

Bus safety strategy

Delivering a safe bus network in London with no-one killed on, or by, a bus by 2030 and no-one killed or seriously injured on, or by, a bus by 2041

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Director of Bus foreword

This Bus safety strategy builds upon our Bus action plan and sets out what we must do to reach our Vision Zero goals for the bus network

Safety is our first consideration in all that we do to deliver bus services in London and is one of our five key priorities set out in the Bus action plan. We strive to provide the best service for our customers as we seek to transition to a more sustainable, healthy and safe city and can only achieve that if the service we provide is safe, and people are confident we will protect them from harm.

I am proud of our track record on safety. Our world-leading Bus Safety Programme is delivering the greatest reduction in people killed or seriously injured per journey of any road-based mode of transport. As stated in the Mayor's Transport Strategy, bus travel is the safest road transport option in the capital.

However, there is much more we can and will do to further improve bus safety in our wonderful city. Even one death or serious injury is too many. It is neither inevitable nor acceptable that anyone should be killed or seriously injured in an incident involving a bus in London. That's why we have embraced our ambitious Vision Zero targets for buses: no-one to be killed on, or by, a bus by 2030 and no-one to be seriously injured on, or by, a bus by 2041.

These targets will not be straightforward to achieve. Far from it. We have a tough journey ahead of us and a lot of work to do. Nevertheless, with the right level of determination, investment and organisation, they are within our reach.

One thing is for certain, we cannot achieve this alone. We have adopted a Safe System approach to safety, which emphasises the importance of close collaboration with partners within and outside our organisation – be they colleagues across the vast array of teams involved in designing, delivering and maintaining a safe network, or bus operating companies and contractors.

Our approach to bus safety is fully aligned with and integrated within the wider TfL family, with the Bus Safety Programme a key priority under TfL's Vision Zero action plan. The Bus Safety Programme is only part of the solution to achieving our Vision Zero goals for the bus network. We also rely on the wider programmes of safety improvements across TfL to get us to zero people killed or seriously injured on the bus network by 2041.

Similarly, we need to remind ourselves that we do not operate in a bubble. It is a fundamental requirement of any successful public transport service provider to not only inspire confidence in its users, but for that to translate into a positive contribution to wider road safety for all road users. The perception of safety is important to ensure that we attract and retain customers as well as encourage growth in active travel. For some more vulnerable passengers, a poor safety experience can mean they lose confidence in us, and this may restrict their future travel and affect their independence.

This Bus safety strategy sets out how we are delivering Vision Zero for buses through the Bus Safety Programme with our partners and contributing towards building a fair and just safety culture.

The Bus Safety Programme is evidence-led, forward-looking and takes a risk management approach to ensure that we are applying the most effective collision and injury reduction measures to the issues that pose the most risk. For it to succeed, we require a culture change from the top down and the bottom up – something we are committed to achieving at every level.

Our innovative Bus Safety Standard is at the heart of the Bus Safety Programme. It is driving innovation across the bus industry. I am delighted to see us demonstrate this customer-led demand for safety and witness its wider value being recognised beyond our own administrative boundaries as it is adopted outside London and the UK.

It would be remiss of me not to emphasise the crucial role that London's bus drivers play in all that we are seeking to achieve. They do a difficult job incredibly well and often without the recognition they deserve. Their welfare is of the utmost importance to me. I want to ensure they have the facilities and support they need so they are able to provide the best possible service for our customers.

Thank you to all our bus operators who have recognised the importance of placing safety first and working together, proactively, to improve bus safety. My gratitude extends to the bus manufacturers, their suppliers and the wider bus and technology industry who we continue to look to for innovation and inspiration.

This is very much a team effort. We're better together and we're safer together.

#bettertogether #safertogether



A handwritten signature in black ink, appearing to read 'Louise Cheeseman', with a long horizontal line extending to the right.

Louise Cheeseman
Director of Bus, Transport for London

Executive summary

The Bus safety strategy sets out our priorities to ensure that we deliver our Vision Zero targets for no-one killed on, or by, a bus by 2030 and for zero serious injuries by 2041

The Bus action plan sets out TfL's plan for delivering the Mayor's Transport Strategy vision for buses, which is to provide the best service for our customers, while the Vision Zero action plan sets out London's commitment to achieving the Mayor's Transport Strategy Vision Zero ambition.

This Bus safety strategy draws together our vision for a safe bus network contained within these two plans and builds upon them to enhance our Bus Safety Programme as we seek to transition to a more sustainable, healthy and safe city.

While this strategy focuses on what has been, and will be, achieved by the Bus Safety Programme, this programme alone will not enable us to reach our goal for no-one to be killed on, or by, a bus by 2030 and for no-one to be killed or seriously injured on, or by, a bus by 2041. The wider Vision Zero programme across TfL also contributes towards achieving a safe bus network and we will continue to work with colleagues towards our common goal.

Reducing road danger is fundamental to creating Healthy Streets and achieving the ambitions set out in the Mayor's Transport Strategy to encourage more sustainable travel.

The Bus Safety Programme is centred on the five key themes of our Safe System to reduce road danger and to drive improvements – safe vehicles, safe speeds,

safe behaviours, safe streets, and post-collision support and investigation – to ensure that all parts of the system are strengthened.

Safety culture

Underpinning this is a focus on building a fair and just safety culture where our people feel empowered to be part of the solution, and which recognises that no death or serious injury is inevitable or acceptable. As professionals, we all have a responsibility to make the system safe for those at risk of greatest harm.

Buses are the safest way to travel on the roads and carry more people than any other public transport mode.

Our world-leading approach to Vision Zero for the bus network is unique to London and we are ahead of other cities in focusing on bus safety and the breadth and depth of the measures we implement through the Bus Safety Programme. Our Bus Safety Standard, which is at the heart of our strategy, is leading the international bus industry in requiring physical and technological safety improvements.

We have analysed our available data to help forecast the level of casualty reduction we can expect to achieve, and which groups of people travelling will benefit from our Bus Safety Standard, which is key to achieving our goals for a safe bus network. This forecast suggests we will make significant

progress towards our Vision Zero targets which, together with the other non-quantified programmes on fatigue, health and wellbeing, training and behaviour change, and the wider work on Vision Zero that complements our Bus Safety Programme, will help us towards reaching our goal of zero people killed or seriously injured on our bus network.

However, a gap remains, and this strategy sets out what we need to do to close that gap. This includes going further on focusing on reducing customer injuries, adapting to emerging risks and evolving the Bus Safety Programme to capture new challenges and address them proactively.

Working together

Working collaboratively with key stakeholders within and outside TfL is fundamental to the delivery of this strategy, including bus operators, bus manufacturers and contractors. We take this opportunity to highlight the vast amount of work undertaken so far to improve safety under the Bus Safety Programme, the extraordinary success of our Bus Safety Standard and the continual drive to support innovation among our colleagues and the bus industry. We cannot achieve our Vision Zero goals alone; this is a team effort.

Achieving Vision Zero requires continued commitment, ongoing research and a range of interventions consistently applied. It is

important to recognise that Vision Zero may be achieved one year, but the challenge will be to maintain it year after year.

The model of safety improvement will need to shift from the traditional road safety approach towards that of the rail and air modes where safety culture and a target of zero deaths have been embedded for longer. This approach is important in not only achieving Vision Zero, but in maintaining it.

Systematic approach

We have developed a clear and systematic programme to realise our ambition of a safe bus network. The Bus safety strategy sets out what we are already doing and what more we need to do to ensure that no-one is killed or seriously injured on our bus network.

We will continue to deliver safe vehicles through innovative technology and physical changes, which includes requirements for new buses entering the fleet through the Bus Safety Standard as well as retrofitting existing vehicles in the fleet to bring forward safety benefits. We will continue to focus on reducing casualties among people walking, who make up the highest proportion of fatalities, as well as increase our emphasis on measures to prevent and mitigate fatal and serious bus occupant injuries. We will develop future requirements for the Bus Safety Standard beyond 2024.

To deliver safe speeds, we will continue to roll out and monitor Intelligent Speed Assistance, which limits buses to the posted speed limit, helping to normalise lower speed limits in London. We will also undertake proactive speed management, working with bus operators to focus on the worst-performing routes currently without Intelligent Speed Assistance.

As well as technology, a focus on safe behaviours and supporting an open culture where safety is at the centre of decision-making and day-to-day operations is vital. We will build on existing training to enhance the training offered to bus operators, including for bus drivers as well as for managers, supervisors and controllers. We will continue to work with bus operators on fatigue management, and improving health and wellbeing, including the delivery of the Fatigue, Health and Wellbeing Innovation Challenge, the roll-out of health kiosks and assessments, and a trial of fatigue detection technology. We will enhance our focus on bus customer injuries through a strategic data-led approach, trialling and evaluating safety solutions, and we will launch a new Bus Safety Innovation Challenge to find innovative measures to reduce customer injuries.

The way we design and use our street spaces has an impact on safety and encourages people to lead more healthy and active lives. To deliver safe streets, we will build upon the existing programmes

through research and analysis, and ensure that appropriate mitigations are established. We will also continue our comprehensive programme of asset management, improving welfare facilities to make it easier for drivers to take a better-quality break and help to combat fatigue.

Post-collision support and investigation underpins our understanding of, and ensures we learn from, the causes of collisions to ensure the Bus Safety Programme remains evidence-led and adapts to new risks and priorities. We will continue to improve our safety monitoring and assurance processes among bus operators, which includes enhancing our incident reporting, investigation processes and benefits realisation.

Action plan delivery

We are championing the delivery of the Bus action plan and Vision Zero action plan and working towards ensuring the bus industry in London is both safe and inclusive. To this end, we will establish a new Women in Bus and Coach Network to support and encourage more women into the industry.

The actions in this strategy incorporate both existing actions already included in the Bus action plan and Vision Zero action plan for our Bus Safety Programme, and new actions that reflect our unwavering commitment through the breadth and depth of this Bus safety strategy to achieving a safe bus network for London.



The design and use of our street spaces affects safety

01

A safe bus network

Delivering a safe bus network is essential to ensuring bus travel in London is inclusive and attractive



Vision Zero for London buses

Our ambition is for a safe and secure bus network

The Mayor's Transport Strategy (2018) and Vision Zero action plan (2018 and progress report in 2021) set out Transport for London's (TfL) bold commitment to eliminate all deaths and serious injuries from the transport network by 2041. As part of this, we committed to ambitious targets to reduce the number of people killed or seriously injured on, or by, a bus by 70 per cent by 2022 against the 2005–2009 baseline and for no-one to be killed on, or by, a London bus by 2030.

The Bus action plan (2022) sets out TfL's plan for delivering the Mayor's Transport Strategy vision for buses, which will see the modern bus network attract more customers and help the capital become a net zero carbon city by 2030. Delivering Vision Zero for buses and creating a safe and secure bus network where everyone is able to travel by bus safely and with confidence is a key part of our Bus action plan. The Bus safety strategy sets out the work we are doing and our priorities to ensure that we deliver our Vision Zero targets for buses.

While this strategy focuses on what has been, and will be, achieved by the Bus Safety Programme, reaching our Vision Zero goals for the bus network will not be achieved solely by implementing it. There are a wide range of safety improvement programmes under way across TfL that are crucial to achieving our shared Vision Zero targets set out in the action plan. For example, there is a programme of road infrastructure improvements and increased roll-out of 20mph limits; work to increase road travel modal shift to more sustainable transport including buses; comprehensive fatigue management and other programmes of work for reducing road danger; and an enhanced focus on training, education and standards setting.

Our Bus Safety Programme was established in 2016 to support our Vision Zero targets for London buses. Significant progress has been made since the Bus Safety Programme was first introduced, and the programme continues to evolve as risks and priorities develop.

Central to our programme is the Bus Safety Standard, which specifies safety standards that new buses entering the London bus fleet must meet, such as occupant-friendly interiors to reduce passenger injuries, and Intelligent Speed Assistance, which limits buses to the posted speed limit. The programme is broad, including fatigue management, and driver health and wellbeing, such as the delivery of Fatigue Management Awareness Training for all supervisors and managers in the London bus operators, and the roll-out of health kiosks across the bus operating companies. It also includes driver training, such as our innovative Destination Zero Driver Certificate of Professional Competence course, which demonstrates road risks with the help of virtual-reality headsets, and the Sarah Hope Line to support those involved in collisions on TfL's network.

