



# Road map to zero

The transition to 100% Zero Emission Buses, what it means for people, and the journey to get there.

**March 2022**

Bus operators and governments across the UK are taking action to support the shift to Net Zero through the decarbonisation of the bus network. This report explores the opportunities and challenges on the journey to 100% Zero Emission Buses (ZEBs), setting out a route map to getting there.



## Contents

Follow our practical guide to how we get there



## Foreword

**A successful transition to 100% Zero Emission Buses in the UK has the potential to reduce the carbon impact of our transport network. It will help meet national emissions and clean air targets, improve the environment in local communities, support modal shift from cars to buses and active travel for the right journeys, and drive up bus passenger numbers creating a thriving public transport system.**

Greening our bus network offers the opportunity to be a transformational driver for increasing passenger numbers. If we get the transition to Zero Emission Buses (ZEBs) right, over one million brand new regular users can be added to the UK bus network.

This has the potential to transform our communities, taking people out of cars and making public transport the default transport option with huge benefits for the environment. **This report lays out our blueprint for making this vision a reality.**

### Not inevitable: risks if we get this wrong

We should be clear though that this modal shift isn't inevitable – it's dependent on us collectively taking the right approach. There are major risks to bus usage if we don't get this right. Passengers have said loud and clear that while they support ZEBs this can't be at the expense of the core reasons they use the bus.

Passengers need to have confidence that electric or hydrogen buses can perform just as well as diesel buses: that they can be frequent, punctual and reliable.

Most importantly, our research identified that passengers need this to happen without a major increase in fares. Passengers expect the transition to ZEBs to be challenging, and for passenger fares to rise as a result. But they are also clear that while they expect this to be the case, this isn't something they can or will easily tolerate.

If bus fares rise by just 10% to cover the costs of decarbonisation, over 12 million bus users would use services less. If we are to achieve a thriving bus network, passengers cannot bear the costs of transitioning to cleaner, greener buses.

Public transport systems are already under significant financial pressure due to the decline in passenger journeys through the COVID pandemic and even lower bus usage as a result of the costs of decarbonisation will have inevitable consequences. It will undermine the environmental benefits of greener buses as passengers are pushed to greater car usage; the cost per passenger of the transition will increase further; and particular routes could become unsustainable. It's clear that the industry and government face a series of critical choices.



**The prize for greening our transport network: more than a million new bus passengers**

## Foreword

# 40 yrs

Stagecoach has been connecting communities

### A transformational shift in how our bus network operates

For more than 40 years Stagecoach has been connecting communities. In doing this we have also been playing a critical role protecting the environment, helping take people across the country out of private cars and onto public transport. Buses are the most efficient use of road space<sup>1</sup>, with every full double-decker bus taking up to 75 cars off the road<sup>2</sup>. A modern diesel bus produces nearly half as many carbon emissions as an average car<sup>3</sup> per passenger kilometre, with lower emissions per passenger-kilometre the fuller the bus is. Bus operators such as Stagecoach have long had a commitment to greening their fleet, introducing more efficient diesel buses across the UK and trialling emerging technologies including vehicle solar panning, higher bio-diesel blends, fuel additives, and hybrid, biogas and hydrogen fuel-cell powered fleets.

However, now the bus sector needs to go even further by fully removing emissions from the fleet. Stagecoach is targeting a transition to a 100% zero emission UK bus fleet by 2035<sup>4</sup>. We strongly support the Government's ambitions set out in the Transport Decarbonisation Plan, and the decarbonisation measures in the National Transport Strategy for Scotland, Llwyr Newydd for Wales and the National Bus Strategy for England. We are working with local authorities across the UK to turn this into a reality locally. But we know this won't be easy to achieve.

A transformational shift in how bus services run across the UK must be achieved while also maintaining and improving the passenger experience. Bus priority measures, such as bus lanes and traffic light priority, will be important supporting measures to ensure ZEBs can run efficiently. Making sure the correct funding structures, infrastructure and workforce are in place will be critical to ensure we get the transition right and make this a success.



**Stagecoach is targeting a 100% Zero Emission UK bus fleet by 2035**

### Collaborating to get the right outcomes for passengers

We know that to get there, everybody with an interest in delivering this commitment will need to work in partnership: national and devolved governments, local authorities, bus operators, and the supply chain.

We want to play our part. This report represents the next step of our efforts to better understand the challenges and opportunities from this transition, and to work in collaboration to overcome the barriers we face. While we are in a critical position to drive change, we know that we cannot do this alone.

This report outlines what the potential prize of bus decarbonisation is for passengers, the workforce and society more widely, and explore the challenges we need to overcome, with a set of clear recommendations. This is our route map to a 100% Zero Emission Bus network, ensuring that nobody is left behind on this journey.

### Driving forward our recommendations

The starting point for our approach has been to look at the bus decarbonisation challenge through the perspective of the **people** who will be impacted; primarily current bus users, potential new customers, and the workforce. We wanted to understand this challenge through a human lens: what do bus users and those who work in the industry care about, what do they see as the risks and opportunities, and how do they want us to address them. We have then considered the commercial, operational and technical factors that are critical to achieving these outcomes.

Our approach has been action-oriented, looking for practical solutions to the challenges identified. We look forward to discussing the recommendations in this report with all those with an interest in securing the right transition to Net Zero for the UK bus network.



## About us

- Stagecoach is one of Britain's leading public transport businesses, helping connect communities for over 40 years.
- Our team of 24,000 people and our 8,500 buses, coaches and trams are part of the fabric of daily life in England, Scotland and Wales.
- We connect people with jobs, skills and training, bring customers to our high streets, connect tourists with visitor attractions, and draw families, friends and communities together.
- Stagecoach is Britain's biggest bus and coach operator. We run megabus, the market-leading value coach operator, and Scottish Citylink, which connects 200 locations across Scotland. In Sheffield, we also operate the Supertram light rail network.
- We are proud to serve communities in major cities including London, Manchester, Liverpool, Newcastle, Hull, Sheffield, Oxford and Cambridge, as well as rural locations from the Highlands and Islands of Scotland to Wales and south-west England.
- Our impact is about far more than transport - we support the economy, help cut congestion on our roads, protect our environment and air quality, boost safety on our roads, and contribute to a healthier nation.



## Our approach

**We would like to thank those who have contributed to the thinking that underpins this report. The views of policymakers and expert stakeholders have contributed to the richness of our recommendations. As a principle, the specific comments made by these individuals during interviews and our roundtable discussion have not been specifically attributed.**

The conclusions and recommendations in this report have been informed by the following external inputs:

- A representative survey of 2,217 adults from across Great Britain, conducted in November 2021. This naturally included 51% who were not regular bus users (either "never" or only "a few times a year or less") and 49% who were regular bus users (those who used the bus "about once a month" or more frequently).
- Five deep-dive qualitative interviews with selected survey respondents to understand their perspective on bus decarbonisation further.

- Ten interviews with Stagecoach employees, including drivers, engineering staff and depot managers.
- A roundtable discussion with ten expert policy stakeholders, held in November 2021, to discuss challenges to achieving 100% ZEBs and potential policy solutions. Attendees represented passenger, environmental, local government and industry perspectives.
- Five structured interviews with national and local government policymakers to understand their priorities and ambitions for the transition including the Department for Transport, Transport Scotland, Oxfordshire County Council and Coventry City Council.

Details of how we conducted and gathered the research information can be found on the inside back cover of this report.



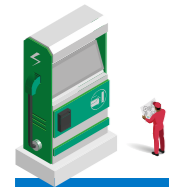
# Progress report: what's happening so far

## Stagecoach's commitment to delivering ZEBs.



# 182

Electric battery buses that Stagecoach is already operating on UK streets



# 95%

Stagecoach has converted 1058 vehicles to Euro 6 emissions standards, that are 95% less polluting than standard vehicles



# 1,184

Stagecoach drivers trained to drive ZEBs, with a further 368 scheduled for training



# £10m

Infrastructure investment Stagecoach has already made in completed and ongoing ZEB projects



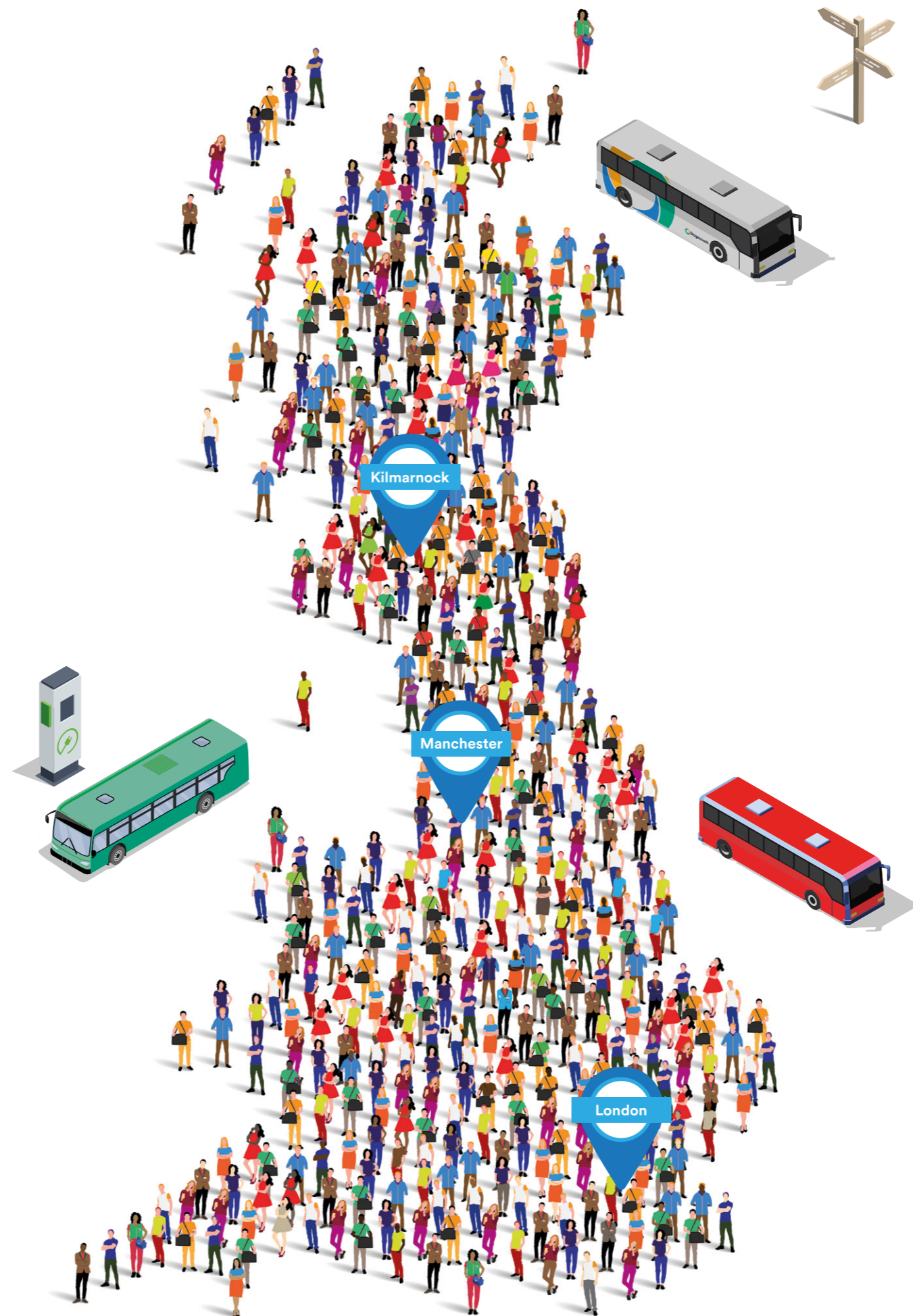
# 8

Zero Emission Bus projects that Stagecoach is currently progressing in partnership with local authorities



# 12

Stagecoach depots converted to accommodate Zero Emission Buses, with more planned for the future



## Kilmarnock

Following an expansion in February of three routes, part funded by Transport Scotland SULEBs Fund, Stagecoach in Kilmarnock currently operates 21 ZEBs. This is 28.7% of its total fleet, showing that it isn't just the big cities that can lead the way in ZEB deployments. It continues to be ambitious and in February 2022 was successfully awarded ScotZEB funding for its bid to add another 10 ZEBs to the depot for use across two routes, while another six ZEBs are being transferred across from Inverness for use once battery upgrades have taken place.

