher up the priority list.²⁹

Transport is just one of numerous sectors increasing their electricity demand. DNOs may not have sufficient power available to electrify every required depot. Increasing capacity in the national grid is a strategic challenge that will only be resolved in decades to come with significant planning and investment.

There is scope to innovate through shared infrastructure use. **Multi modal charging depots could be used by freight, taxis and buses, by creating infrastructure which is dynamically allocated to different user groups at different times of day. Manufacturers spoke positively about the opportunity of multi-modal charging as a way to increase efficiency and cost-effectiveness of charging infrastructure. Buses have a three to four hour charging window, leaving potential free time during the day for other EV road users.**

Shared infrastructure does have challenges. Because of the fluid way that assets are used, it can be a challenge to know how to charge for the electricity used without creating additional barriers. Shared charging can also increase safety and security challenges, given the responsibilities of the main depot occupier in respect of health and safety. Introducing uncontrolled variables, such as vehicles left unattended or blocking spaces designated for buses, could disrupt operations and create significant safety hazards. Moreover, new users unfamiliar with the depot's strict safety protocols could elevate the risk of accidents, potentially compromising the highly controlled environment that operators rely on. These can be addressed before implementing shared infrastructure but do need consideration in planning. Additionally, it may be difficult to communicate and enforce who can use the infrastructure and when.

Upgrading grid connections for every single depot across the country may not be feasible but sharing charging facilities can provide a cost-effective solution for commercial fleets. Locations of depots across the UK are widespread but do exist in clusters around major cities and ports. The existing clustering of depots provides an opportunity for collaborations between operators to ensure sufficient energy is available for their fleet as they transition to zero emissions and also to allow them to share charging facilities where appropriate.

Recommendations:

- Working with Ofgem, Government to introduce a new statutory duty on Distribution Network Operators (DNOs) to prioritise grid infrastructure that will deliver social and community benefit, such as electrification of bus depots.
- Support and accelerate strategic engagement with DNOs to understand the necessary pipeline of investment for enhancing grid capacity.
- Develop a national electrification strategy to set standards and commitments for depot electrification, allowing more clarity and less risk to operators and manufacturers.
- Explore options for developing strategically located shared charging facilities to be shared by multiple operators and vehicle types.



INNOVATION AND ALTERNATIVES TO BATTERY POWERED BUSES

Whilst battery electric buses are the primary vehicles being procured and considered in the ZEB roll out across the UK, it is important to recognise that there are alternative vehicle types and approaches that have been highlighted by manufacturers, operators and authorities in their fleet decarbonisation journeys. This section briefly explores the challenges and opportunities in procuring and rolling out hydrogen buses and the option of repowering newer diesel buses.

Hydrogen

Some of our members are procuring or exploring the procurement of hydrogen buses, which are seen as more appropriate for longer and rural routes. A number of routes operating outside of the urban centres, for example, are longer and with steeper terrain than those which are viable for current battery technology, as well as running through rural locations with limited opportunity charging potential to enable them to top up their charge. **However, the current issues with the hydrogen refuelling network cause reliability and resilience challenges, influencing decision making on technology choices and the speed with which our members can deliver.**

Hydrogen Fuel Cell Electric Buses (FCEVs) provide an alternative zero emission solution to battery electric buses and charging infrastructure. FCEVs offer potentially greater range compared to their battery equivalents, with similar refuelling times to diesel and produce only water vapour at the tailpipe.

Currently in the UK, hydrogen is overwhelmingly produced from fossil-fuel intensive processes—so called ‘grey hydrogen’—which globally accounts for 2% of carbon emissions. ‘Green’ hydrogen, produced through electrolysis using renewable electricity, offers the largest emissions reductions compared to other forms of hydrogen energy.³¹

The UK hydrogen bus market is in its infancy. Therefore, cost benefits would be driven by higher purchase volume. Currently, hydrogen vehicles are more expensive to purchase and run than a battery vehicle.

According to one manufacturer interviewed as part of this research, for the hydrogen market to make progress in the UK, there needs to be an initial order of 200 to 300 buses for the infrastructure to materialise at a level that would reduce the ultimate costs.

Members have also highlighted the lack of a dedicated funding stream, for example to conduct trials, as a challenge in procuring hydrogen vehicles, given the high vehicle and infrastructure costs hampering business cases.

Members have explored alternative financing options to access hydrogen vehicles. Merseytravel procured the hydrogen buses through a ‘Partners in Procurement’ Supply of Buses Framework Agreement. Alexander Dennis Limited (ADL) were successful in winning the mini-competition to provide the buses. The hydrogen bus fleet is owned by Merseytravel and leased to two bus service operators in the Liverpool City Region.

However, issues with hydrogen supply saw Merseytravel experience delays with the deployment of their 20 hydrogen buses. This was in part due to global hydrogen supply issues. Operators in England have also encountered challenges with current planning and safety guidance and speed of approvals in deployment of hydrogen buses.³²

Barriers to installing infrastructure for hydrogen continue to present significant challenges. Many of these have been recognised by the Department for Energy Security and Net Zero (DESNZ) as published in *Hydrogen Projects: Planning barriers and solutions research findings*, during December 2023. It is recognised that planning regulations should be updated accordingly so that all hydrogen infrastructure can be effectively approved and implemented. Planning process in other European countries, such as Germany, the Netherlands, is further advanced – offering more efficient and straightforward processes with fast turnaround times and early engagement – putting the UK at a competitive disadvantage.