Figure I sets out which incidents are included in or excluded from both our Vision Zero targets and the Bus Safety Programme. Our Vision Zero targets include passengers on the bus and road users (such as people walking, riding cycles or motorcycles) outside the bus who are involved in a collision with a bus. All collisions are included, whether or not contributory factors that led to a collision are assigned to a bus, other road users or bus passengers.

Our target excludes incidents of violence and aggression unless they result in a collision, such as road rage. Our priorities and actions on addressing violence and aggression to help ensure people feel safe and secure are set out in the Bus action plan.

While private roads and land such as bus garages and bus stations are not recorded in the STATS19 database (national police-recorded collision data), and therefore casualties from bus-involved collisions on private premises are not officially counted within our Vision Zero target, we consider these as part of the Safe System approach. A number of our measures therefore include bus garages and bus stations as well as a focus on post-collision learning where collisions do occur at these locations.

While some deaths and injuries are excluded from the Vision Zero target, they are not excluded from the focus of TfL and the improvements being sought through the Bus Safety Programme and in its wider work. Alongside the activities set out in this strategy and the Bus action plan, other TfL initiatives that address our workforce's health and wellbeing, tackle work-related violence and aggression, and seek to provide medical assistance to our staff and customers when required, for example, are regularly reported in our quarterly Safety, Health and Environment reports.

Figure 1: Types of incidents included in, or excluded from, our Vision Zero targets and the Bus Safety Programme

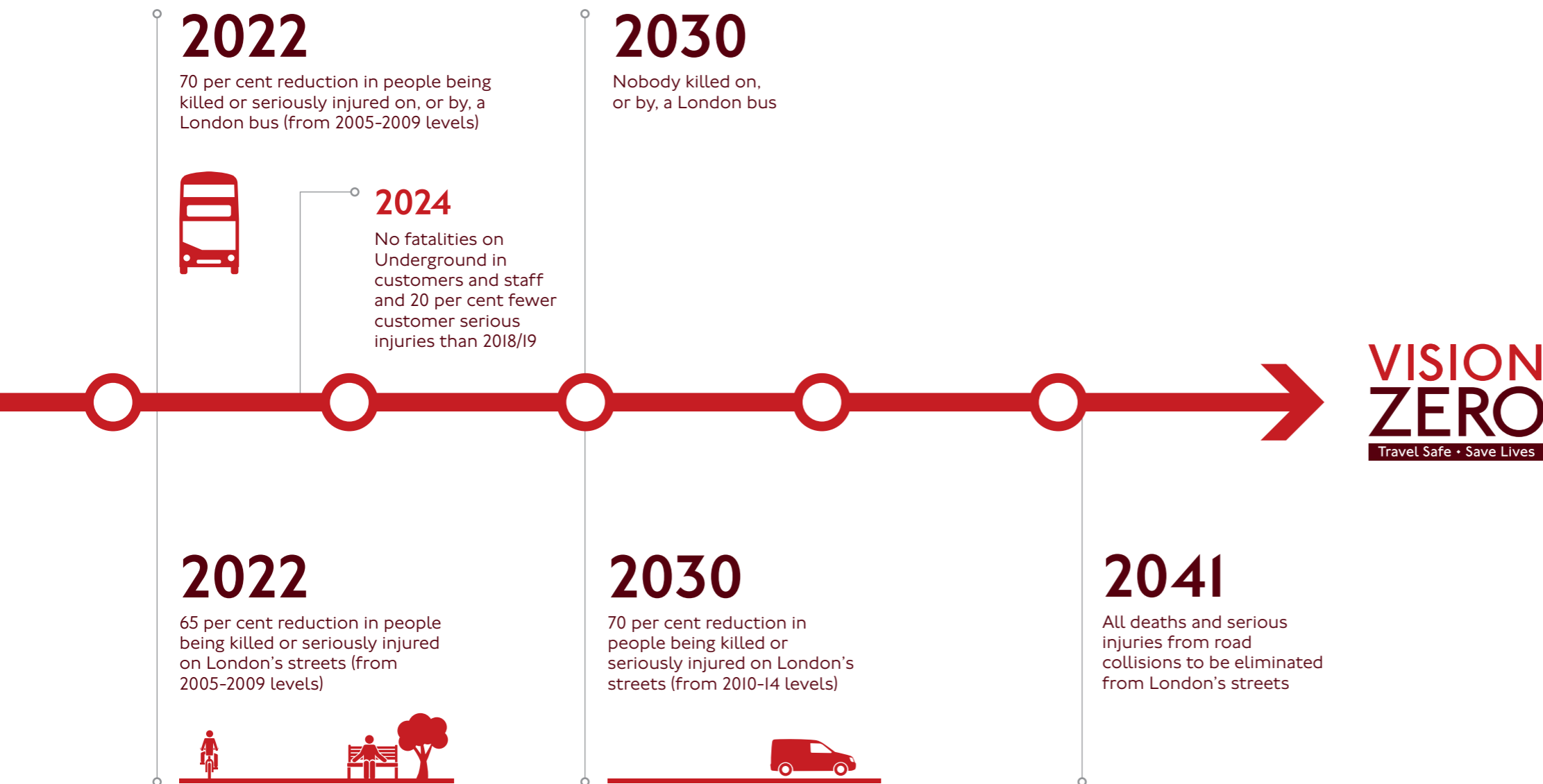
Cause	Included in bus Vision Zero target	Included in Bus Safety Programme
Death or serious injury on a bus due to a collision (bus passenger or driver)	✓ ¹	✓
Death or serious injury by a bus due to a collision (external parties such as people walking or cycling)	✓ ²	✓
Injury caused by a collision as a result of road rage	✓	✓
Bus fire resulting from collision	✓ ³	✓
Slight injury on, or by, a bus due to a collision	✗	✓
Bus fire not resulting from collision	✗	✓
Death or serious injury on private road or land (bus station/garage)	✗	✓
Medical fatality	✗	✗
Injury caused by violence and aggression	✗	✗

1 Excludes confirmed deliberate acts
 2 Excludes confirmed deliberate acts
 3 Only where it results in injuries



Buses are the safest way to travel on London's roads and becoming safer

Figure 2: Mayoral targets in achieving Vision Zero



Our Vision Zero targets are focused on reducing fatal and serious casualties as they represent the most harm. However, while passenger slight injuries are not part of our Vision Zero targets, we are committed to reducing them and they are regularly scrutinised by our operational directors. A reduction in slight injuries supports our priorities for an inclusive customer experience where the bus network is easy, comfortable and accessible for all.

A reduction in passenger slight injuries is particularly important for our vulnerable customers where a slight injury may have a greater effect on confidence and willingness to travel by bus in the future. It is important to note that measures to prevent fatal and serious injuries will naturally aid the reduction of slight injuries too, where the contributory factors are similar.

Zero harm

is our ambition that no customer, colleague or supplier should be harmed while travelling or working on our services



Safe System approach



Our world-leading Bus Safety Programme follows Safe System, an internationally recognised approach to road danger reduction that follows these principles:

- People make mistakes so our transport system needs to accommodate human error and unpredictability
- There are physical limits to the kinetic energy that the human body can tolerate. Our transport system needs to be forgiving, so that the forces involved in a collision are not sufficient to cause fatal or serious injury
- All those with a role in designing, building, operating, managing, enforcing and using our streets have a responsibility to reduce danger

As stated in our Bus action plan, the approach is centred on the five key themes to drive improvements to ensure that all parts of the system are strengthened.



Safe speeds

Ensuring buses do not go above the speed limit, and travel safely in all conditions.



Safe behaviours

Building knowledge and awareness to encourage safe behaviours.



Safe streets

Reducing road danger at locations where the likelihood of injury is higher, and designing an environment that is forgiving of mistakes and encourages sustainable and active travel.



Safe vehicles

Reducing the road danger risk posed by buses through innovative technology and physical changes to improve vehicle safety.



Post-collision support and investigation

Understanding and learning from the causes of collisions is fundamental to helping to prevent their recurrence. It is vital that we work with our partners to ensure anybody affected by a collision receives the support they need and deserve, including signposting victims of collisions to appropriate restorative justice and post-collision services.

Underpinning the above principles is a drive for a culture change within the bus industry to ensure that safety is at the heart of everything we do.

02

Working together

We work closely with the bus industry, including bus operators, manufacturers and suppliers, in the development and delivery of our Bus Safety Programme



Working collaboratively to deliver the Bus Safety Programme

Delivering the Bus Safety Programme can only be achieved in partnership and with mutual trust

We work closely with bus operators in London, bus manufacturers and their tier one suppliers to contribute towards building state-of-the-art buses and a fair and just safety culture.

We work with bus operators to develop and deliver projects and workstreams within the Bus Safety Programme – this includes working with safety managers, engineering teams and senior leadership. We also liaise with bus operators on day-to-day safety, health and environment issues, helping to resolve and escalate issues where necessary. We hold regular meetings with representatives from the bus operators' safety teams, to share learning from noteworthy incidents, and discuss emerging risks and issues.

We host, jointly with bus operators, a programme of site visits and engagement events, including Incident Prevention Days at hotspot incident locations across the bus network to gather first-hand understanding of location-specific issues, raise the profile of Vision Zero and share knowledge

and insight. To ensure a consistent and robust approach to training, we work with bus operators to deliver training programmes for bus drivers as well as managers, supervisors and controllers.

Our work with bus manufacturers, or original equipment manufacturers, and their tier one suppliers includes regular engagement on our technical requirements in the Bus Safety Standard to ensure delivery is achievable and robust. It also involves collaboration through engineering forums, working groups and the delivery of trials. We ensure that research and analysis completed as part of the Bus Safety Standard and wider Bus Safety Programme are shared with the bus industry through the publication of research reports on our website as well as through targeted workshops and briefings.



TfL works in close partnership with bus operators across London

We meet regularly with Unite the Union to engage and collaborate with them on the development of the Bus Safety Programme as well as on specific initiatives. One recent measure was the development of the Responsive Acoustic Vehicle Alerting System for new buses through the Bus Safety Standard. This provides an artificial sound so that quiet-running buses are audible to vulnerable road users outside the bus. As part of this, we engaged with various stakeholders, including disability groups such as London Vision, Guide Dogs and Living Streets.

Other initiatives include the roll-out of health kiosks as part of our work to improve driver health and wellbeing, and the development of an action plan to reduce and mitigate pedal application error.

We engage with independent research specialists to support the development of the Bus Safety Programme and build a body of knowledge to benefit wider bus safety improvement.

We are a member of the International Bus Benchmarking Group, which is a consortium of urban bus organisations from around the world that benchmark performance and share experiences and best practice. It includes medium and large bus organisations and provides an independent, confidential and effective forum for information exchange. We regularly provide input and seek information from members to inform the Bus Safety Programme.

Through our wider programme to deliver Vision Zero, we work closely with London boroughs, communities and stakeholders to implement Healthy Streets schemes. This includes rolling out 20mph speed limits, pedestrian crossings and allocating increased space to support more and safer walking, cycling and public transport use.

Governance forums provide oversight and assurance in the delivery of the Bus Safety Programme. This includes working groups and steering groups at both a project and programme level, up to senior governance meetings within TfL Bus Operations and Safety, Health and Environment. We also report to the Safety, Sustainability and Human Resources Panel.

‘We have benefited greatly from the direction that TfL and their academic partners provide. Through working with TfL, I have seen an openness between the operating companies and an active sharing of best practice; it is very clear that there is a combined and robust approach to safety, and this benefits us all’

Jon Sweet
Head of Health, Safety,
Environment and Risk, Arriva London

Global Vision Zero progress

Vision Zero was conceived in Sweden in 1997 as a radical new approach to road safety. It has now been adopted by many countries and cities around the world, including the Netherlands, Norway and New York City. Norway officially adopted the approach in 2002, with a strong focus on reducing car use and facilitating walking and cycling – 2019 was the first year in which there were no deaths of people walking or cycling in the capital, Oslo.

While zero fatalities have not been maintained every year since then, numbers of deaths and serious injuries remain very low. This highlights that, while Vision Zero may be achieved one year, the key challenge is to maintain it.