# 28.7%

of the fleet electric

## Manchester

Stagecoach Manchester currently runs 32 Zero Emission Buses across two routes - the 43 and the 111, which goes from Manchester Airport to the City Centre. There are big plans to increase the size of the Manchester EV fleet, as Stagecoach works on a ZEBRA bid that would completely electrify the Stockport depot with 170 ZEBs.

# 32

ZEBs across two routes

## London

Stagecoach London runs 77 Zero Emission Buses, operating six routes from five garages across east and south east London at Barking, Catford, Plumstead, Rainham and West Ham. This number is only growing as every TfL tender responded to includes ZEBs.

# 5

garages operating six routes



# Understanding passenger expectations

The opportunity to grow passenger usage of bus services is central to the National Bus Strategy for England, the Wales 2021 Transport Strategy and the Scottish National Transport Strategy<sup>6</sup>. We agree that driving up patronage should be a primary objective of the transition to 100% ZEBs.

The benefits of our vision for a greener future are not just derived from reducing the emissions associated with buses. They will also come from securing modal shift away from private car usage and onto cleaner forms of public transport for journeys that can be better undertaken by bus. For many people, having access to a car will remain critical for certain journeys, but it may be less appropriate or necessary for others. Modal shift onto buses and the technological transition to ZEBs will need to happen alongside each other, but arguably achieving modal shift can be achieved more quickly – and potentially with even greater impact – than replacing diesel vehicles.

To achieve this increase in passenger volumes – with the fall in patronage during COVID-19 well documented – passengers need to find bus services attractive. This means that new ZEBs – and the journey experiences offered – need to align with the expectations of passengers.

Throughout this report we have shared consumer insight illustrating their perspective on key elements of bus decarbonisation. However, at the outset it is worth understanding what consumers think about the transition generally.

## 66%

of the public think that the move to Zero Emission Buses is a good thing, while only 11% think it is bad

## What do passengers think of the transition to ZEBs?

Two thirds (66%) of the public – across both bus users and non-bus users – support the transition to ZEBs and agree that they are the right thing to do.

The public recognise that there are higher costs associated with ZEBs, but a majority (61%) believe that, even acknowledging this, it is still right to transition to greener buses as the environmental benefits outweigh any increased costs. As we will explore further, this does not reflect willingness for these costs to be passed onto passengers.

While the decision to move to 100% ZEBs is essential to mitigate the environmental impact of the bus network and should not be contingent on public agreement, taking the public with government and industry on the transition to Net Zero is critical. It is therefore worth acknowledging the significant level of public support for this change.

In particular, a transition to 100% ZEBs would see a significant increase in the perception of non-bus users towards buses in their local community. The average rating of local bus companies would rise significantly from 5.4/10 to 7.4/10 - with nearly three times as many non-users giving a rating of 8, 9 or 10 (see graph to the right). As modal shift is a priority for operators and governments alike, improving the perception of non-bus users will be a critical first step.

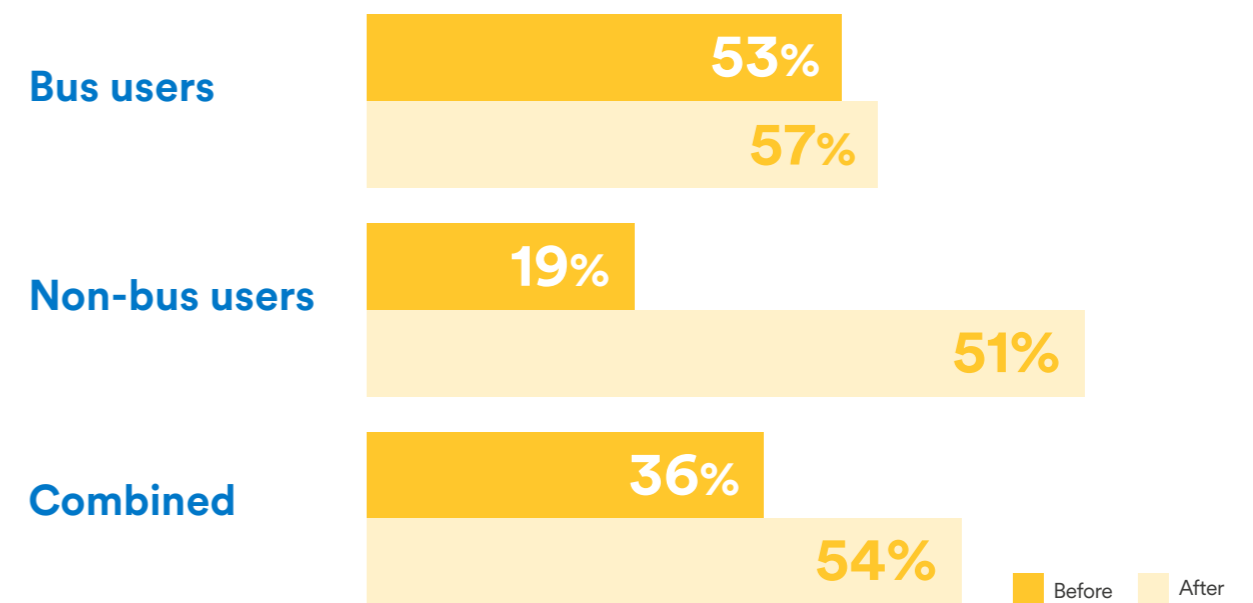
## 61%

of the public believe that the environmental benefits of using a Zero Emission Bus outweigh a higher lifetime cost, compared to 12% against

# How does the move to ZEBs affect passengers' views of their local bus operator?

We asked the public how satisfied they were currently with their local bus operator, and how they expected this to change following the introduction of ZEBs. The graphic below shows how satisfaction is likely to increase significantly amongst non-bus users.

## Respondents with a good impression of their local bus company/ies (8-10 out of 10).



## x2.7

more non-bus users would rate their local operator 8 out of 10 or higher if ZEBs were introduced





## Understanding passenger expectations

### How will the transition impact bus usage?

**Our research shows that the transition to ZEBs has the potential to have a transformational impact on bus usage.**

We asked respondents (both bus users and non-bus users) whether their likelihood of using a bus for travel would increase – and to what extent – with the introduction of ZEBs. We made clear that key factors determining decisions – cost of travel, frequency and reliability of services – would remain the same as they currently are, with the only change being that a new, electric bus would be introduced instead of their current diesel bus. The public told us that they would be more likely to use the bus in these circumstances.

The change in fuel type itself is likely to be only one factor supporting this decision. It is widely understood that new buses can have an impact on patronage, with new services and facilities including wi-fi and charging points acting as a ‘pull factor’ for passengers. However, it is important to note that the rollout of new buses across the UK at this scale is unlikely without the shift to ZEBs creating an incentive to replace buses earlier than planned.

If fares increase even by a small proportion to fund the transition to ZEBs, the likelihood to travel will drop relatively quickly.

# 10%

**with this increase, over 12m people will use the bus less often**



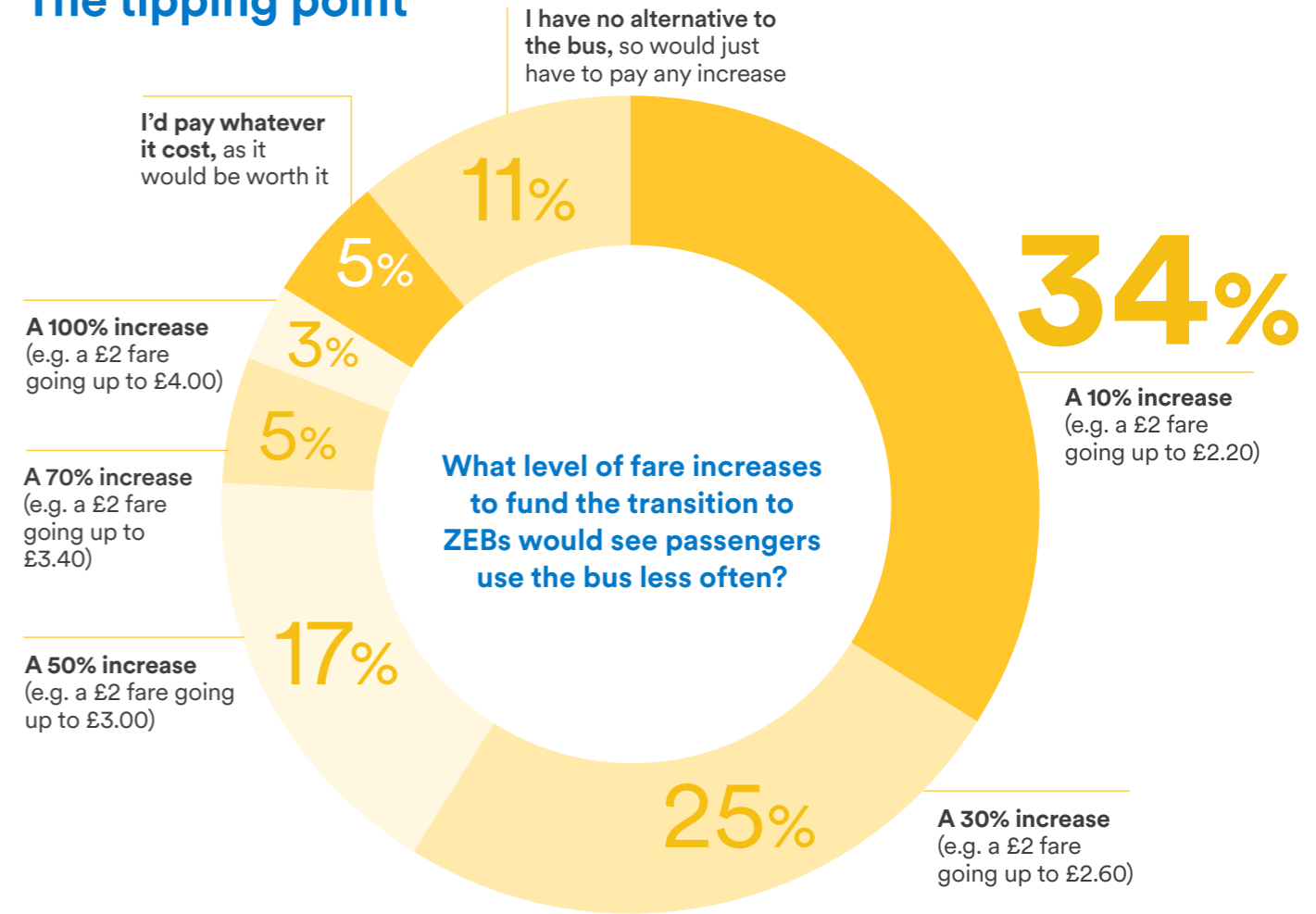
But there are also risks attached with the transition in relation to bus patronage. Our analysis shows that passengers are not willing to significantly increase the amount they pay for travel in order to use cleaner, greener buses. The expectation is that these should be provided at the same cost to the passenger as diesel buses.