The number of public hydrogen refuelling stations in the UK remains inadequate for a hydrogen bus roll out at scale, with only nine currently in operation - seven for cars and two for buses. There are currently fewer hydrogen refuelling stations than in 2019, when there were fourteen such stations.³³ Stations were closed due to lack of demand and because of the expense involved in producing hydrogen in volume as a fuel.

Recently plans have been approved to build one of the country’s biggest hydrogen refuelling stations in Bradford, with development expected to be completed by 2025. The facility at the Birkshall gas storage site will have the capacity to produce about 12.5 tonnes of hydrogen per day. The site could achieve the decarbonisation equivalent of removing 800 diesel-fuelled buses a day from West Yorkshire’s roads.

For hydrogen infrastructure, significant cost savings can be achieved at scale, where costs become comparable to high power DC charging once a fleet size reaches 50-60 vehicles. Higher volumes will result in a lower unit cost of hydrogen.

Recommendations:

- Speed up the commencement of hydrogen transport hubs across the UK with a roll out strategy for a network of national hydrogen refuelling infrastructure.
- Update planning regulations accordingly so that hydrogen infrastructure can be more efficiently approved and implemented.
- Give certainty over the supply of green hydrogen for bus and coach operators and ensure operators can access shared refuelling sites.
- Provide financial support to roll out alternative fuels and undertake hydrogen bus trials.

Repowering

Zero emission “repowering” is the process of converting an existing diesel bus into a zero-tailpipe emission vehicle. The process involves the complete removal of the existing diesel powertrain and replacing it with an entirely zero-emission powertrain. Repowering sees the reduction of 5-10% of space on board for passengers but is approximately half the cost of buying a new battery powered vehicle. This may not be a suitable option for buses aged over 7-9 years old due to structural warranties and depreciation over the remaining life of the vehicle.

Repowering technology is evolving but it is currently very new. **If this technology is proven and is found to provide value for money, it may provide an effective means of transitioning to ZEBs without disposing of the existing diesel fleet.** This is particularly important given that a large number of diesel vehicles in service are relatively new. Repowering could offer a cost-effective solution instead of disposing of these vehicles early. From an environmental point of view, it represents the opportunity to reuse existing assets rather than incur the additional emissions associated with manufacturing new vehicles from scratch.

Despite these advantages, concerns over safety, the age of vehicles being repowered and whether correct products are being purchased to enable the repowering process remain, particularly considering the service is typically being offered by third party companies not OEM manufacturers.

Some operators are trialling repowering, and recognise the potential opportunity it provides, however concerns remain about its impact due to the issues many have experienced with retrofitting to Euro VI standard. It is widely believed that it is too expensive at the moment for SMEs, and there could be no business case without significant government funding to support repowering.

Recommendation:

- Explore support for repowering trials to achieve assurance that the process is safe, the supply chain is robust and to assess the relative operational performance of repowered vehicles.



CONCLUSION

The progress made in the last decade in decarbonising the UK's bus fleets, particularly those in our city regions, is to be welcomed. However, the road to fully decarbonised fleets is long, and with locally set net zero deadlines fast approaching, the roll out of ZEBs must be accelerated.

The speed of ZEB roll out has increased significantly over the last decade, with the UK now leading the way in the zero emission bus market. Despite this progress, only 4.3% of buses in England are zero emission. This leaves over 15,000 buses left to decarbonise across our member areas and over 28,000 vehicles across England.

Whilst progress has been made over the last decade, in order to achieve the bus fleet decarbonisation targets set by city regions, the delivery of ZEBs must be accelerated at pace. Over 15,000 buses across our member areas still need to switch to zero emission operations – equal to on average 1,200 ZEBs delivered per annum to meet targets. Currently UTG members do not have enough secured funding to meet their committed Net Zero target fleet decarbonisation plans.

Expanding the production rate to cover demand across England or meeting accelerated UTG member roadmaps would see the domestic supply chain exceed its historic maximum capacity requiring the support of the international supply chain to meet demand.

There are also significant issues present in the various stages of ZEBs roll out – from procurement to electrifying depots. In order to create an accelerated and smooth roll out of ZEBs, the local supply chain must be strengthened and issues with the current funding approach, grid capacity, charging infrastructure, and lack of policy certainty must be addressed.

The challenge ahead is considerable and time is running out. With the manufacturing sector confident they are able to step up to meet the demand and authorities and operators ready to face up to the challenge, positive rhetoric and potential now must be supported by the right funding, policy and engagement instruments. Without urgent progress across all of these policy areas, it is unlikely that current decarbonisation targets will be met.

Bus and coach only contribute 3% of total transport emissions. Therefore, it is crucial to view the decarbonisation of bus fleets in the wider policy goal of modal shift. A joined up policy programme across transport modes that would support transport authorities in delivering integrated, sustainable, accessible and affordable public transport solutions must be at the core of this challenge.



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Wellington House, 40-50 Wellington Street, Leeds LS1 2DE

T 0113 251 7204

E info@urbantransportgroup.org

www.urbantransportgroup.org