New York was the first North American city to launch a comprehensive Vision Zero action plan in 2014 and saw a reduction in all fatalities from 2000-2018, but an increase was seen in 2019 and 2020.⁴ In 2017, the European Union committed to the goal to ‘move close to zero deaths and fatalities by 2050’⁵ and this ambition was reiterated in the Road Safety Policy Framework 2021-30.⁶

World-leading approach

Our approach to Vision Zero for buses is unique to London and we are ahead of other cities in terms of our focus on bus safety and the breadth and depth of the measures we implement through the Bus Safety Programme. In particular, the Bus Safety Standard is world leading in requiring new technology to improve bus vehicle safety, both ahead of, and in addition to, regulatory requirements.

Such technology includes Intelligent Speed Assistance, which was introduced in 2019 for new buses as part of the Bus Safety Standard, ahead of regulatory requirements. Our knowledge and experience in implementing this particular technology on new buses was used to inform the European Transport Safety Council’s development of requirements of Intelligent Speed Assistance. Our work in this area has also informed a programme to retrofit the technology to the TfL commercial fleet.

We also developed, jointly with AECOM, Anderson Acoustics and Zelig Sound, an Acoustic Vehicle Alerting System for quiet-running buses two years ahead of the regulatory requirements and have exceeded these requirements through the development of an Urban Bus Sound. We have subsequently licensed this sound for use in cities, towns and regions throughout the United Kingdom and Republic of Ireland, including by National Express in Coventry and Birmingham, by First Bus in Glasgow, First Bus West Yorkshire in Hunslet Park, Stagecoach in Aberdeen, Kilmarnock and Perth, and in Belfast and Ballymena in Northern Ireland. Licensing the Urban Bus Sound to other areas in the UK was specifically requested by lobby groups representing vision-impaired and disabled people. At the 2021 UN Climate Change Conference in Glasgow (COP26), the buses used to transport attendees were fitted with the Urban Bus Sound.

As the number of electric, hydrogen and hybrid buses in the UK increases, there is an opportunity to license the Urban Bus Sound to more bus operators and places throughout the UK and beyond.

We share knowledge with the bus industry and wider stakeholders through ongoing project engagement and we publish research and data on our website. Sharing research and data is important in encouraging and enabling the development of new technology, which in turn helps to bring down the costs of implementing the technology in London and elsewhere.

We introduced the Bus Safety Summit in 2017 to provide a forum for the bus industry to share best practice and knowledge, and support collaboration and innovation. Previous events have included live demonstrations of the Bus Safety Standard technologies, presentations of research and insight, as well as talks from bus operators, suppliers and manufacturers on the work they are doing towards achieving Vision Zero. The coronavirus pandemic has impacted our ability to hold a Bus Safety Summit more recently, but the next event is planned to be held in 2023.

4 nypost.com/2022/04/09/nyc-traffic-deaths-up-35-percent-so-far-this-year/

5 transport.ec.europa.eu/news-events/news/european-commission-welcomes-launch-global-plan-un-decade-action-road-safety-2021-2030-2021-10-28_en

6 op.europa.eu/en/publication-detail/-/publication/d7ee4b58-4bc5-11ea-8aa5-01aa75ed71a1

‘The TfL Bus Safety Standard has brought the bus industry together in a real team effort around the common goal of making our transport system even safer’

Jamie Wilson

Head of Concepts and Advanced Engineering, Alexander Dennis

‘We believe that many of the Bus Safety Standard developments will be attractive and applicable to other operations across Europe and we are proud to be able to contribute towards making buses in London safer through introducing TfL’s Bus Safety Standard’

Shaun Millar

Business Development Manager, e-Mobility, Irizar UK

As part of the development of this Bus safety strategy, we engaged with a range of stakeholders through a number of workshops to ensure we captured all relevant issues important to our stakeholders and customers. These included bus operators, bus manufacturers and supporting organisations, as well as London Underground, DLR and other stakeholders such as Living Streets, London Cycling Campaign, London Road Safety Council and the Independent Disability Advisory Group.

In addition to feedback received directly through our extensive initiative-specific bus driver engagement activities such as pedal application error, an independent road safety expert spent time with bus drivers to gather more informal input on bus safety from their unique perspective.

To engage the bus industry when we launched our Bus Safety Standard, we held a stand at the Euro Bus Expo in 2018, a leading industry gathering. We continue to share our progressive and innovative Bus Safety Programme through presentations at conferences and the European Transport Safety Council, to industry groups such as the Road Risk Group and the Urban Transport Group, and with international colleagues, including those from Dublin, Spain, Mexico, Hong Kong, India and Argentina.

Sharing knowledge is important for improving safety culture across the bus industry. It also stimulates development of safety measures that help to reduce costs and improve delivery of innovative solutions.

‘At Translink we have used the research developed as part of the Bus Safety Standard and have implemented many of the features on our buses. The Bus Safety Standard and the work done by TfL through the Bus Safety Programme has greatly supported the development and implementation of our programme of measures to improve bus safety’

David Barnett

General Manager, Engineering, Translink Northern Ireland

03

Our progress

Significant progress has been made in reducing deaths and serious injuries on, or by, a bus in London over the past decade. Buses are the safest way to travel on the roads and carry more people than any other public transport mode



Our progress

Our Bus Safety Programme is achieving the greatest reduction in people killed or seriously injured per journey of any mode on the roads in London

Buses are the safest way to travel on the roads and carry more people than any other public transport mode, with fewer than 0.68 people (and 0.27 bus occupants) killed or seriously injured per million bus miles between 2017 and 2021.⁷ There were more than six million bus journeys made on a typical day in London in 2019,⁸ representing around one in five of all journeys made.⁹

During the pandemic, traffic levels dropped significantly and therefore so did the number of people being killed and seriously injured on London's roads in 2020 and 2021. However, 2022 saw a reversion to more typical numbers and patterns of injury as travel recovered following the ending of coronavirus restrictions.

By the end of 2022, the number of people killed in collisions involving London buses had reduced by 65 per cent against our 2005-09 baseline, compared to an overall reduction in people being killed on London's roads of 52 per cent.¹⁰ There was an overall decrease of 54 per cent in the number of fatalities and serious casualties in 2022 against our 2005-09 baseline (with the number of bus occupants injured down by 49 per cent), compared to an overall reduction in people being killed or seriously injured on London's roads of 38 per cent.¹¹ While this is very positive progress, it does mean that we have missed our ambitious target of a 70 per cent reduction in people being killed or seriously injured on or by a bus by 2022 despite a continual downward trend and having achieved this target for the previous two years. The particularly steep fall in 2020 should, however, be considered in the context of the pandemic, which had a significant impact on travel demand.

7, 8 Latest available data, as reported in Casualties in Greater London 2022, TfL

9 Vision Zero action plan progress report 2021, TfL

10, 11 Latest available data, as reported in Casualties in Greater London 2022, TfL



Bus deaths and injuries have greatly reduced over the last 10 years

In 2022, the number of people killed or seriously injured as a result of collisions involving buses increased by 15 per cent against the 2017-2019 pre-pandemic average.¹² The latest changes in serious injury figures have been driven largely by bus passengers sustaining injuries often as a result of slips, trips and falls. In 2022, there was an increase in road casualties amongst all transport modes, not just buses. The increase in casualties involving buses has been less than the average across all road casualties, indicating that, while there has been an increase, buses are still performing better on average.

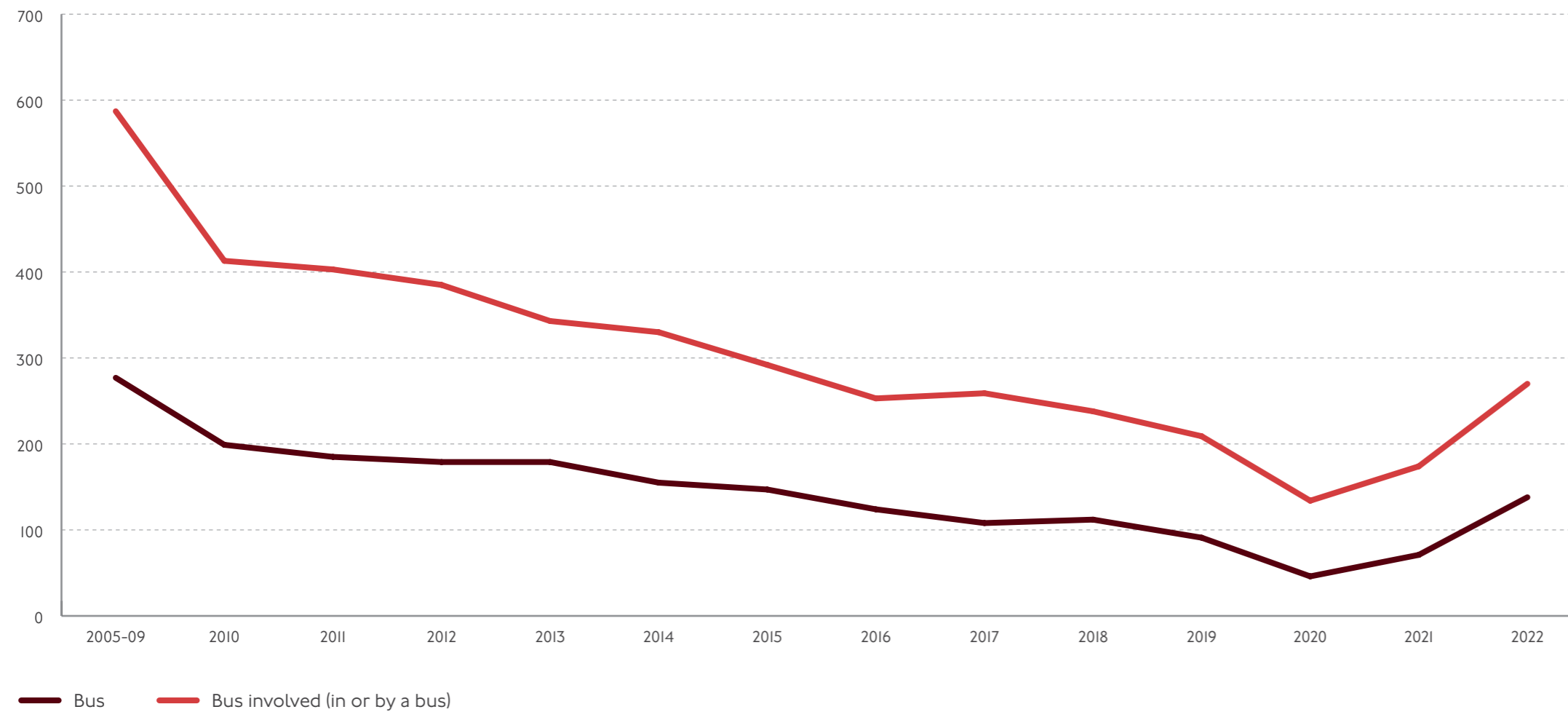
This is a testament to the progress that has been made in reducing road danger caused by buses and the consequences to those inside the vehicle. However, a key challenge will always be to continue to reduce casualty numbers year on year, and to ensure we remain on track to meet our Vision Zero targets, with sustained investment and commitment fundamental to achieving this.



Real progress has been made in reducing road danger from buses

¹² Latest available data, as reported in Casualties in Greater London 2022, TfL

Figure 3: People killed or seriously injured on or by a bus^{13,14}



While casualties involving buses make up a small proportion of the overall road casualties in London relative to their share of traffic, larger vehicles such as buses present the greatest road danger risk to people walking, cycling and riding motorcycles in particular, and are more likely to result in a fatality. It is essential therefore that we continue to reduce the road danger caused to vulnerable road users from buses.

Reducing road danger is fundamental to creating Healthy Streets and achieving the ambitions set out in the Mayor’s Transport Strategy to encourage more walking, cycling and public transport use to achieve an 80 per cent sustainable mode share by 2041. Making buses safer for both bus passengers and people outside the bus helps to improve the attractiveness of sustainable modes by ensuring people feel safe and confident to choose public transport, walking and cycling. While significant progress has been made to reduce the number of people killed or seriously injured on, or by, a bus, sustained action and investment are critical to ensure we continue to reduce deaths and serious injuries to achieve the Vision Zero targets for London buses.