If we as a sector – government, operators and local transport authorities – end up passing the increased costs of decarbonisation to consumers, we could see a major drop in bus usage. Fares are already under pressure from increasing fuel, labour and parts costs. With only a 10% increase in fares compared to current levels, over twelve million passengers are likely to use the bus less. This increases significantly with greater percentage increases in fares.

It is worth noting the cumulative effect in this section. Therefore, while a third of passengers would use the bus less if fares rose by 10% due to the introduction of ZEBs, this would rise to 59% if they rose by 30% and 76% if there was a 50% increase.

If those 12m bus users made 5% fewer bus journeys as a result of increased fares, this would lead to 81m (2%) fewer bus journeys, or a reduction in bus use of 462m passenger kilometres, equivalent to travelling around the world over 11,500 times. If all those journeys were done by car instead, this could lead to increased carbon emissions of 40 thousand tonnes of equivalent CO<sub>2</sub> per year (equivalent to 400,000 return economy flights between London and Paris).

### The tipping point



Public sample: Those using bus more than never = 1711

#### Key takeaways

- Our research demonstrates the prize that can be unlocked from getting the ZEB transition right. ZEBs can be a powerful tool to drive bus patronage.
- Between 1.03m and 1.7m extra bus passengers (non-users at the moment) whose usage would increase if ZEBs replaced diesel, and fares + frequency remained the same.
- However, passengers are not willing to significantly increase the amount they pay for travel in order for it to be cleaner and greener.
- If this becomes inevitable there is likely to be a fall in bus patronage. Between 12.4m and 14.3m people would use the bus less if fares rose 10% (e.g. a £2 fare became £2.20).

#### What it means for passengers

- Over a million extra bus passengers will transform the viability of many bus routes, and make a major contribution towards reducing UK transport emissions with the public moving from private car to bus for many journeys.
- Passenger numbers being reduced as a result of the costs of the transition being borne by bus users will have significant implications. It is likely to lead to the cost of the transition to ZEBs being significantly higher per passenger, fares rising, and less popular services - particularly rural routes that will become unsustainable and potentially placed at risk.



# Understanding passenger expectations

continued

Getting the transition wrong will have significant consequences.

# 12.4m

Fewer passengers

Between 12.4m and 14.3m people who would use the bus less if fares rose 10% e.g. a £2 fare became £2.20\*.

# 14.5m

Disappointed customers

Between 14.5m and 16.4m people who would potentially be disappointed if ZEBs didn't improve one or more of punctuality, experience and frequency.



## Get it wrong

Getting the transition right will see a positive increase in passengers.



# 1.03m





Increase in passengers

Between 1.03m and 1.7m additional bus passengers (non-users at the moment whose usage would increase if ZEBs replaced diesel and fares + frequency remained the same).



## Get it right

The wrong approach would lead to:

<p><b>Increased emissions</b> Potential bus users now travelling by car for journeys instead</p> 	<p><b>Higher costs</b> The cost of the transition to Zero Emission Buses being significantly higher per passenger, with costs being passed onto passengers</p> 	<p><b>Drop in service</b> Less popular services particularly rural routes becoming unsustainable and potentially at risk</p> 	<p><b>Job pressure</b> Falling demand in the bus sector and wider supply chain could result in lower employment</p> 
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# 9.05m

Increase in frequency of use

Between 9.05m and 10.7m current bus users would use the bus more if buses became zero emission.

\*A 30% fare increase would prompt 22.6 – 24.7m to use the bus less.



## Understanding passenger expectations

### Paul, 57, from Edinburgh likes to use the bus on his morning commute to enjoy his favourite podcasts

I use a rider app and it's great, you can plot your route and find new times, I find the convenience of using a bus outweighs any negatives of using a bus. The bus I use has a Wi-Fi service which is helpful when I want to listen to my podcasts.

I think if buses went to zero emissions the noise and traffic pollution would be a lot better, we already have emission exclusion zones in Edinburgh, and I think that's a great idea. My only reservation about this is fares, I think they are good value for money at the moment.

**"I find parking difficult in the city centre whereas the bus has stops pretty much everywhere, it's an excellent service"**



### Vicky, 55, from Hull is a pet sitter and uses the bus to get to and from work

I think we all have to do our bit for the transition. I'd be even more encouraged to use a Zero Emission Bus if there was a government provided discount. I wouldn't be able to afford to set up an electric car in my house but do want to do my bit. I have to go all over the place so I can do my job and so the price is really important to me.

Zero Emission Buses would make me feel better about what I'm doing to help the environment. I've also noticed that some of those kinds of buses are usually cleaner and have charging points which I'd prefer on all my buses.

I believe the Government should take responsibility for the transition because they are able to influence a greater amount of change.

**"I'm not in a position to be able to afford an electric car so the bus is the best alternative to protect our planet"**

**The images used are stock images.**  
The bus passengers quoted in this report were interviewed as part of a national study and are not necessarily Stagecoach passengers.





# Overcoming the barriers to 100% ZEBs

# 53%

of the public see the transition as hard for bus operators to achieve

If done in the right way, it's clear that the public support the transition to ZEBs. While they won't accept the cost of this transformational change being carried by passengers, they welcome the industry and government's ambition.

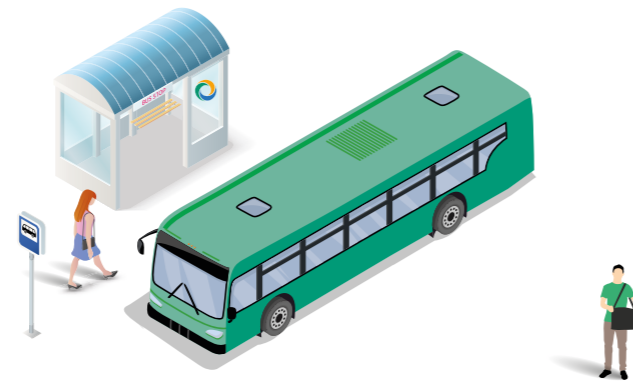
In particular, two-thirds of the public believe that a shift to Zero Emission Buses will improve air quality locally, while 39% believe that it will improve the experience of what it will be like on the bus.

They also recognise that it won't be easy to achieve this. 53% of the public believe that bus companies will find the move to Zero Emission Buses hard, while another 31% believe it will be of a middling difficulty. This leaves only 17% of the public who think bus companies will find the move easy, showing an understanding of the overall challenge faced by the industry.

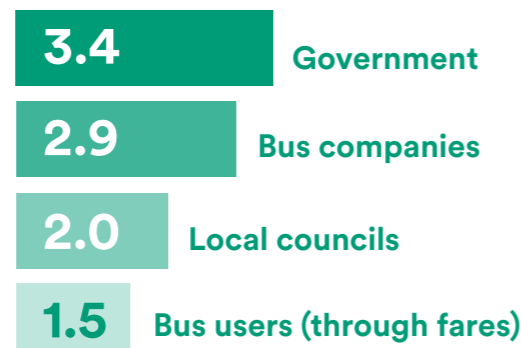
## Who is primarily responsible?

We asked the public who they saw as primarily responsible for paying for the transition to ZEBs. There was significant awareness of the shared responsibility for the delivery of bus services. The public perceived a number of different organisations – most notably bus operators, national and devolved governments and local authorities – as holding significant responsibility for the transition to ZEBs.

The public were given ten points to allocate according to how much responsibility they thought each of the following groups hold for paying for the transition to Zero Emission Buses. The above chart reflects the average score out of ten.



## Who's responsible for paying for the transition to ZEBs?



Ten points allocated per person, giving more points to those who have more responsibility and less (or none) to those who have less. Public sample: 2217

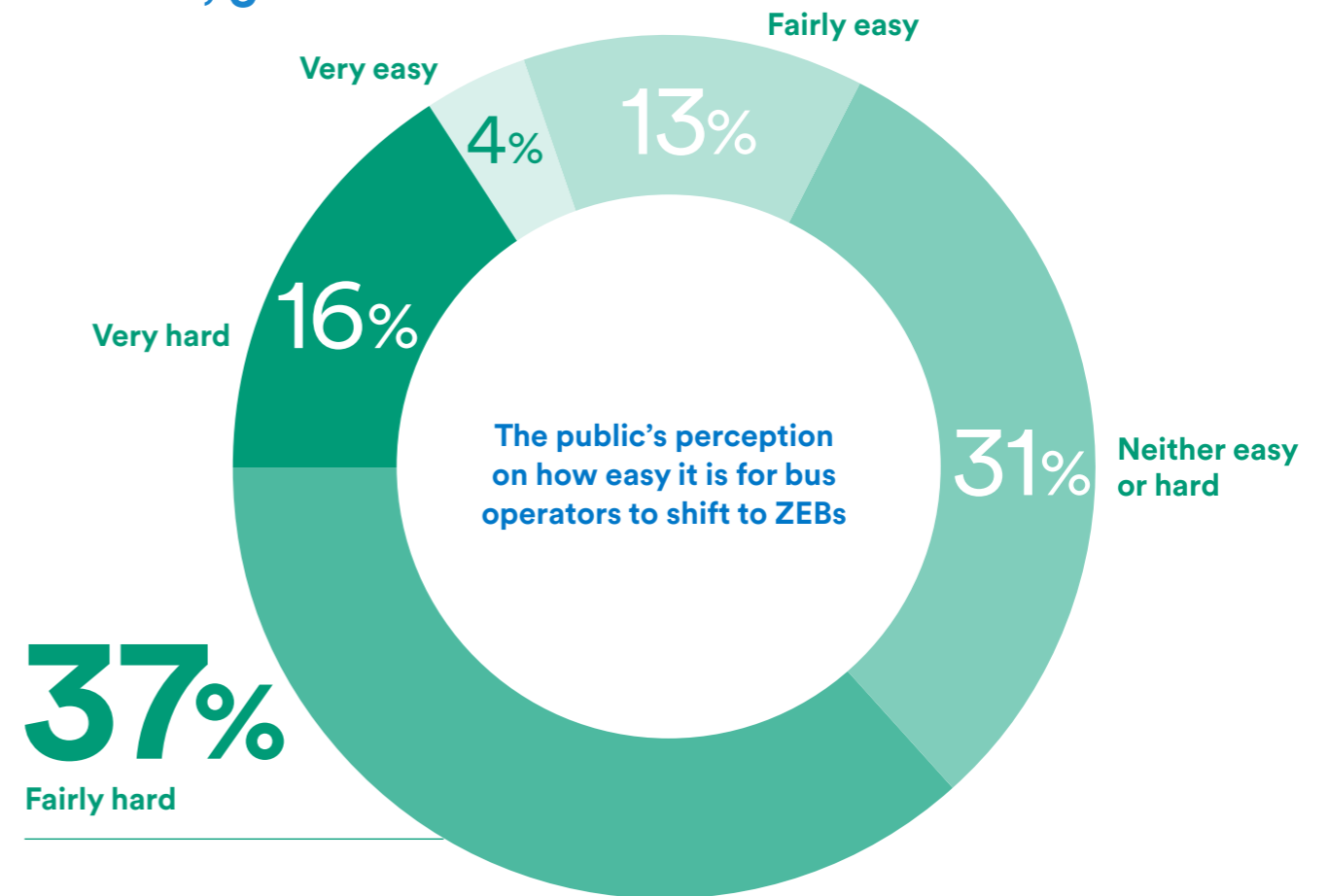
This reflects the reality of the situation on the ground: achieving this mission will require significant collaboration and partnership working both at a policy level and in terms of sharing innovation and best practice at an operational and technical level.

However, it's a clear reminder that the public expect the different stakeholders with an interest in this challenge to work together to solve it.

## What are the barriers that need to be overcome and how do we overcome them?

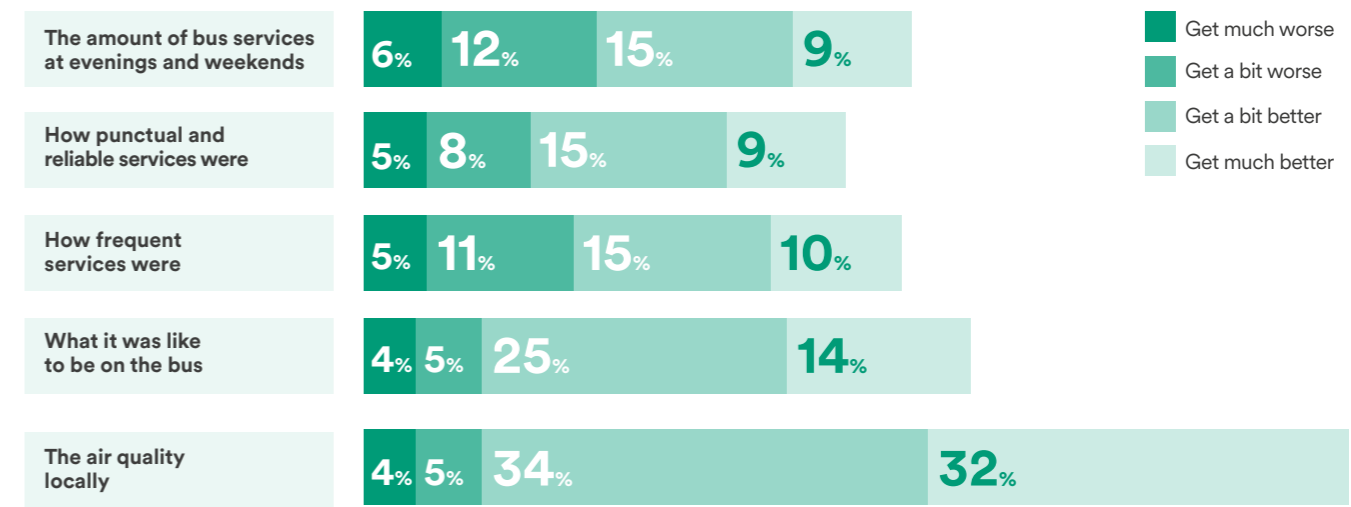
The next sections of this report will look in turn at a number of the most challenging barriers we collectively face, exploring solutions to addressing these. If we can get these three elements - the right infrastructure, upskilling the workforce, and funding we will collectively be in a strong position to meet passenger expectations.

## How easy is it to get to cleaner, greener buses?



## Impact on key factors such as service levels, reliability and cleanliness

As part of the UK trying to reach Net Zero carbon emissions, bus companies are being asked by the government to replace traditional diesel buses with Zero Emission Buses (either electric or hydrogen powered). What impact, if any, do you think a move to ZEBs would have on the following things?



Public sample: 2217



# Infrastructure

At the heart of the transition to ZEBs are the physical assets that will make it possible: the cleaner, greener vehicles and the charging infrastructure to fuel them. These are changes that will have implications for the experience that passengers receive, the reliability and frequency of services and whether buses are commercially viable to operate. This report focuses particularly on battery-electric buses, but many of the challenges will be common to other fuels.

Grid connections to depots, the point at which batteries are replaced and the supply chain for ZEBs may sound like technical issues. But when considering passenger expectations, how these issues are addressed will determine whether the transition to electric buses is consistent with the priorities of passengers: reasonable fares, regular and reliable services and routes in the right places.

## Depot charging infrastructure

Bus depots are already struggling for space. The introduction of Zero Emission Buses, which have greater space requirements, along with charging infrastructure, is only exacerbating this. On average we'd expect each bus to require 25% more depot space. As well as this, the current range constraints of an electric bus compared to a diesel bus means that more buses are often needed to deliver the same service levels, increasing the number of buses in any one depot.

Bus depots are typically already operating with little excess space. This could require bus operators to expand existing depots (where possible) or develop new depots where this is not possible. This will have cost and time implications.

# 25%

**expected increase in additional depot space a ZEB requires through size and charging infrastructure**

# 16MWh

**of power needed to charge 60 buses per day, enough to power 66 homes for a month**

## Recommendation 1:

Local authorities and bus operators should have early conversations over the viability of existing depot arrangements as part of the Enhanced and Bus Service Improvement Partnerships being put in place.

Where further space is required, local authorities (LAs) should look to identify where they can support to ensure the development of this as quickly as possible and at the lowest cost, for example fast tracking the planning development process.

## Grid upgrades

New charging infrastructure is dependent on sufficient capacity in the local electricity grid. Greater electrification across the economy – particularly transport and heat – will see greater demands on the grid, and regional Distribution Network Operators (DNOs) are already taking steps to improve capacity and resilience.

Therefore, while the challenges outlined here are not unique to buses, the electrification of the bus network is likely to add localised pressure, at significant scale. Depots – which on average will need to charge 60 or more buses per day – will need to be able to rely on the local grid to meet this need. A depot of 150 buses would need an electricity connection with at least 11MW capacity (to cover the peaks in charging load), the equivalent of 1,500 homes.

Where ZEBs are already being rolled out, bus operators have taken steps in partnership with grid operators to ensure the local network is sufficiently reinforced to meet these needs. It is clear from the conversations to inform this report that the approach and outcomes have been inconsistent across the UK. This is perceived as one of the most significant barriers to the full rollout of electric buses across the UK.

## Case study: An urban depot where planning challenges threatened the timely installation of grid connections.

When an urban Stagecoach depot sought a quote from a DNO on installing grid connections to support a new delivery of ZEBs, it wasn't clear that it was only based on a desktop study without consultation with the local authority.

When the local Stagecoach team pushed ahead with the project, local authority engagement made clear the routing of cabling was a challenge and initially an agreement couldn't be found. However, by meeting with the local authority on site and walking the length of the proposed route to discuss pinch points, suitable revisions were found and agreed.

This proactive on-site engagement with the local authority meant works were completed in time for the ZEB delivery. However, given that one of the options was to run cables underneath a railway bridge, the need for involvement of other third parties could have delayed the project further.

This shows practical communication between operators, DNOs, contractors and local authorities should take place early in the process to minimise the risk of delays to the installation of important infrastructure.



## What are the specific challenges impacting the rollout of new charging infrastructure and grid upgrades?

Through discussions with those on the ground and informed by the views of our expert roundtable, several specific challenges can be identified:

- Operators perceive **new ZEB grid infrastructure is not sufficiently prioritised by Distribution Network Operators (DNOs)**, with the response to requests for grid upgrades – in some cases – being slow, with insufficient forward planning.
- In many cases **work to upgrade the grid is undertaken by sub-contractors, adding additional complexity to the process**. DNOs feel that they are not brought into the process early enough and want to be perceived as a critical partner rather than a delivery provider.
- **DNOs are restricted in their ability to plan for capacity ahead of time**. This means grid upgrades to depots cannot be future proofed and have to take place incrementally. This is inefficient for all parties. The new RIIO-ED2 regulatory framework proposed by Ofgem for electricity distribution companies will support greater anticipatory investment by DNOs into the electricity network to support the move towards Net Zero, however barriers remain.
- **Cost estimates from DNOs, Independent DNOs and Independent Connection Providers typically only last several months before expiring**. The complexity of the planning and development process for introducing new ZEBs (including applying for funding nationally in partnership with LAs) means that it can typically take 12-18 months to make an investment commitment. In many cases cost estimates have expired meaning that bus operators need to begin the process of engaging with DNOs again. There have also been cases of the increased grid capacity allocated for a bus depot electrification project being reallocated to another party in the meantime.
- **Local authority consent (for planning and street works permitting) for new grid infrastructure can also cause delays**, with a number of cases where permission has been refused or the proposed route has had to be revised to meet LA requirements.



# Infrastructure

continued

## Recommendation 2:

Local Transport Decarbonisation Partnerships should be established between different bus operators, DNOs and local authorities at the outset to ensure sufficient infrastructure is in place to support the transition to ZEBs and to establish the gaps between the existing grid capacity and that required to achieve full ZEB rollout in each community. These could increase co-ordination, the sharing of best practice and act as a forum to facilitate regular discussion as required in that locality, chaired by the Local Transport Authority.

Attendees at our roundtable suggested that there could be potential to relocate depots to areas where there is greater capacity in the grid. Clearly there are challenges associated with this and significant potential operational inefficiency consequences, but this could be the most appropriate solution in some particular areas. If these options are to be taken forward local authorities, bus operators and DNOs should work together to find the most effective way of delivering them, with a clear focus on where costs should be allocated.

## Recommendation 3:

National Governments, local Government, regulators, distribution network operators and bus operators should jointly commit to an approach, with measurable outcomes, for the upgrading of grid infrastructure, building on the work of the EV Energy Taskforce, the Welsh Government Task & Finish Group and the Scottish Energy Network Principles. This could include agreement on the point at which each party becomes involved in the process, best practice KPIs on timing, and a protocol for resolving delays and disagreements.

## Recommendation 4:

Government (DfT and BEIS) and Ofgem should review existing practice to understand the extent to which grid connection challenges risk being a major barrier to 100% ZEB rollout and consider whether intervention beyond a collaborative voluntary commitment is required. This could include a new statutory duty on DNOs to prioritise grid infrastructure upgrades which have a significant social and community impact, including bus charging infrastructure.

### Route and scheduling challenges

With the introduction of any new technology, there will be a number of operational and technical challenges to overcome. At the current early stage of deployment, the reliability and maintenance requirements of electric buses has yet to be assessed over a whole vehicle lifecycle. There are also potential obsolescence risks given the rapid rate of technological development.

These challenges are not fundamental barriers to the deployment of ZEBs, however consideration should be given to how they can be best mitigated and they highlight the higher costs associated with ZEBs. This is considered further in the funding section of this report.

Bus operators plan how to deliver each of their routes across the number of vehicles they operate in the most efficient way. Each bus – and driver – is allocated a set of routes to cover each day. This could include multiple journeys on the same route or a combination of different routes. Buses are then returned to depots – typically overnight – to be re-fuelled, cleaned and washed. While planned maintenance is taken into account within this schedule, there is little space available for buses to be out of action.



## In relation to electric buses three factors could have implications for routes and schedules:

### 1. Range

The range of an electric bus is less than a diesel bus, meaning that buses will be able to provide less service time before needing to be recharged.

### 2. Reliability

The reliability of ZEBs is less well-understood than diesel buses. The maintenance schedule and life cycle of a diesel bus and its key components have been analysed carefully and factored into

the commercial and operational model that bus operators base their services on. While we expect ZEBs to be more reliable, we do not yet have evidence of ZEB reliability throughout their lifecycle.

### 3. Refuelling

It takes significantly longer to refuel an electric bus compared to a diesel bus. As the information below shows, it takes 6 hours to refuel an electric single decker bus, compared to less than ten minutes for a diesel bus.

## An electric bus vs diesel bus Comparing charge time and range

### Diesel single-decker

Capacity:

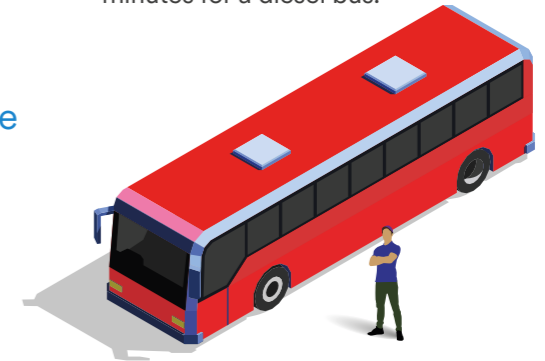
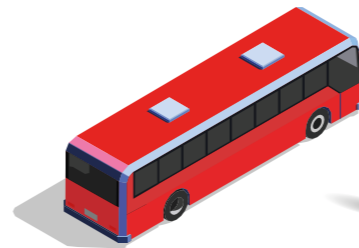
**220l**

Fuelling time:

**<10 minutes**

Range:

**~380 miles**



### Battery electric single-decker

Capacity:

**350kWh**

Charging time:

**~6 hours**

Range:

**Up to 190 miles**

### What will this mean for passengers

The factors above are likely to have a number of implications for passengers and bus operators. It will likely mean that operators need to increase the number of buses available in order to maintain service frequency and reliability. With operators already facing increased pressure on space at depots due to the siting of charging equipment, these challenges will be compounded with an increase in the number of vehicles.