¹³ ‘Bus’ casualties comprise bus occupants only

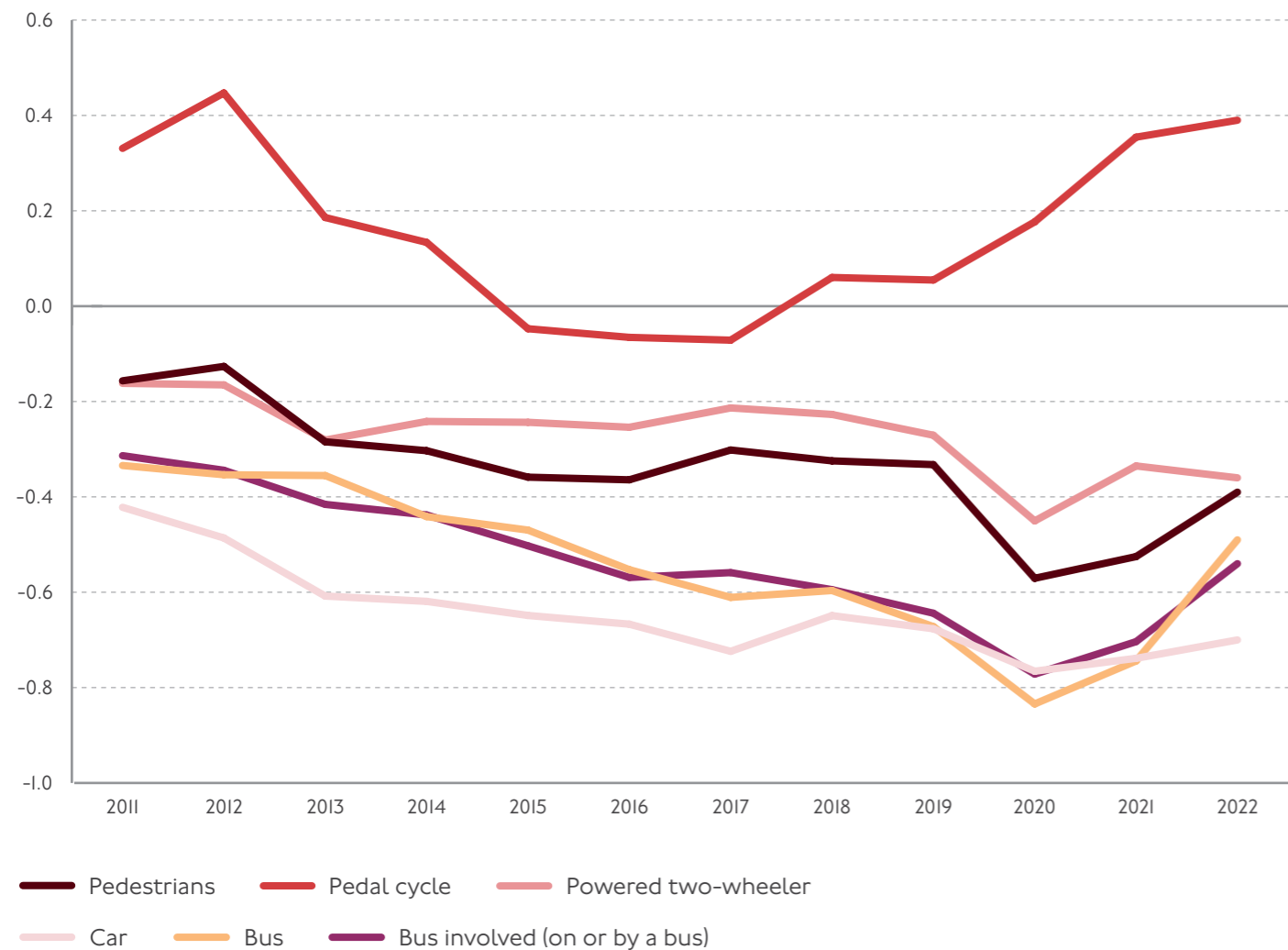
¹⁴ ‘Bus involved’ casualties comprise anyone involved in a collision involving a bus (including bus occupants and anyone outside the bus)

Reducing road danger

Bus-involved collisions, which include all collisions involving a bus as well as road users outside the bus and occupants of the bus or within other vehicles, constitute a small proportion of the overall deaths and serious injuries on London's roads. Figure 4 shows that the biggest road safety improvements, in terms of deaths and

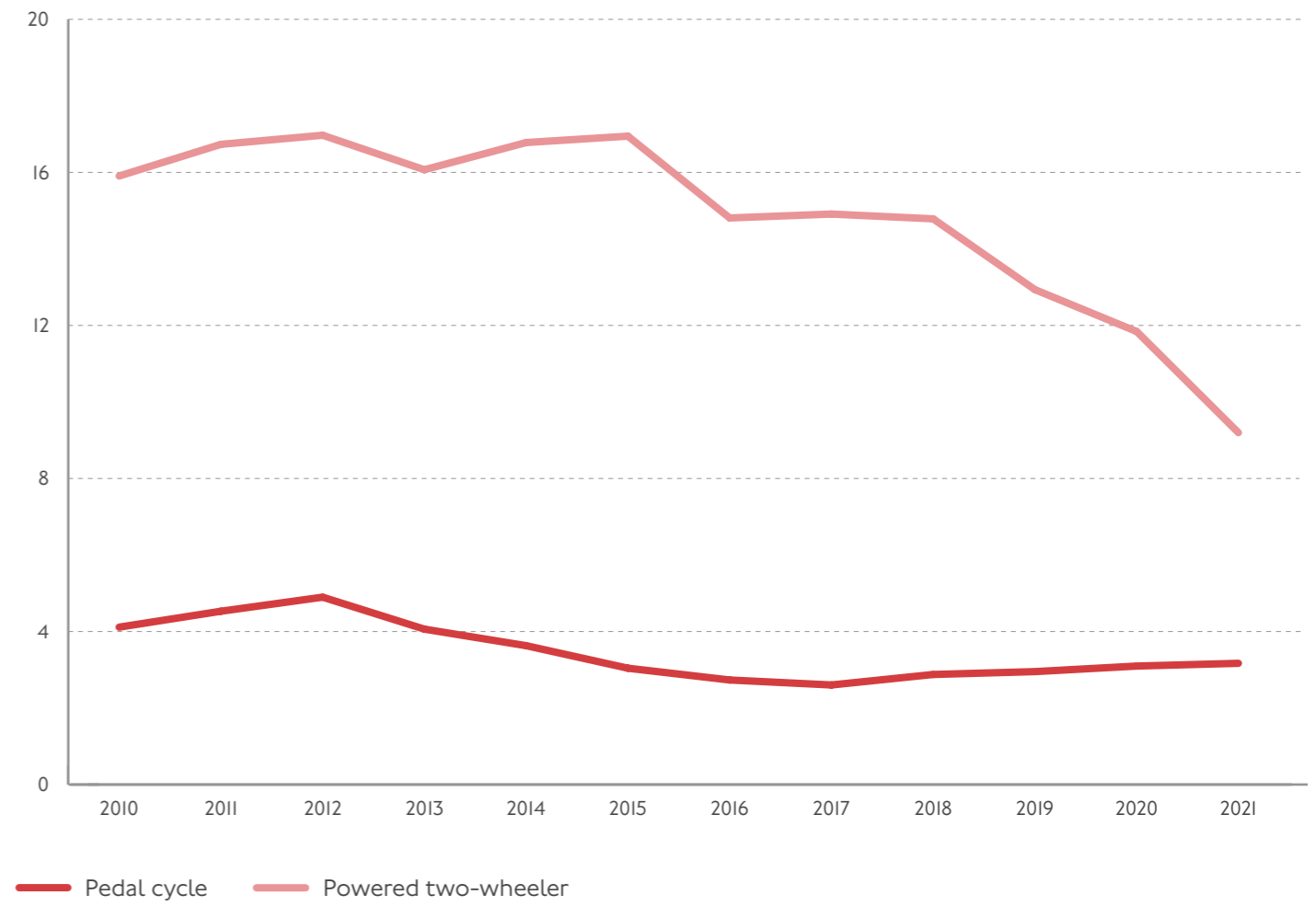
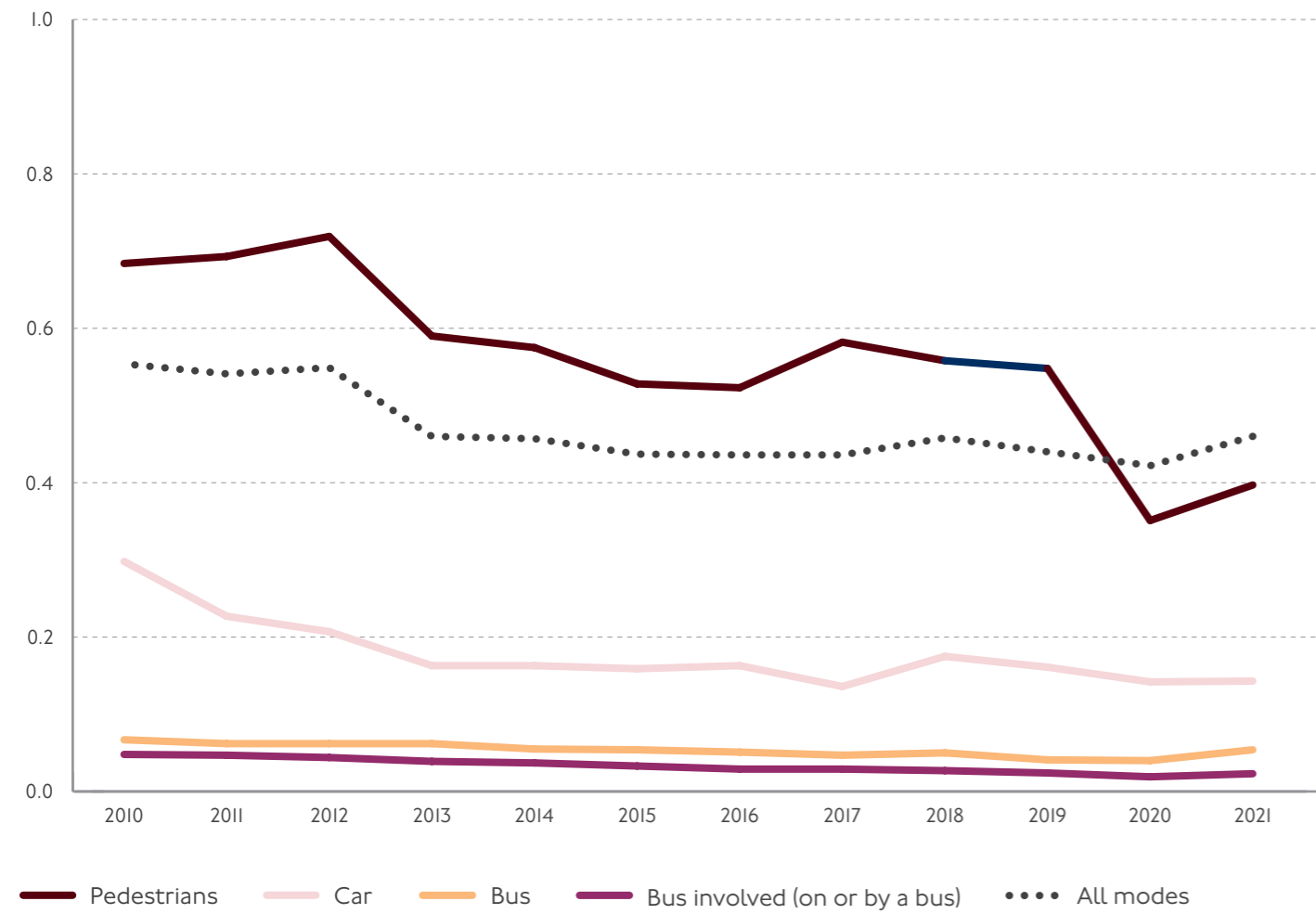
serious injuries, have been in the modes of car occupant, followed by bus-involved and bus occupant, in contrast to all other modes of road transport. Figure 5 (see page 21) shows that buses are the safest way to travel on the roads and carry more people than any other transport mode.

Figure 4: Number of people killed or seriously injured against the 2005-09 baseline (absolute numbers)



Reducing road danger is fundamental to creating Healthy Streets

Figure 5: Risk of death and serious injuries (per million journeys)¹⁵



¹⁵ Latest available data, STATS19, Travel in London 2021, TfL

Risk by mode

Monitoring fatalities and serious injuries involving a bus

People walking form the largest group of those killed on London's roads (41 per cent in 2022), and make up the highest number of fatalities in collisions involving a bus, accounting for 57 per cent of all bus fatalities in the five-year period from 2018 to 2022 (Figure 6). This is followed by bus occupants and people motorcycling, accounting for 17 per cent and 14 per cent respectively, and people cycling, accounting for nine per cent.

When looking at serious injuries in collisions involving a bus, more than three-quarters (76 per cent) involved people walking or bus occupants in 2022 (Figure 7). Over the five-year period from 2018 to 2022, people walking accounted for 32 per cent of all serious injuries involving a bus, and bus occupants accounted for 44 per cent. This was followed by people cycling, people motorcycling and car occupants, each accounting for between six and 10 per cent of all serious injuries.

Figure 6: Bus-involved fatalities by mode of travel (2018-2022)

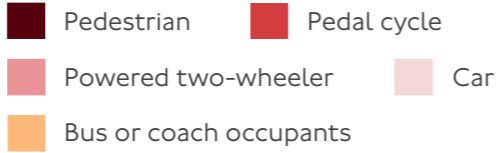
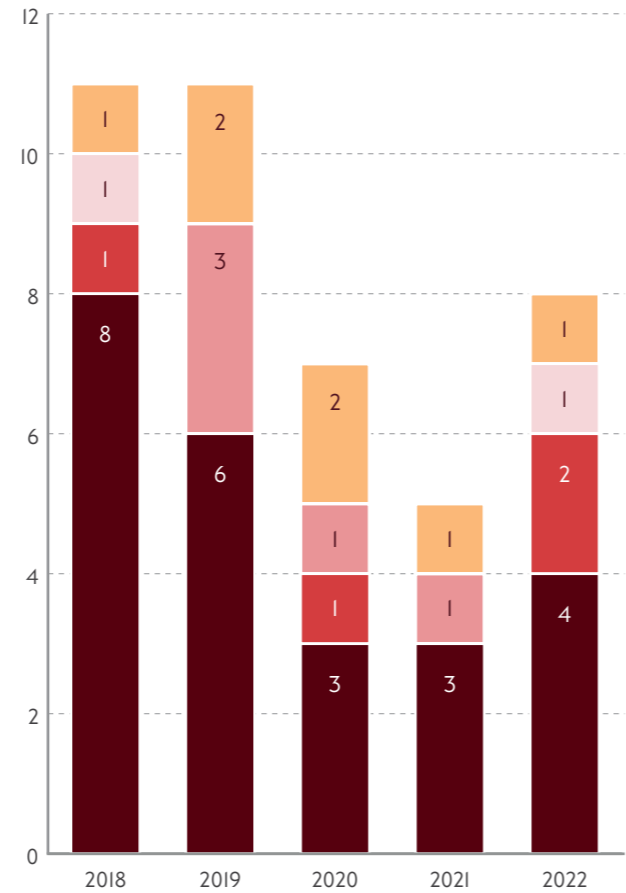


Figure 7: Bus-involved serious injuries by mode of travel (2018-2022)

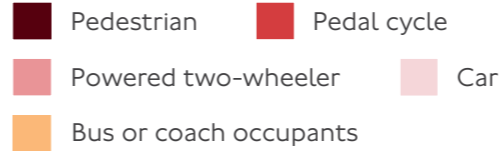
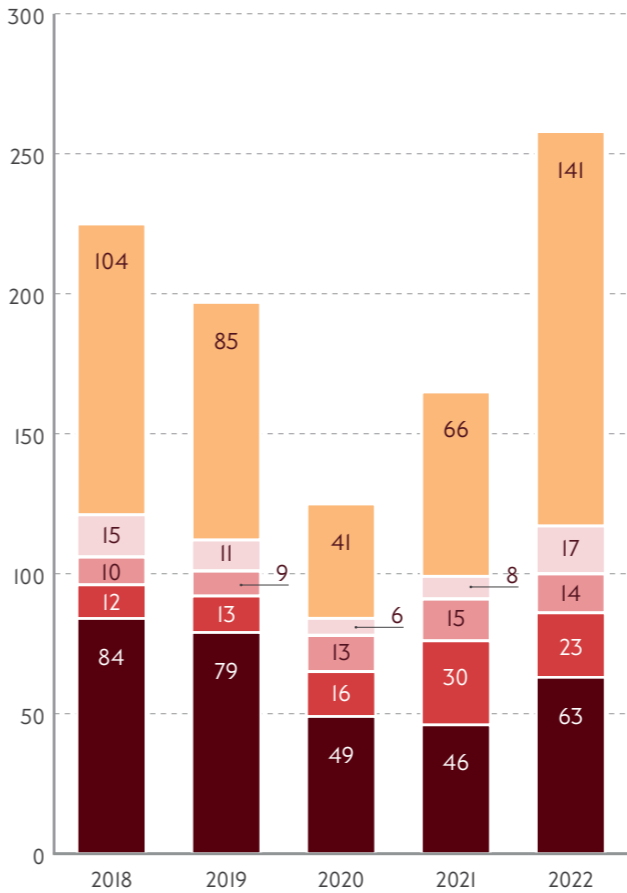
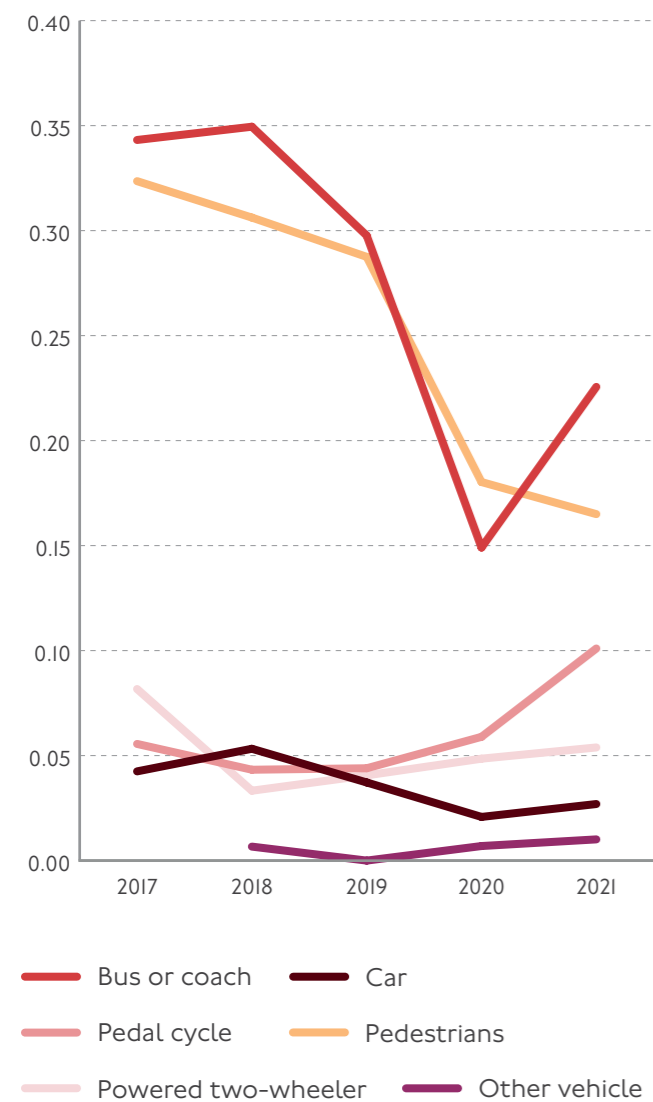


Figure 8: Bus-involved killed and seriously injured risk per million operated miles¹⁶



Travelling by bus is the overall safest form of road transport, but while there has been a continued reduction in the absolute number of people being killed or seriously injured on, or by, a bus, the level of risk reduction is not equal across all modes when a bus is involved in the collision (Figure 8). People walking and driving/riding on the bus have the highest risk of death and serious injury per million operated miles of all modes in collisions involving a bus. The relative risk to people cycling, while lower when compared to people walking and bus occupants, is not trending downwards. In the future, this could mean that, should cycling on London’s roads increase, then the number of people cycling being involved in a collision with a bus also has the potential to increase.

Many of the safety measures included in the Bus Safety Standard roadmap will benefit both people walking and cycling, so the risk to both will reduce as time goes on. We will continue to work with teams across the business to address the danger that buses pose to cyclists, aligning with the Cycling action plan.

We need to continue to address the risk to vulnerable road users from buses, particularly to people walking, who make up the highest number of fatalities in collisions involving a bus, and one of the highest proportions of serious injuries. We also need to look at the risks to people cycling, as well as to bus passengers who account for the largest overall proportion of serious injuries.

Bus passenger risk of being killed or seriously injured has remained relatively static since 2017. There was a small increase in bus passenger risk from 1.3 fatalities and serious injuries per million boarding journeys (in 2019 and 2020) to 1.7 in 2021. The changes being made to bus interiors to improve passenger safety only started to be introduced onto new buses in 2021 in line with the Bus Safety Standard roadmap so the benefits of these measures are not yet there to see in our data. However, we will be closely monitoring bus passenger risk to ensure the benefits of the positive changes we have made are being realised.

It is important that those with the highest risk exposure benefit most from the Bus Safety Programme initiatives over the next few years to ensure that this risk is reduced sufficiently and consistently to result in steady reductions in people being killed or seriously injured on, or by, a bus. Future changes to the Bus Safety Standard in particular need to reflect this approach.

¹⁶ Latest available data, STATS19, Travel in London 2021, TfL

Bus travel demographics

Understanding who is most at risk, and why, is important

As well as a difference in casualty risk by mode of travel, it is also important to understand bus usage and risk by demographics. Research¹⁷ shows that:

- Bus usage is higher among Black, Asian and minority ethnic Londoners, with 65 per cent using the bus at least once a week compared to 56 per cent of White Londoners. The proportion of Black Londoners using the bus at least once a week is 73 per cent
- The bus is the second most frequently used type of transport (after walking) among women, with 65 per cent using the bus at least once a week compared to 56 per cent of men
- Bus use is also higher among Londoners aged 65 or over, with 68 per cent of Londoners aged 65 to 79 using the bus at least once a week. This decreases among Londoners aged 80 or over to 56 per cent
- Regular bus use is common among younger Londoners, with 75 per cent of Londoners aged 11 to 15 years using the bus at least once a week compared to 59 per cent of all Londoners

- Buses are the most commonly used type of public transport (apart from walking) by both disabled and non-disabled Londoners. However, disabled Londoners are less likely to use the bus than non-disabled Londoners, with 82 per cent of disabled Londoners having used the bus within the past year compared to 91 per cent of all Londoners
- People living in households with a lower average income are also more likely to use the bus every day: 30 per cent of Londoners living in a household with an annual income of less than £20,000 use the bus at least five times a week compared to 26 per cent of Londoners with an income of more than £20,000

When considering risk to bus passengers, research shows that older females and children have a higher risk of suffering an injury on board a bus. In terms of risk outside the bus, research shows that those aged 60 years or over are at a higher risk of a fatal or serious injury while walking. Further research is needed to understand these risks in more detail and to ensure that the benefits arising from the Bus Safety Programme are suitably targeting the highest-risk groups. This will be looked at as part of our work both on the Bus Safety Standard and to reduce customer injuries.

Along with bus occupant injuries from collisions involving a bus, there are non-collision incidents where either the bus is stationary and bus passengers slip, trip or fall while boarding or alighting the bus, or when a bus is moving and bus passengers on board slip, trip or fall, often as a result of acceleration, braking or other manoeuvres. While slips, trips and falls are often, but not always, less severe in their consequences than those resulting from collisions, this remains an important focus for bus safety. When an older or more vulnerable passenger is injured, this is more likely to result in a more severe injury or post-event complication than when a younger person may be involved. Every slight injury has the potential to be a more serious injury should circumstances or those involved be a little different.