The use of charging en-route, through methods such as pantographs – bus-top connectors to connect to overhead power lines – is being explored in some

areas, but it is costly and requires cooperation from local authorities who control roads. There are also practical challenges: unless restrictions are put in place other vehicles could be using these, and there may be challenges with different models of buses – potentially from a variety of different operators – needing to use this facility.

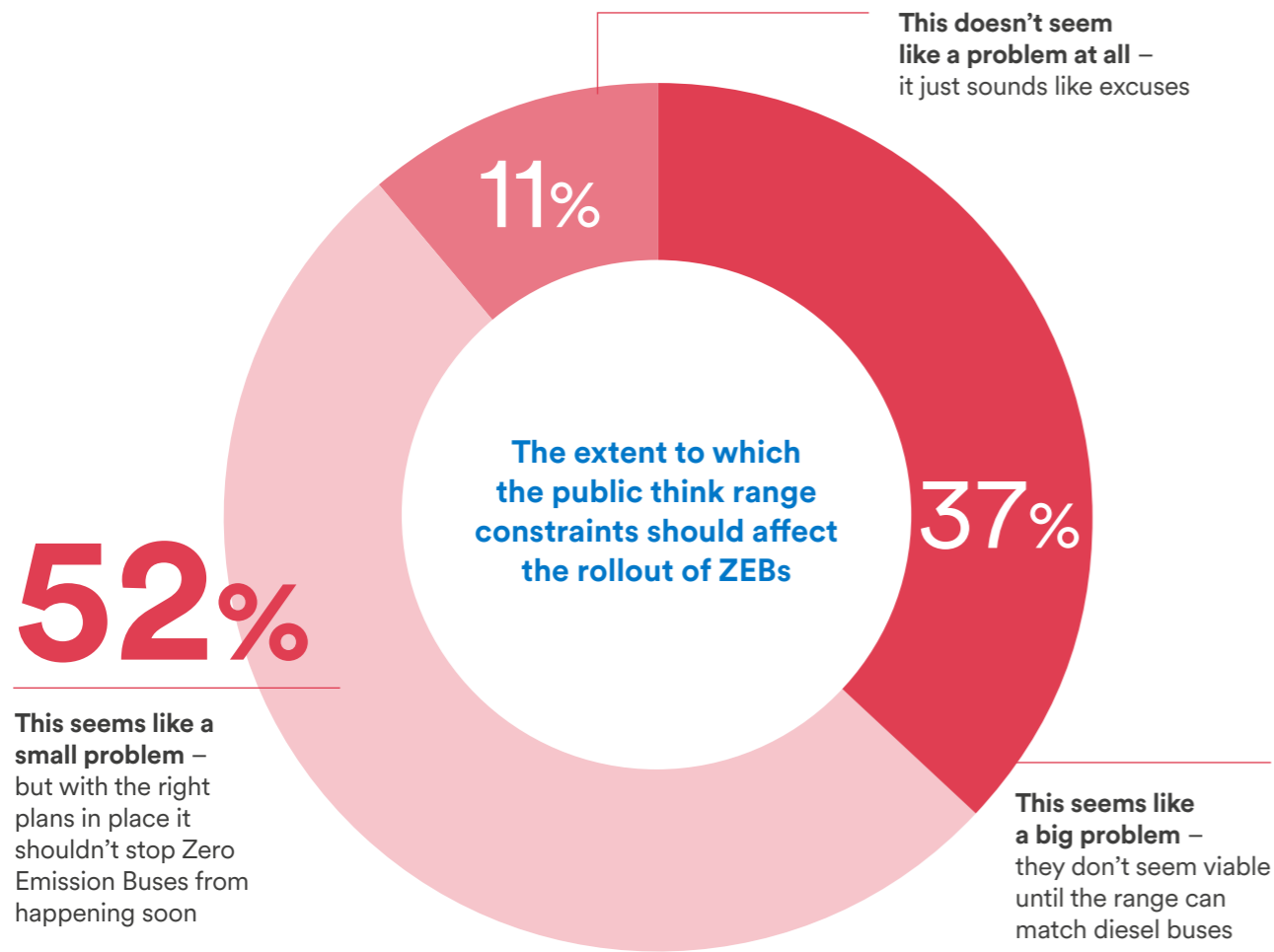
Service resilience will need considering carefully. The challenges set out on the next page will become even more critical in the event of disruption to the local network, for example road closures or traffic incidents.



# Infrastructure

## To what extent, if at all, should range constraints affect the rollout of Zero Emission Buses?

The public are alive to the challenge that the range of Zero Emission Buses will present in their rollout, with only 11% of the public not thinking it will be an issue. While over half of the public think that while it is a problem, it is a small one that can be overcome with the right plans in place, over a third think it is a big problem that makes ZEBs unviable until their range can match diesel buses.

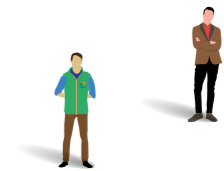


Public sample: 2217



# 9.3m

people live in rural areas in England (18% of the total population)



### The impact on rural areas

There are rightly concerns over the particular impact that any implications for vehicle range could have on rural areas. Our assessment is that there are only a very small number of routes – in the most rural areas – where whole routes could be unsuitable for ZEBs. In these cases ‘opportunity charging’ on route, for example at bus stops, might be necessary.

Rural advocacy groups highlighted at our stakeholder roundtable that there was a real risk that ZEBs could lead to the existing challenge of ‘public transport deserts’ across the UK being exacerbated. The increased capital costs required for the transition to ZEBs could shift the cost equation for many rural services from break-even to loss-making, potentially making them unsustainable.

It should also be recognised that rural areas may face wider challenges in relation to EV charging facilities. Bus operators could play a role in supporting the wider transition to low carbon transport by making this infrastructure more widely available to local communities where appropriate. Stagecoach and SSE have committed to a joint pilot project to trial community charging hubs in Scotland, with bus charging facilities available to the public during the day while buses are operational. These initiatives could improve the investment case for electrifying bus services locally.

It is worth noting that the areas and routes that have been chosen as early adopters of ZEBs at the initial stage of the rollout are those most suited to accommodating electric buses. While this report is focused on buses rather than coaches, the range challenge is particularly pronounced in relation to inter-city bus services, which are often operated by coach vehicles. Industry is taking steps separately to explore how this can be overcome.

Risks to service resilience should also be considered seriously, with the move to 100% ZEBs introducing new challenges. The effective running of services on any one day is dependent on buses being successfully charged up overnight. Currently it is dependent on buses having sufficient fuel. While clearly there are occasions in which fuel can be difficult to obtain, local bus operators can more easily plan to mitigate against this risk. Power outages or other challenges with charging infrastructure could lead to buses being unable to operate on any one day.

Anecdotally it is understood that there have been some cases where charging infrastructure has failed to operate effectively overnight with staff having to deploy diesel buses on these routes instead. Where a depot has moved to 100% ZEBs this solution would not be available. Local authorities are rightly reluctant for bus operators to have fossil-fuel powered backup generators installed at depots.



# Infrastructure

continued

## Recommendation 5:

Government to set up a rural transport decarbonisation taskforce, involving industry, communities, third parties and local authorities. This group will be able to work collaboratively to share best practice and make recommendations on how to decarbonise rural transport without affecting services.

## Recommendation 6:

Future rounds of the Rural Mobility Fund should be focused on supporting the decarbonisation of rural bus routes.

## Recommendation 7:

Government, through the Office of Zero Emission Vehicles (OZEV), to explore and fund further research and development into the potential for opportunity / enroute charging such as pantographs and wireless charging, and the best route to rolling these solutions out at scale in order to address range concerns on longer routes.

## Recommendation 8:

At a regional level, operators should join up their thinking with local transport priorities and connect with other forms of travel. Bus operators should work where appropriate with local authorities and other industries on community charging hubs and the potential for shared rapid charging facilities.

## Recommendation 9:

Bus operators should establish contingency plans at each depot for a scenario in which charging provision fails and buses are unable to operate properly on a particular day. These should be shared with local authorities on a regular basis through partnership frameworks. This could include having access to an alternative fuel supply or making plans for use of an alternative source of buses at short notice.

## Vehicles and batteries

The deployment of electric buses in the UK is at an early stage. Bus operators are continuing to learn lessons as to how to best operate them. It is important to acknowledge that there has not yet been a full life cycle of ZEBs to demonstrate how reliability, performance and full life cycle costs compare with diesel buses. This presents a number of challenges:

- Due to the infancy of production and the low numbers currently being manufactured, the cost of electric buses remain high, generally twice that of a diesel equivalent. While it is widely expected that costs will fall relatively quickly as the level of production increases, the experience from electric cars is that cost savings have been passed onto increasing range rather than necessarily reducing the headline cost.
- While there are a number of bus manufacturers in the UK who are at the forefront of innovation and development of ZEBs, the vehicle manufacturing market is less developed than for passenger cars, with a relatively small number of manufacturers. This limited competition has implications for cost and supply. The significant demand for ZEBs globally, with limited supply, means that obtaining greener, cleaner buses can be a challenge.
- Bus operators have less knowledge over how these vehicles operate, and the implications that has for day-to-day reliability and lifetime value. It is expected that new ZEBs will have a similar lifespan as their diesel equivalents, and batteries will need to be replaced mid-life. However, there is uncertainty over these lifecycles, which could be under or overestimating the reality. This will have implications for reliability – impacting service operations – and the commercial operating model.
- The workforce – drivers and engineers – are less familiar with the vehicles and are having to adapt to their introduction. This is explored in depth in the next section.

## Recommendation 10:

Government should take steps to encourage bus manufacturers to enter the UK market, helping drive jobs and economic growth across the UK. This will increase the supply of buses readily available to UK operators, ensuring that as many of the economic benefits of the transition to ZEBs as possible are received in the UK. It could also improve supply chain resilience, with bus operators less dependent on overseas manufacturing capacity.

## Recommendation 11:

Bus manufacturers, government and the research and innovation community, working through the Faraday Institution – the battery science and technology research organisation – and other bodies, should collaborate on further work on the specific energy and power demands on batteries for bus applications. The most appropriate battery chemistry and ZEB battery reuse & recycling, recognising that these may be different from those for lighter duty applications such as passenger cars.

## Recommendation 12:

Bus operators should work with local authorities to effectively promote locally and support with complimentary measures the introduction of new buses to ensure their introduction is effectively maximised as a potential trigger point for modal shift.



## Key takeaways

### Space

Our depots and operations will need to be transformed with ZEBs taking up 25% more space and taking 36 times longer to charge than a diesel bus currently takes to refuel.

### Cost

ZEBs are significantly more expensive across their full life cycle than diesel buses, and are still in their infancy meaning bus operators are still learning how best to deploy and maintain them.

## What it means for passengers

- New ZEBs are likely to significantly improve the passenger experience, with modern, highly quality, clean and reliable buses equipped with the latest facilities.
- However, if we don't get the infrastructure and vehicle deployment right ZEBs could lead to implications for service quality, reliability and frequency, particularly in rural areas.
- New infrastructure and more expensive vehicles have the potential to put pressure on fares unless there is a clear and long term funding solution in place.