Bus occupants have experienced the largest decrease in slight injuries against the baseline of period 2005-09 (39 per cent reduction) compared to all other modes, despite a 10 per cent increase in 2022 from 2021.¹⁸

Bus passenger slight injuries are not counted within our Vision Zero target, but we are committed to reducing them and scrutinising our progress regularly within senior management forums and through our Safety, Health and Environment quarterly reports. This supports our wider objectives in buses to ensure an inclusive customer experience where travelling by bus should be easy, comfortable and accessible. A passenger slip, trip or fall resulting in a slight injury may disproportionately affect the confidence of older or disabled passengers to use the bus.

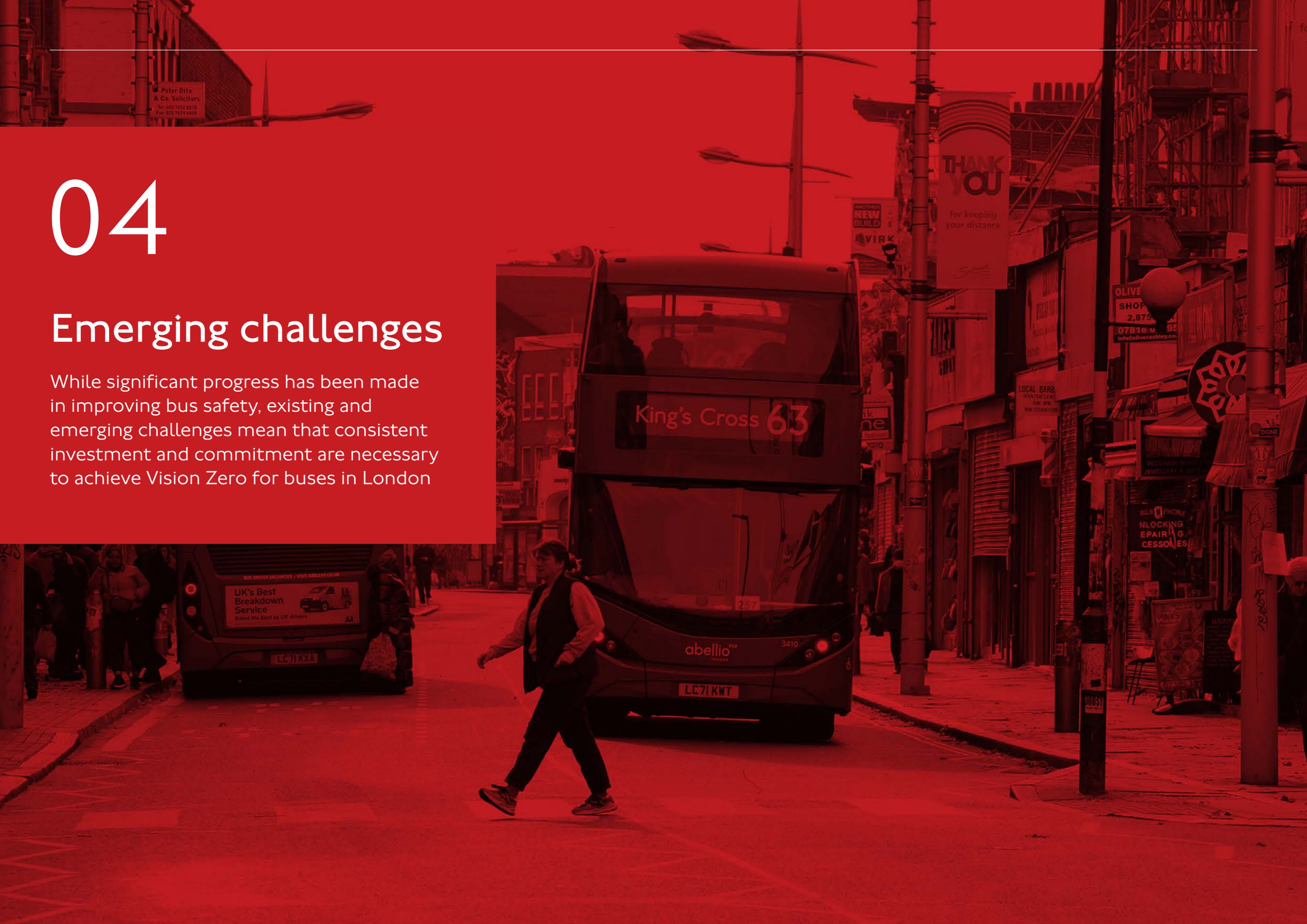
¹⁷ Travel in London: Understanding our diverse communities, 2019

¹⁸ Casualties in Greater London 2022, TfL

04

Emerging challenges

While significant progress has been made in improving bus safety, existing and emerging challenges mean that consistent investment and commitment are necessary to achieve Vision Zero for buses in London



Constant and consistent

There is no simple solution to achieving Vision Zero for buses. It requires continued commitment, ongoing research and a range of interventions consistently applied

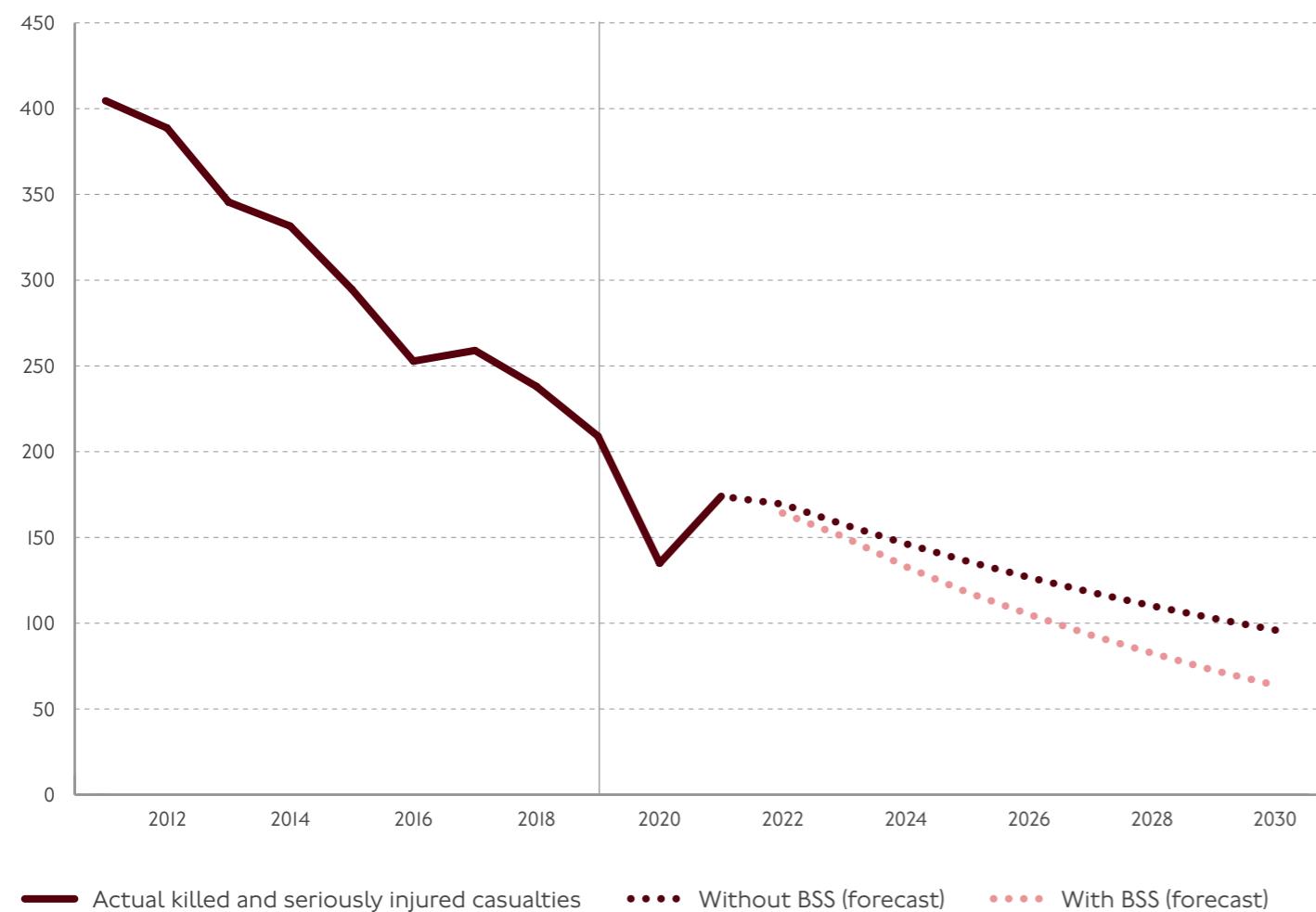
There are many factors that influence safety, which means all aspects of the Safe System need to be considered together. There are factors we can control and wider factors that, although not within our direct control under the Bus Safety Programme or across TfL more generally, we can influence, which will affect our ability to achieve Vision Zero. For example, the Bus Safety Programme can influence TfL's wider implementation of Healthy Streets schemes, and TfL can seek to influence UK and international policies on e-mobility and safety regulations in conjunction with our Vision Zero target timescales.

Through delivery of the Bus Safety Standard – over which the Bus Safety Programme and TfL have the most control – we have forecast that there could be a significant reduction in the number of people killed or seriously injured (see Figure 9). This is based on rolling out our 2019, 2021 and 2024 requirements (set out in our roadmap) to the whole fleet as new buses are introduced each year.

Control and influence



Figure 9: Forecast number of killed and seriously injured with and without the Bus Safety Standard*



* BSS introduced in 2019

If we consider this forecast to be a best-case scenario for the current Bus Safety Standard roadmap and exclude any further additions to the Bus Safety Standard beyond 2024 and all other factors contributing towards our bus safety targets (both within the Bus Safety Programme now, and more widely across TfL, which are less easily quantified), then there remains a gap in achieving our Vision Zero targets, which we must seek to close. This gap has been vastly reduced by the development and delivery of our Bus Safety Standard, which justifies our use of this evidence-led approach to the Bus Safety Programme.

The Bus Safety Standard, while at the heart of the Bus Safety Programme, is just one pillar under which we are seeking to achieve our Vision Zero targets, but it is the easiest to quantify the potential casualty reduction. There are other areas of the Bus Safety Programme that cannot be so easily quantified, as their potential effectiveness is not known or cannot be established, and so these are not included in the forecasts for the Bus Safety Standard set out in Figure 9.

These areas comprise, for example:

- Fatigue management
- Bus driver health and wellbeing
- Destination Zero (our bus driver safety training)

- Technology retrofitted to our bus fleet that enables safety reductions to be achieved sooner, for example our active Intelligent Speed Assistance retrofit programme
- Any additional programmes of retrofit that are being developed now
- Further Bus Safety Standard requirements beyond 2024, including detecting and reducing fatigue and other forms of driver impairment
- More general programmes of activity to reduce traffic levels and improve road user education

The measures that are included in this forecast include all safety requirements up until 2024 in the Bus Safety Standard roadmap, such as:

- Intelligent Speed Assistance; Acoustic Vehicle Alerting System; improved slip-resistant bus flooring (required from 2019)
- Camera Monitoring Systems; wiper protection; runaway bus interlocks (required from 2021)
- Advanced Emergency Braking; optimised bus-front design; enhanced bus occupant-friendly interiors (required from 2024)

To achieve our longer-term 2041 target, some of the activity that contributes to achieving Vision Zero for buses is the responsibility of others to deliver or embed. This relates particularly to our behaviour change activity, as well as to the wider influence on improving the safety culture within the bus industry, both of which require significant commitment from our London bus operators. While we will put in place the activities and measures to support the improved safety outcomes we need, and reduce any barriers to achieving these outcomes, including the monitoring and assurance of the programmes, we have less control over how many of these behaviour change programmes are embraced at an individual level.

This further contributes towards our uncertainty about the size of the gap that remains in achieving our Vision Zero targets for the bus network. In addition, there is also the potential for other emerging risks that could make the gap larger because many factors influence what is happening and, as shown by the pandemic, there is always the potential for disruptions to our plans and assumptions; for example, the increase in micromobility, such as the use of private e-scooters, was not factored into our development of the Bus Safety Standard. It is therefore important to control or mitigate these known risks.