## Infrastructure



### Gordon, 51, from Reading, uses the bus as a convenient and green alternative way to get to work

I rate my local bus services very highly, they're always reliable and fantastic at keeping the buses fresh. It's really interesting to see what buses are already doing with alternative fuels, it's imaginative.

I'm very aware of what's going on with climate change and ideally, I'd like to end up with an electric car, but for now a bus is good substitute. More depots with charging points are better than having lots of car charging points in my opinion. If the government is serious about a transition, I think they need to encourage research and development, and to get more people using public transport.

"I believe in the merit of public transport, it's greener!"

The images used are stock images. The bus passengers quoted in this report were interviewed as part of a national study and are not necessarily Stagecoach passengers.



## Workforce



**Buses are about people. That's largely about passengers, but it's also about the workforce that keep them moving. Drivers, engineers and mechanics, the support teams that sit behind them, and the thousands of people who work in the wider supply chain across the UK.**

From talking to employees at depots across the country it's clear that there's enthusiasm and excitement for the rollout of ZEBs. Stagecoach employees want to be working with the technology of the future and contributing to greener local communities.

As with any major programme of change, the introduction of ZEBs will bring new challenges for the workforce as well as significant opportunities. These are not insurmountable and with careful thinking significant opportunities for the tens of thousands of employees in the bus sector can be unlocked.

### Creating and protecting the jobs of the future

As we have already set out in this report, if the transition to 100% ZEBs is done correctly, over a million new bus users can be unlocked. This will support the sustainability of bus services and protect – and potentially grow – employment in the bus sector.

If the transition isn't managed carefully, over 12 million current bus users are likely to use services less often. Lower bus patronage has the potential to mean fewer services, which in turns means fewer buses and a smaller workforce.

The level of usership has implications for employment in the sector:

- Maintaining or increasing current levels of usership is necessary to protect the number of jobs provided directly by bus operators.
- Growing usership – and unlocking the million extra passengers which our analysis has shown us is possible – is likely to require an increase in the bus sector's workforce with more drivers, engineers and support staff.
- The development of a successful UK supply chain – with thousands of new green jobs being created – is dependent on high levels of demand for bus services.

The introduction of ZEBs is likely to support employment during the upgrading process with the installation of new charging equipment and the potential development of new depots requiring skilled workers.

If we get this transition right, thousands of new jobs could be created and tens of thousands of existing jobs protected. If the transition faces barriers and usership falls, skilled and stable jobs in the bus sector could be at risk.

### Communicating the benefits of the transition to the workforce

Those working in the bus sector are excited about the introduction of new ZEBs, but also have understandable questions about what it means for their role and practical questions over the skills required to drive and maintain these vehicles.

This can include:

- How driving or maintaining a ZEB bus is different to their current work on diesel buses?
- What new skills or training are required to support with this transition, and whether these will be provided to all employees?
- Whether the workforce required to maintain ZEBs is the same as that for diesel buses?
- When ZEBs are likely to be rolled out in their area?

Anecdotal evidence from depots where ZEBs have already been introduced shows that staff are more likely to view the move to ZEBs positively once they have seen depot colleagues have a positive experience with them. Hearing about it going well in other parts of the country has allowed those with potential concerns to better understand what it is likely to mean for them in practice. Engaging members of the depot from an early stage is important to give confidence. This will require senior managers at bus operators to set the agenda on this, as well as sharing best practice from those parts of the workforce who have already engaged with ZEBs and had a positive experience.



## Workforce

### Recommendation 13:

Bus operators should engage with all their staff at the earliest possible time to explain their own plans for the transition to ZEBs, communicate what it is likely to mean for staff in each area and highlight the opportunities it will provide. They should facilitate staff already working on Zero Emission Buses to share their experience with colleagues as ‘ZEB peer champions’.

### Attracting new talent to the bus workforce through ‘green apprenticeships’

The bus sector is a major provider of apprenticeships. New ‘green’ engineering apprenticeships, working on innovative, cutting-edge technology have the potential to be highly attractive to young people, providing secure, highly-skilled and sustainable employment. However, the current content of apprenticeships in the bus sector is predominantly focused on diesel buses and this will need to continue over the transition period to fully zero emission fleets. It will be necessary for these to be updated to be more reflective of ZEBs with awarding bodies working closely with the industry to develop a comprehensive syllabus that responds to the needs of operators.

The funding of bus driver and engineering apprenticeships will also need to be reviewed. Including ZEBs in the curriculum will significantly increase the scope and complexity of training, with the resource to provide this also increasing.

To promote these, the bus sector has the opportunity to take a more active approach to engaging with schools and colleagues, encouraging young people into the bus industry – particularly highlighting it as a sector at the vanguard of technology, innovation and green jobs – and changing perceptions of buses.

# 1,000

driver, engineering and other apprentices in training with Stagecoach

### Recommendation 14:

The bus sector should collectively promote new ‘green engineering apprenticeships’ to young people across the UK, securing a sustainable workforce of the future. As part of this, bus operators should work in communities with schools and community groups on sessions that engage young people on the potential of this as a career path as a green, active choice, and provide useful resources to careers departments to support this.

### Recommendation 15:

The Education and Skills Funding Agency (ESFA) should work with industry to evolve technical services qualifications to ensure they are fit for the era of ZEBs. Funding provided by ESFA should be uplifted to recognise the complexity of syllabus and increased costs that training on electric and hydrogen buses involves.

### Upskilling the workforce

Electric buses drive differently to diesel buses and naturally need to be maintained differently. New vehicles mean new skills, improving the prospects of the workforce.



# 90k

total drivers employed in the GB bus sector

### A number of factors need to be considered in relation to the training and management of the workforce:

- Electric buses are a different driving experience compared to diesel buses, with a different approach needed with regards to braking and handling. This could cause problems, particularly in depots with constricted space, if not accounted for. Drivers need adequate training time behind the wheel of a ZEB to ensure they are comfortable.
- Electric buses naturally require more electrical skills, however there are still a relatively significant number of mechanical parts that will require maintenance. Stagecoach has addressed this by creating joint mechanical and electrical apprenticeship programmes, with new engineers equally proficient in both disciplines. During the transition this allows most efficient use of the workforce with the same staff able to work on both electric and diesel buses.
- Given the need to retrain a large percentage of the existing workforce over time as the industry transitions to ZEBs, consideration needs to be given to how new and existing engineers over the age of 25 can be retrained.
- As a result of the differences in the way ZEBs are built and serviced compared to diesel, some skills will be needed less frequently. Operators will need to ensure sufficient training refreshers are provided to keep the workforce fully trained.
- Bus drivers have to undertake 35 hours of training across a five year period in order to retain their Certificate of Professional Competence (CPC). Training modules undertaken as part of this are

a significant opportunity to share best practice between operators across the sector. These training modules are particularly important for smaller operators, who may have more limited capabilities and resources in providing their own regular training. CPC modules therefore provide a significant opportunity to ensure the role and introduction of ZEBs is engaged with by drivers with consistency across the sector.

- Electric bus maintenance is likely to be scheduled differently to diesel bus maintenance. Analysis shows that electric buses are likely to require less frequent engineering attention on a routine basis. However, the likely need for battery replacements on average every seven years could cause pressure on the fleet if all vehicles in a depot are acquired at the same time. This will have implications for the planning and deployment of vehicles and engineering staff.

The nature of bus depots means they are spread around the country. Therefore, the upskilling of workers can contribute significantly to the levelling up agenda and ensure the benefits of decarbonisation are felt in every community.

### Recommendation 16:

Operators should work with the Driver and Vehicle Standards Agency (DVSA) on the introduction of a Certificate of Professional Competence (CPC) module on the subject of electric buses, including driving styles, safety, charging, and what the transition could mean for passengers. This will engage drivers in the transition, particular those at smaller operators, and enable the sharing of best practice across the sector.

### Key takeaways

- There’s enthusiasm and excitement for the rollout of ZEBs amongst drivers and engineers, but this will present change making it critical for bus operators to explain the benefits to their workforce early.
- An increase in bus patronage driven by the move to ZEBs has the potential to protect and create thousands of new green jobs, but falling passenger numbers could put this at risk.
- ZEBs will require a new approach to skills and training, with the shift having the potential to attract more young people into the industry through ‘green’ apprenticeships working on buses driven by the latest innovative technology.

Barking



## Brian works as a garage supervisor in London and has overseen the introduction of Zero Emission Buses at his depot.

It took over three months to integrate the first Zero Emission Buses into the garage as we had to work out a good system to accommodate space and utilise the charging points.

The electric buses are easier to manage because they require fewer mechanical calls, but we will see whether this remains the case a few years down the line.

Looking ahead, I think that space will be an issue when a new zero emission route is introduced, and we will need to work together to find a solution to this.

“The century-old garage will require modernising changes to infrastructure to house electric vehicles”

## Steven drives electric buses on the 173 route in Barking.

Electric buses are dream vehicles to drive but they require sufficient training and take time to get used to. Not driving one for a while can mean you feel out of practice.

Initially we reported concern around the transition to electric buses, but the vehicles became much more popular once people had practiced driving them.

The workforce has proved themselves to be willing and adaptable. The fear of the unknown can be alleviated by personal familiarisation and hearing positive experiences from other drivers.

“The fear of the unknown can be alleviated by personal familiarisation and hearing positive experiences from other drivers.”

London





# Funding

The public have made clear where they stand on Zero Emission Buses: they are in favour, but not if they bear the burden of the costs. Our analysis shows that passing on costs to passengers doesn't just risk the one million potential new passengers who could be gained by the transition, it risks over twelve million passengers cutting their usage if fares have to go up by just 10% in order to fund this transition. A 30% rise is even more stark, and would result in 59% of all bus users lowering their usage. This would lead to 22.6m people using the bus less.

Our polling shows that the public see responsibility for funding this transition as a shared mission between government, bus operators and local councils. The current approach to funding the introduction of ZEBs reflects this.

## What funding approaches are already in place

In England, funding has been made available by the DfT through the Zero Emission Bus Regional Area (ZEBRA) scheme. The October 2021 Spending Review announced that a further £150 million would be available to support the ZEBRA scheme, taking the total funding available for the scheme to £270 million in the financial year 2021 to 2022. This scheme covers 75% of the additional cost of introducing ZEBs compared to a diesel bus, with the remaining costs covered by bus operators.

The Scottish Government recently announced a £62 million funding package as part of the first phase of the Scottish Zero Emission Bus Challenge Fund (ScotZEB). It is designed to encourage the market to agree and implement new and innovative ways to finance Zero Emission Buses as part of its target for a majority of diesel buses to have been switched to ZEB by 2023.

In Wales, further detail on the Welsh Government's approach is expected in the coming months building on their recent commitment<sup>8</sup> to ensure all buses are zero tailpipe emissions by 2040.

## Support with higher capital costs

Zero Emission Buses are significantly more expensive than diesel as a capital investment. While there is an expectation that increased competition amongst suppliers and a scaling up of production will cause the cost of technology to reduce, the experience from electric cars suggests that there remains doubt as to whether this will happen or on what timescale. As we have seen with electric cars, each time cost savings in technology have been made, it has been invested into improving technology to increase vehicle range. This has meant that costs so far have not reduced even as technology advances.

The current funding approach has helped play a significant part in the successful initial rollout of ZEBs. It requires operators to adopt a significant proportion of the risk, while providing government support for a change that will add significant public value. A grant funding approach – like ZEBRA or ScotZEB – is highly appropriate for early adoption and market creation.

However, such an approach is unlikely to be appropriate or sustainable in the long term as the market builds. Funding certainty will be critical and so consideration of more predictable and reliable sources of revenue is likely to be necessary.

It should also be recognised that the wider decisions that local and national government make in relation to the environments in which bus services operate will have implications for the resources that bus operators have available to invest in ZEBs. For example, bus priority schemes lower operational costs which will reduce the pressure on fares and allow for investment in critical new infrastructure.

## An electric bus vs diesel bus whole life cost comparison

# £672k

Diesel single-decker

Purchase cost:

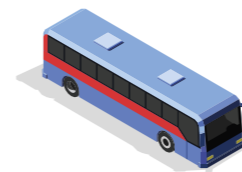
**£238k**

Fuel cost:

**£185k**

Service & maintenance:

**£249k**



# £798k

Battery electric single-decker

Purchase cost:

**£330k**

Fuel cost:

**£113k**

Service & maintenance:

**£226k**



Mid-life battery replacement:

**£100k**

Infrastructure cost:

**£29k**



# 19%\*

Cost increase

Source: [www.ebrd.com/infrastructure/goingelectric.pdf](http://www.ebrd.com/infrastructure/goingelectric.pdf)

\*Calculation excludes staff and overhead costs

## Medium term funding

The ZEBRA scheme – and similar schemes in Scotland – take a proportionate approach to spreading the increased costs between operators and government.

Through conversations with bus operators and local authorities, there are opportunities to refine the schemes further in the short to medium term.

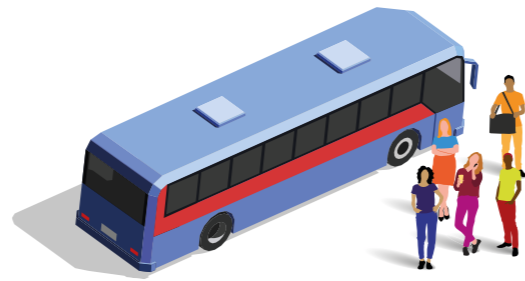
- There is a lack of visibility over future funding, across administrations. Operators need the confidence that future funding will be available to support the government's immediate ambitions, including the commitment to introduce 4,000 ZEBs in England. The recent Spending Review allocated funding for only a short timeframe, making it hard for government, local authorities, operators and manufacturers to adequately plan ahead.
- A lack of regular and predictable funding has implications for the supply chain. This results in inconsistent order cycles making it harder for suppliers to deliver as required and to create sustainable green jobs.

- Under the ZEBRA scheme in England, bus operators and local authorities are not currently able to invest in future depot infrastructure beyond the number of ZEBs that are being funded. This will lead to a piecemeal and inefficient approach to reaching 100% ZEBs, because depots won't be developed in the most efficient way, but in a segment at a time.
- The process for applying for ZEBRA funding is unnecessarily complex, burdensome and bureaucratic to navigate. This can be difficult and off-putting, particularly for small local authorities and smaller bus operators. A number of local authorities raised concerns during the development of this report over the complexity required to develop a ZEBRA business case. While it is right to establish a rigorous and robust case, there is a perception that the fundamental case for ZEBs has to be remade in each ZEBRA submission, when the process could be better used to identify and overcome local challenges to implementation many of which have been highlighted in this report.



## Funding

continued



### Recommendation 17:

Government should commit that ZEBRA funding will be available for at least the 4,000 buses announced by the Prime Minister.

### Recommendation 18:

Funding should be able to be used to future-proof the rollout of ZEBs in a particular locality, with operators permitted to fund and install infrastructure beyond that required for the specific number of new ZEBs introduced as part of that grant allocation. Delivering projects like this at once is likely to be more efficient and cost-effective than an incremental approach.

### Recommendation 19:

Funding processes must be simplified to make it easier for local authorities, particularly small ones, to navigate. The ZEBRA grant process should be streamlined with the amount of information and data local authorities are required to provide reduced. Local authorities should not need to remake the case in principle for ZEBs each time.



# 100%

wholesale electricity prices more than doubling between March and October 2021

### Long term funding

While shorter term changes to the current grant-based funding models are necessary, we recognise that over the longer term an alternative funding approach is likely required. The expectation of governments across the UK is that direct public subsidy for the higher capital costs associated with ZEBs should reduce over time. This mirrors recent changes to the Plug-in Car Grant in the passenger car market.

However, the significant increase in capital costs compared to diesel buses – and the potential that any reduction in capital costs over time may be limited – mean that operators will need further support to introduce ZEBs at scale, meeting the governments' ambitions.

There are a number of options for longer-term financing – more appropriate for a maturing and growing market - that should be explored.

Several countries in Europe have introduced new financing models to fund the deployment of ZEBs. These include the leasing of buses and batteries from third party providers with the bus operator removing itself from ownership. These leasing models enable operators to transfer the residual value risk from themselves to a third party and help those operators without ready access to sufficient capital to deploy Zero Emission Buses. Where an operator has access to capital markets and a sufficient breadth of operations to deploy vehicles effectively throughout their working lives, it is our long-term expectation that the most cost-effective model will be to own the vehicle for its whole life, rather than a leasing arrangement. This is particularly important given the price sensitivity of bus patronage discussed earlier in this report.

Consideration should also be given to other forms of public support, that can be more predictable, reliable and long-term. In particular, allocating funding raised directly through taxation could be more appropriate. Local Authorities across the UK are introducing or considering introducing new schemes intended to support transport decarbonisation and the improvement of air quality in their communities. These include local congestion schemes and Clean Air Zones.

Other local authorities have introduced (for example, Nottingham) or are considering introducing (for example, Leicester and Oxford) Workplace Parking Levies to encourage car users to consider other transport modes. Low Traffic Neighbourhoods have also provided revenue for local authorities in some urban areas.

There could be potential for revenue from these initiatives – aimed at improving local air quality and encouraging modal shift – to be ring-fenced for transport decarbonisation projects, including the funding of Zero Emissions Buses. This could be designed as a place-based solution which gives control to local authorities, however there would need to be a clear national framework to provide consistency.

### Recommendation 20:

Bus operators, local authorities and national governments should work collaboratively to continue to explore opportunities to introduce new or innovative long-term funding models that could reduce the overall cost of introducing ZEBs. These should include local revenue raising solutions. There must be clear evidence that these deliver value for money for both passengers and taxpayers, and any new model should be trialled in a small number of local authorities first.

### Uncertain operating costs

Whilst the operating costs for electric buses are expected to be significantly lower than diesel buses, there remain significant risks, particularly at a time in which electricity prices are rising rapidly, with wholesale electricity prices more than doubling between March and October 2021<sup>9</sup>.

Bus operators are currently able to fix their fuel costs up to five years in advance of use through the derivatives trading market. Electricity costs can be significantly more unpredictable, making it difficult for operators to calculate the prices to bid on a long-term tender or to assess the commercial viability of new routes. Virtual Power Purchase Agreements (VPPAs) may help operators to mitigate against electricity price changes to avoid passing on unexpected increases to customers.

### Recommendation 21:

Government and industry need to work collaboratively with electricity markets to assess how VPPAs may help operators to mitigate electricity price fluctuations. This is vital for providing greater certainty for the bus decarbonisation transition.

### Key takeaways

- Passengers are not prepared to bear the cost burden of the transition to ZEBs, with a clear risk that patronage will fall if fares rise significantly to fund greener buses.
- Bus operators are investing in new ZEBs, but the significant cost increase means further public support is required.
- The current grant-based schemes have made a significant contribution, but it will be critical for government and industry to work together to identify a long-term sustainable funding mechanism.

### What it means for passengers

- If government and bus operators are unable to establish a long-term sustainable funding mechanism, there will be implications for passengers.
- Either fares will rise to fund this or service coverage and frequency will be scaled back. Even 10% fare increases will see significant reductions in passenger numbers.
- Failure to identify future funding could also see the transition to ZEBs slowed down with passengers seeing the environmental and customer experience benefits later than anticipated.



# Final destination: what does this mean?

**Decarbonising the UK’s bus network presents some significant challenges. There is clearly a technical challenge: introducing thousands of new buses running on a new type of fuel and rethinking depots, routes, and ways of working to make this possible. It’s also without a doubt a commercial and funding challenge: cleaner, greener buses will come at a premium and while likely to be cheaper to operate, require significant upfront capital investment.**

However, even more fundamentally this is a human challenge. Buses are about people. They are about connecting families; helping shoppers get to high streets making them thriving places to do business; making education, training and jobs accessible; and enabling people travel to the leisure activities and essential services they need to live their day-to-day lives.

Our blueprint for delivering a fair and effective transition to 100% ZEBs is based on people and understanding their priorities and concerns. If we can meet their expectations, it’s clear that there is a significant pool of new bus users ready to be unlocked. We can get more than a million new bus users if this shift is done right.

If we fail to meet their expectations, we risk over twelve million regular users travelling by bus less often. If fares rise, services become less regular or reliable, and route coverage less comprehensive, passengers will be willing to walk away from bus services.

This would be bad for individual passengers, bad for local economies and communities, and bad for society and the government’s Net Zero ambitions.

But this isn’t inevitable – there’s an opportunity to ensure that passenger expectations are met and the transition is delivered in a way which unlocks millions of new passengers.

Within this report we have set out a detailed blueprint for how to do this. Our set of twenty one recommendations will help drive forward a passenger-centric shift to low carbon public transport. At a high level there are three key principles that should be at the heart of the approach that government, industry and local government take - see over page.

This approach – and the detailed recommendations set out in this report – will help us get to 100% Zero Emission Buses as quickly as possible, at the lowest cost, and in line with public expectations. Bus operators and governments risk delaying the transition and increasing the cost if this isn’t done correctly.

There is too much at stake to not do this. The potential gain of getting it right is over one million additional new bus users. The consequence of getting it wrong is over twelve million passengers using the bus less. This highlights just how much of an incentive we have to get this right.



## Three key principles that should be at the heart of the approach that government, industry and local government take:

### 1. Funding

**The costs of the transition cannot be borne by passengers as patronage will fall further.**

The current shared funding approach has delivered results and should be the basis for the continued rollout. Greater visibility over future funding allocations is essential to ensure a smooth transition.

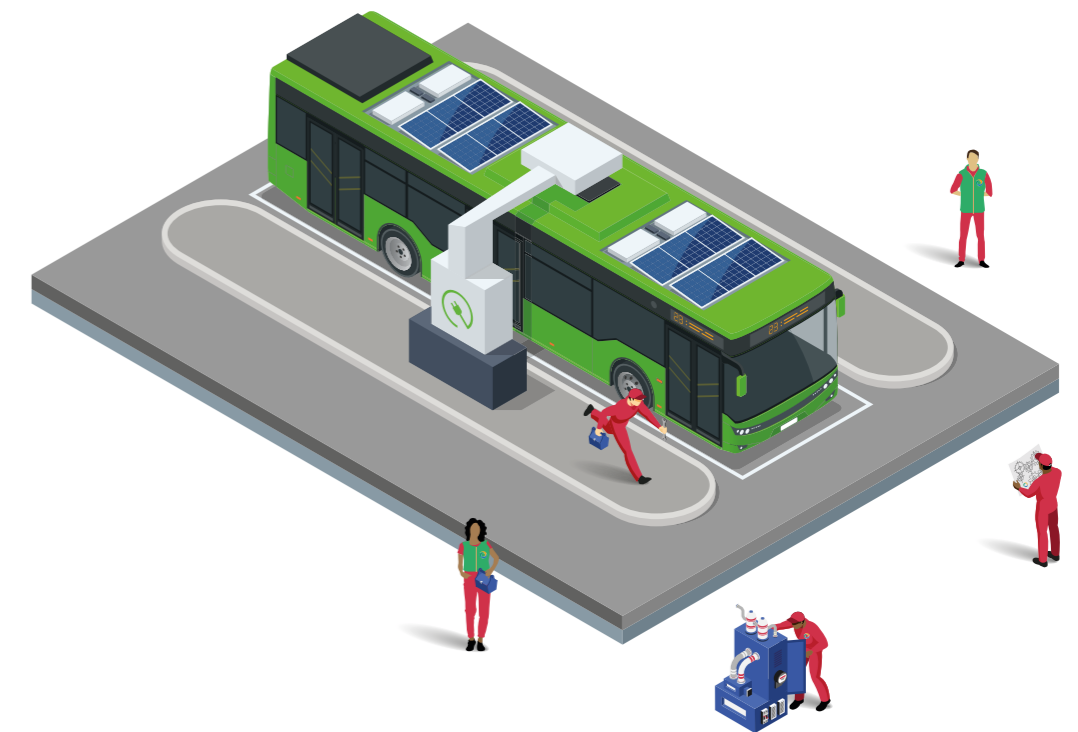
### 2. Customer experience

**Passengers need to feel that the quality and reliability of service they receive when travelling by bus will improve with the introduction of green buses, rather than be put at threat.** Our research shows that there is significant support for cleaner, greener buses but the public expect their core

priorities when travelling by bus – reasonable fares, reliability and frequency of services, and comprehensive route coverage – to be protected. All those delivering this transition need to ensure these factors are at the heart of individual decisions, and that passengers recognise this.