The current risks critical to successfully achieving our Vision Zero targets are:

Fleet renewal

The roll-out of the Bus Safety Standard is dependent on new buses entering the bus fleet each year. As new buses with the new technology replace older buses, our fleet is forecast to become safer. The roll-out of the Bus Safety Standard therefore is highly dependent on the number of new buses joining the fleet each year. If budgetary constraints mean that the life of a bus is extended beyond the normal 14-year maximum, this means that it will take longer for new vehicles fitted with the latest safety systems to enter service and begin to influence our Vision Zero targets. The reduction in services as a result of the Financial Sustainability Plan (2021) has reduced the number of new buses entering the fleet for the past two years.

Effectiveness of new technology

Monitoring the effectiveness of new technology introduced through the Bus Safety Standard is essential to understanding whether the forecast impact of the technology is realised. In-depth research and testing have informed our forecast casualty reductions from the Bus Safety Standard. While TfL thoroughly researches new technologies before putting them into service, to satisfy ourselves that they are as safe as can be, given that many of the measures we have introduced, or that are due to be introduced, are innovative, there remains an element of uncertainty as to the exact effect, particularly in terms of any unintended behaviour and consequences from new technology. This is an entirely new area of research in some cases, not only for buses, but for the wider transport industry.

One example of this is the performance of Advanced Emergency Braking, which is a requirement for new buses from 2024. Our current forecast of the number of casualties this can prevent is based on a predicted level of braking that offers the greatest potential to avoid or mitigate collisions with vulnerable road users. However, if systems come forward with lower levels of braking than anticipated, then the potential to avoid or mitigate collisions with vulnerable road users will be lower than currently forecast.

London is the first city to require Advanced Emergency Braking on city buses – this system is therefore being used in a more complex urban environment than on motorways for example, which means there are unknowns in terms of the system capabilities and the effectiveness of the technology. Monitoring is therefore essential to our roll-out of Advanced Emergency Braking on new buses.

Mode share

We have a long-term target to increase the proportion of journeys in London made by walking, cycling and public transport to 80 per cent by 2041, from the current rate of 61 per cent. This shift away from private vehicles to sustainable modes will reduce road danger risk overall, however an increase in the number of people walking and cycling also increases the potential conflicts with buses and the possibility that some of these will result in a collision. A joined-up approach to ensuring safe vehicles, safe speeds, safe behaviours and safe streets is therefore fundamental to reducing road danger for, and from, buses.

All other things being equal, an increase in travel by a mode of transport increases the overall exposure to risk for that travel type.

An increase in the number of people walking, people cycling and bus occupants means the potential number of casualties also increases. Measures to reduce the road danger from buses and to ensure safe and Healthy Streets are therefore fundamental to enabling increased sustainable travel.

Deviation from the Bus Safety Standard roadmap

While the first Bus Safety Standard roadmap sets out our requirements for new buses, the delivery of the additional safety features requires considerable investment by bus manufacturers and assumes that delivery keeps pace with technology advancement, particularly the 2024 requirements.

The pandemic has affected the entire supply chain's ability to achieve the estimated timescales, and this has been compounded by ongoing market instability, including TfL's own reduction in the number of new buses required, impact on research delivery and budgetary constraints. This has resulted in some deviation from the roadmap and some unavoidable derogations granted to new buses entering the fleet in order to ensure the continued bus supply required to achieve wider TfL goals such as improving air quality. While efforts are made to minimise the impact and to offset the deviations, there will inevitably be some detrimental impact on our casualty reduction forecast.

Stakeholder challenge

'Buses are more in our control than any other vehicle type, therefore a more ambitious Vision Zero target has been set, of zero deaths on, or by, a bus by 2030.'

Through our Bus safety strategy engagement, it was evident that a key challenge is the avoidance of perverse incentives and rewards, in particular the need to ensure that safety measures do not add substantial cost to bus operations, which may impact fares and make the bus less attractive to users. If people move to more dangerous modes such as cars or scooters, then overall safety will get significantly worse. If bus usage goes down, so will bus mileage as passengers are consolidated on fewer buses, again reducing the service level and attractiveness. Therefore, ensuring buses are attractive and accessible is a key part of achieving Vision Zero as well as adhering to the Bus action plan.



Making buses an attractive option is fundamental to achieving Vision Zero

Emerging risks

The number of e-scooters started to grow before the pandemic, despite being illegal and uninsured for private use on public highways, and represent a new safety risk for buses. In the future, they may be legalised with other vehicles under a new vehicle class, and would therefore become part of the range of vehicles on the road that will need to be considered under the Bus Safety Programme. E-scooters are just one example of an emerging trend towards small lightweight vehicles, including e-bikes and e-cargo bikes, which can range from the size of a pedal cycle to something that looks like a miniature van and typically reaches higher speeds. These are legal variants of a bicycle and so can legally go where a cycle goes, including cycle lanes and most bus lanes. These represent new risks on the road network to achieving our Vision Zero targets that require monitoring.

Similarly, the increasing automation of vehicles over the time period of the Vision Zero targets may bring new risks and opportunities in terms of what road users are used to, how they behave and how manually driven and automated vehicles interact.

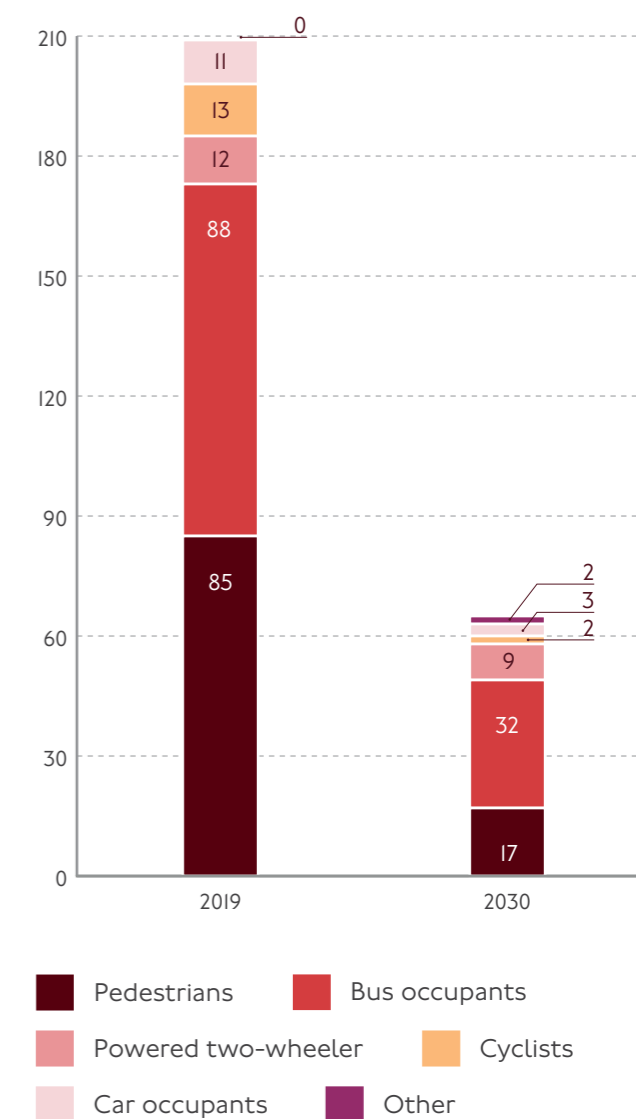
Building on the forecasts for casualty reductions earlier in this chapter, estimated by the introduction of our Bus Safety Standard, Figure 10 shows the breakdown of serious casualties on, or by, a bus by mode in 2019 along with a forecast of what casualties may remain after the roll-out of our current Bus Safety Standard for 2030. Again, these forecasts do not take into account the harder-to-quantify benefits of the Bus Safety Programme, such as alleviating fatigue, and enhancing health and wellbeing, or the wider contribution of safety improvements from other programmes across TfL. However, reviewing the breakdown of forecast casualties over time allows us to look forward to determine if we are applying the Bus Safety Standard most effectively, and where we should be focusing our funding investment.

The 2019 breakdown shows an even split between bus occupants and people walking for serious injury casualties, but when only fatalities are considered, the majority (55 per cent) are people walking. The 2030 forecast for serious injury casualties shows increasing importance for bus occupants and powered two-wheelers, and a decreasing proportion of casualties among people walking and cycling.

This is because the majority of measures currently in the Bus Safety Standard target people walking as they make up the most significant proportion of fatalities and one of the highest proportions of serious injuries. Moreover, a number of the measures in the Bus Safety Standard that aim to reduce casualties among people walking also benefit people cycling.

Therefore, in 2030 there remains a particular gap in measures in the Bus Safety Standard that address bus occupant casualties. While the absolute number of bus occupant casualties is forecast to reduce over time to 2041 (88 in 2019 to 27 in 2041), of these remaining casualties still forecast as likely to occur in 2041, bus occupants will form the largest proportion.

Figure 10: Breakdown of seriously injured casualties, on or by a bus, in 2019 and forecast in 2030, based only on delivery of the Bus Safety Standard



Effectiveness of measures

As the Bus Safety Standard was only introduced in 2019 on a rolling basis, there is not yet sufficient data to comprehensively understand the benefits of the measures introduced on new buses to date. In addition, the coronavirus pandemic significantly impacted travel demand and therefore our ability to draw trends in casualty numbers over the past two years. Benefits monitoring is therefore a key part of the continued roll-out of the Bus Safety Standard to understand both the individual and combined impact of the measures.

Limited window of opportunity

The 2024 requirements for the Bus Safety Standard are finalised and the next set of the requirements that can be introduced are due in 2027, which means the window of opportunity to roll out new technology on buses through the Bus Safety Standard is limited before 2030. Retrofitting technologies provides an opportunity to ensure existing buses in the fleet meet the latest Bus Safety Standard requirements and will take us closer to achieving our Vision Zero target. However, for older buses soon to leave the fleet, the economic viability of retrofitting technologies is reduced and some elements, such as front-end design, cannot be cost-effectively retrofitted.

There are also several activities within the wider Bus Safety Programme for which a casualty reduction forecast cannot be quantified. These include workstreams to influence behaviour and safety culture, including fatigue management, health and wellbeing, and training.

Active risk management

Continued risk management is needed to understand new challenges and issues ideally before they emerge, but also to respond to them. For example, pedal application error is an event where a driver mistakenly presses the accelerator in the honest belief that they are pressing the brake, or vice versa. While this is a rare event, the potential impacts are significant, which means active risk management is necessary.

Other risk management areas include:

- Bus fires – while there have been no significant injuries related to bus fires to date, this requires careful management and mitigation to reduce the potential risk
- The changing bus fleet – the future TfL bus fleet will be different from the majority of today's bus fleet. For example, currently around 10 per cent (970) of the bus fleet is zero emission, and this will continue to rise significantly over the coming years as we work towards our zero carbon goals. The risks associated with these vehicles are not the same as those for the older diesel buses or hybrid bus models typically in use today

Diminishing return on investment

Sustained investment is needed in all areas of road safety including roads policing, enforcement, asset management, and Healthy Streets. New actions to ensure we meet our Vision Zero targets also require additional investment and, as the number of casualties falls, the measures required to prevent the remainder of casualties will become more challenging.

Historically, road transport has a poor safety record, but over the last two to three decades, this has improved significantly, with substantial investment and commitment to reducing road deaths and serious injuries. As the number of people killed or seriously injured on, or by, a bus in London has significantly fallen over the past decade and continues to fall, a key challenge will be addressing the remaining casualties. These will be rarer events, where drawing meaningful conclusions will become more challenging, and the issues to be addressed and measures needed are likely to become progressively harder to solve.

As buses move towards our Vision Zero targets, we will be ahead of other sectors of road transport. In a time of budget limitations, our increased need for investment to achieve Vision Zero early will be competing for investment with other safety interventions outside buses that may well offer much better returns on investment because they will be coming from a poorer baseline. Therefore, as we progress towards Vision Zero, the model of safety improvement action is likely to shift from the traditional road safety approach towards the rail or air modes where safety cultures and a target of zero fatalities have been embedded for a much longer time.