### 3. Partnership

**All stakeholders with an interest in delivering this vision need to work collaboratively to solve the barriers to rollout.** No one organisation can deliver this single-handedly and overcoming the challenges we’ve outlined in this report will need to involve close partnership working.





# Our recommendations

## Infrastructure

1. Local authorities and bus operators should have early conversations over the viability of existing depot arrangements.
2. Local Transport Decarbonisation Partnerships should be established between different bus operators, Distribution Network Operators and local authorities to establish the gaps between existing grid capacity and that are required to achieve full ZEB rollout in each community.
3. National Governments, local Government, regulators, distribution network operators and bus operators should jointly commit to an approach, with measurable outcomes, for the upgrading of grid infrastructure, building on the work of the EV Energy Taskforce, the Welsh Government Task & Finish Group and the Scottish Energy Network Principles.
4. Government and Ofgem should assess the need for a new statutory duty on DNOs to prioritise grid infrastructure upgrades which have a significant social and community impact, such as bus charging infrastructure.
5. Establish a rural transport decarbonisation taskforce to share best practice and make recommendations on how to decarbonise rural transport without affecting services.
6. Future rounds of the Rural Mobility Fund should be focused on supporting the decarbonisation of rural bus routes.
7. OZEV to explore and fund further research and development into opportunity / enroute charging such as pantographs and wireless charging.
8. Bus operators work with local authorities and other industries on community charging hubs and the potential for shared rapid charging facilities.
9. Bus operators should be required to establish contingency plans at each depot for a scenario in which charging provision fails and buses are unable to operate properly on a particular day.
10. Government should take steps to encourage Zero Emission Bus manufacturers to enter the UK market, helping drive jobs and economic growth across the UK and increasing the supply of buses readily available to UK operators.
11. Bus manufacturers, government and the research and innovation community, working through the Faraday Institute and other bodies, should collaborate on further research on the specific energy and power demands on batteries for bus applications, the most appropriate battery chemistry and ZEB battery reuse & recycling.
12. Bus operators should work with local authorities to promote the introduction of new ZEBs to ensure their introduction is effectively maximised as a potential trigger point for modal shift.

## Workforce

13. Bus operators should engage with all their staff at the earliest possible time to explain their own plans for the transition to ZEBs, communicate what it is likely to mean for staff in each area and highlight the opportunities it will provide. They should facilitate staff already working on Zero Emission Buses to share their experience with colleagues as 'ZEB peer champions'.
14. The bus sector should collectively promote new 'green engineering apprenticeships' to young people across the UK, securing a sustainable workforce of the future. As part of this, bus operators should work in communities with schools and community groups on sessions that engage young people on the potential of this as a career path as a green, active choice, and provide useful resources to careers departments to support this.
15. The Education and Skills Funding Agency (ESFA) should work with industry to evolve technical services qualifications to ensure they are fit for the era of ZEBs. Funding provided by ESFA should be uplifted to recognise the complexity of syllabus and increased costs that training on electric and hydrogen buses involves.
16. Operators should work with the Driver and Vehicle Standards Agency (DVSA) on the introduction of a Certificate of Professional Competence (CPC) module on the subject of electric buses, including driving styles, safety, charging, and what the transition could mean for passengers. This will engage drivers in the transition, particularly those at smaller operators, and enable the sharing of best practice across the sector.

## Funding

17. Government should confirm that ZEBRA funding will be available for at least the 4,000 buses committed to by the Prime Minister.
18. To improve efficiency, funding should be able to be used to future-proof the rollout of ZEBs in a particular locality, with operators permitted to fund and install infrastructure beyond that required for the specific number of new ZEBs introduced as part of that grant allocation.
19. Funding processes must be simplified to make it easier for local authorities, particularly small ones, to navigate.
20. Bus operators, local authorities and national governments should work collaboratively to explore new or innovative long-term funding models, including local revenue raising solutions.
21. Government and industry need to work collaboratively with electricity markets to assess how VPPAs may help operators to mitigate electricity price fluctuations.

## Glossary

**Bus Service Improvement Plan (BSIP):** Plans which describe in outline how LTAs and operators in an area can achieve the overarching goal of the National Bus Strategy - to grow bus patronage: both to build it back after the pandemic and then to increase it and raise buses' mode share.

**Certificate of Professional Competence (CPC):** A qualification for professional bus, coach and lorry drivers, introduced across Europe with the aim of improving road safety and helping to maintain high standards of driving.

**Distribution Network Operators (DNOs):** The operator of the electric power distribution system which delivers electricity to most end users.

**Independent DNOs:** Companies that develop, own, operate and maintain smaller, local electricity distribution systems within the DNO network.

**Independent Connection Providers:** An accredited company that carries out works on behalf of clients on the electricity network.

**Modal Shift:** A change from one form of transportation to another.

**RIIO-ED2:** The RIIO-ED2 price control sets the outputs that the electricity DNOs need to deliver for their consumers and the associated revenues they are allowed to collect for the five-year period from 1 April 2023 to 31 March 2028.

**Rural Mobility Fund:** Part of the government's deal for bus users, where English local authorities were invited to bid for funding to trial on-demand bus services in rural or suburban areas.

**Zero-emission buses (ZEBs):** Buses that do not release any carbon emissions from the tail pipe.

**Zero Emission Bus Regional Areas scheme (ZEBRA):** UK Government funding scheme to help local transport authorities, outside London, to introduce zero-emission buses and the infrastructure needed to support them.

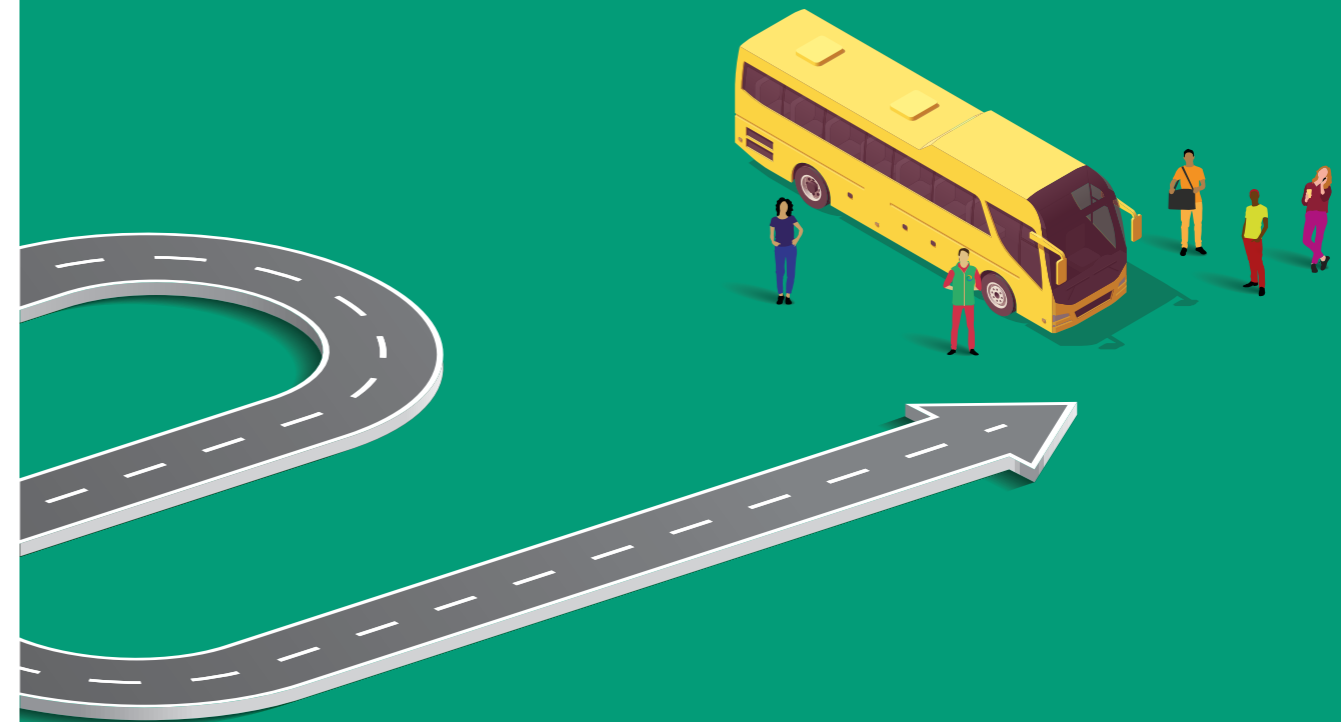
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9. Ofgem, Wholesale Market Indicators

## Report data methodology

- This report contains estimates that have been scaled-up from our survey results (e.g. potential new bus users). The basis for these estimates is the latest ONS data on UK adults, which shows there are 51,435,642 who are aged 18+. There may be people who are under 18 who would be persuaded to use the bus (or use it more often) if a switch to ZEBs happened, but we cannot extrapolate that from our data as we did not survey anyone under 18.
- To present data in a non-sensationalist way, each percentage was taken at the lowest end of its confidence interval (95% confidence level used), before being scaled up, e.g:
- The survey showed that 2.7% of our respondents were people who never used the bus at the moment but would use it more if ZEBs were introduced. Accounting for sampling error at the 95% confidence level, this actual answer may be anywhere between 2% and 3.3%.
- We took this lowest figure of 2% and multiplied it by total GB adults, giving a figure of 1,028,713 – the quoted “million more” in the report. The highest potential passenger gain supported by our data would be at the upper end of the confidence interval (3.3%), which is equivalent to 1,697,376 new users.
- Due to rounding some questions won't equal 100%.
- Throughout this report we refer to bus decarbonisation. By this we specifically mean the transition to 100% ZEBs.
- The focus of this report is on electrification through the deployment of battery electric buses in order to manage the scope of the report. We recognise that a range of technology solutions will likely be required to achieve full bus decarbonisation. Battery electric buses are at a further stage in technological and commercial development than hydrogen buses at present, although hydrogen is likely to have an important contribution to make to bus decarbonisation, particularly for specific applications. Some of the challenges identified will also have implications for

hydrogen, whereas others are more specific to electric buses.



**Greening our bus network offers the opportunity to be a transformational driver for increasing passenger numbers.**

**If we get the transition to Zero Emission Buses (ZEBs) right over one million brand new regular users can be added to the UK bus network.**



## Contact

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