Illustrating this point, the air accident investigation branch of Government was established in 1915 and the rail equivalent was established in 2005. A Road Safety Investigation Branch was only announced in summer 2022 and is not yet up and running. Considerable investment has continued in rail safety while the number of fatalities is low, and we believe this is what is needed in road transport, not only to get close to achieving Vision Zero, but also to maintain it over a prolonged period, as has been achieved in the rail sector.

05

The Bus Safety Programme

We seek to strengthen all components of the system through our Bus Safety Programme, which encompasses safe vehicles, safe speeds, safe streets, safe behaviours and post-collision support and investigation



The Bus Safety Programme

The programme follows the Safe System approach to road safety – seeking to strengthen all components of a system. If one were to fail, people are still protected by others

The Bus Safety Programme was established in 2016 to address a strategic gap in the bus business area at TfL, and concern about the level of people being harmed on the bus network. Later, it was adapted to support the Vision Zero targets for buses set out in the Mayor's Transport Strategy and Vision Zero action plan in 2018. The Bus Safety Programme is also one of the five priorities within our Bus action plan.

The Bus Safety Programme is fully integrated within Bus Operations and has continued to evolve since its inception, with new workstreams and initiatives incorporated as risks and priorities have developed and, importantly, it is always evidence-led. Culture change is fundamental to delivering Vision Zero for buses and we are committed to achieving this in partnership with the bus industry.

'The Bus Safety Programme has provided an excellent opportunity to work together and share best practice, irrespective of size of bus operator. We understand that TfL also like to see this level of engagement and collaboration between operating companies'

Richard Todd
Head of Operations, Uno Buses



Collaboration between bus companies is essential to improve safety



Safe vehicles

All buses using London’s roads must have safety at the forefront of their design

Bus Safety Standard – what we are doing

The Bus Safety Standard, developed with the Transport Research Laboratory and launched in October 2018, contractually requires the use of safer vehicles, and supports safer behaviours and speeds, specifying safety requirements that new buses entering service in London must meet. These safety requirements for new buses were first specified in 2019, with subsequent requirements in 2021; the next set of measures are due to be introduced in 2024. The safety requirements extend over four different areas: driver assist, partner assist, occupant protection and partner protection.

- Driver assist: covers features intended to help the driver to avoid or mitigate the severity of a collision (also known as Advanced Driver Assistance Systems)
- Partner assist: helps other road users to avoid a collision
- Occupant protection: aims to minimise injury to bus drivers and passengers if a collision occurs
- Partner protection: aims to minimise injury to other road users if they become involved in a collision with a bus

The 2019 safety measures include: Intelligent Speed Assistance, which limits buses to the posted speed limit; an Acoustic Vehicle Alerting System for quiet-running vehicles to ensure the bus is audible to road users outside the bus; non-slip flooring to reduce passenger slips, trips and falls; pedal indicator lights to reduce incidences of pedal application error; and blind spot mirrors to increase visibility of vulnerable road users.

The 2021 safety measures include: Camera Monitoring Systems that replace wing mirrors in order to reduce blind spots; additional occupant-friendly interior measures; and a mechanism to prevent the bus from moving when the driver leaves the cab, substantially reducing the risk of rare but potentially dangerous bus rollaway incidents.

The Bus Safety Standard is evolving as new technology and insights are developed, with the next set of measures to be introduced in 2024, including Advanced Emergency Braking and a new bus front-end design to reduce the impact in the event of collisions.

Bus Safety Standard measures

Driver assist

Helping the driver to avoid or mitigate the severity of incidents:

- Advanced Emergency Braking
- Intelligent Speed Assistance
- Improved direct and indirect vision
- Pedal application error
- Runaway bus prevention

Occupant protection

Reducing severity of injuries for people on board the bus:

- Occupant-friendly interiors
- Slip protection

Partner assist

Helping other involved road users – the collision partners – to avoid the collision:

- Acoustic conspicuity
- Visual conspicuity

Partner protection

Reducing severity of injuries for road users outside the bus in a collision:

- Vulnerable road user frontal crashworthiness

Advanced Emergency Braking

We first began discussing the potential for Advanced Emergency Braking to address fatalities among people walking as early as 2015. By 2017, Alexander Dennis was developing and trialling a prototype that formed the basis of the assessment in the 2018 Bus Safety Standard work. Once that work had shown that the benefits of Advanced Emergency Braking were likely to substantially outweigh the additional risks to bus occupants from false positive activations (where a system alerts in error), it was expected that some production versions could start entering the fleet as early as 2019.

However, while the market for Advanced Emergency Braking is global, it is focused on the high-volume passenger car market, and development is expensive. Combined with ongoing concerns about potential impacts on unrestrained or standing passengers, the response from the market was much more cautious and conservative than expected.

While we are delighted that Mercedes can offer Advanced Emergency Braking on its buses, and that ZF has publicly announced the availability of the first independent system ahead of the 2024 schedule, it has taken more work and more time than anticipated to reach this stage.

The systems are now expected to limit deceleration by more than originally thought (in other words, they will deliver more gradual braking), which may reduce effectiveness. These developments have shown how hard it can be for one city alone to move an international market.

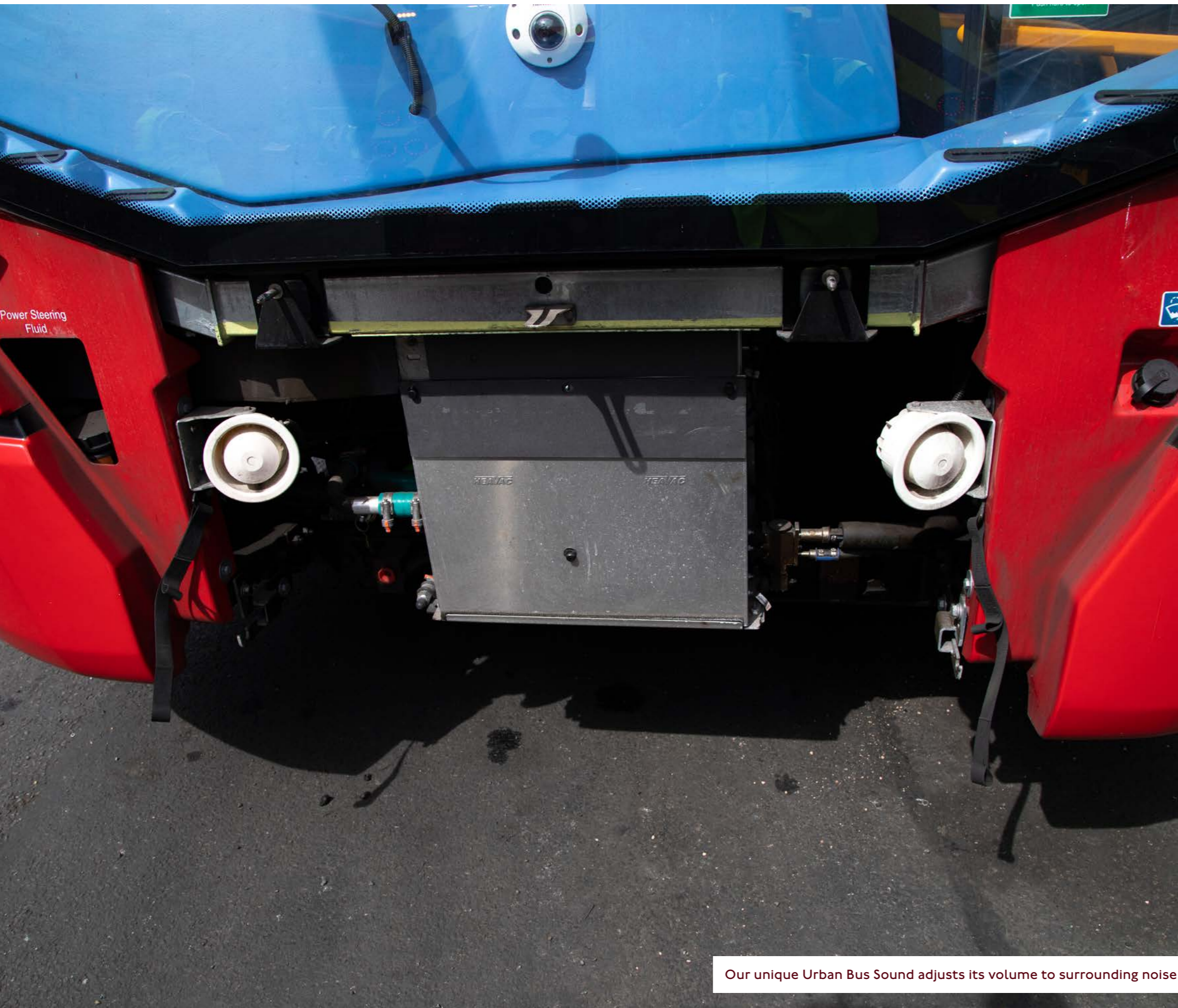
Stakeholder challenge

'Bus drivers are not always braking hard enough to avoid a collision for fear of hurting passengers'

Bus drivers have a duty of care to their customers and should brake as gently as they can to minimise the chance of injury to bus passengers. However, when facing an imminent collision, harsh braking is needed to avoid a collision. The risk of a serious injury to someone walking, cycling or even riding a motorcycle greatly exceeds that posed to bus passengers by braking. In instances of an imminent collision with a heavier, better protected vehicle, the impact is likely to represent at least as big a risk to passengers as would the extra braking to avoid the collision.



Emergency braking systems have been shown to reduce fatalities



Our unique Urban Bus Sound adjusts its volume to surrounding noise

Acoustic Vehicle Alerting System

We introduced an Acoustic Vehicle Alerting System for new buses in 2019. We exceeded the United Nations Economic Commission for Europe regulatory requirements by developing a unique Urban Bus Sound to ensure it was distinguishable over typical city background noise. We improved acoustic conspicuity compared to a diesel bus, with the sound required even while the bus is stationary to help blind and visually impaired bus passengers. The Urban Bus Sound also includes a 'beacon' element to provide directionality to blind and visually impaired people or anyone not looking at a bus.

More recently, we have developed a responsive Acoustic Vehicle Alerting System, which adjusts the sound levels to the ambient environment, increasing the volume in busy areas and lowering in quiet areas. To develop this, we worked closely with bus operators, bus manufacturers and suppliers as well as a range of stakeholders including bus users, pedestrians, blind and visually impaired people, and a representative from Tranquil City (an urban calm initiative).

In response to strong stakeholder feedback, we have made our Urban Bus Sound available to the bus industry via licence to ensure it can only ever be used by buses. We have also presented our work on the Acoustic Vehicle Alerting System to the Institute of Acoustics.

Blind spot mirrors and camera systems

As part of measures to improve direct and indirect vision, blind spot mirrors were introduced on new buses in 2019 and were retrofitted to the entire bus fleet.

Further improvements were made in 2021 with the introduction of Camera Monitoring Systems for new buses, which are a combination of cameras placed outside the bus along with corresponding monitors inside the driver's cab. The system removes the risk of mirrors hitting someone walking or infrastructure, significantly reduces blind spots and assists drivers by improving visibility in adverse conditions and low lighting as well as enhancing hazard perception



Blind spot mirrors improve visibility for bus drivers



External cameras connect to monitors in the driver's cab

‘The mirror screens are great, no danger of hitting the left mirror on bus stops or shelters’

‘The mirror screens work very well in bad weather, especially when it's raining’

Metroline drivers
on Camera Monitoring Systems

Collision Alerting Technology

Through our 2018 Bus Safety Innovation Challenge, bus operator Abellio led a trial with Mobileye, technology that provided an alert to the driver when the system deemed there was a risk of an imminent forward-facing collision with another vehicle or someone walking or cycling. While Mobileye's technology is widely used in the automotive and haulage industries, this was the first trial with a bus in London.

During the trial period, there was a 26 per cent reduction in collisions across the three bus routes included in the trial. A reduction in passenger injuries was also observed, with the technology encouraging drivers to keep a greater distance between their vehicle and that in front, which allows more time to plan and react smoothly.

Abellio won the 'Most Innovative Transport Project' at the 2020 London Transport Awards for its trial with Mobileye. While this is not a prescribed part of the Bus Safety Standard, other operators are undertaking their own trials and adopting this technology.



Collision Alerting Technology gives more time to react to hazards ahead

Bus Safety Standard

The people and organisations that make a real difference to transport in the capital have been recognised at the London Transport Awards. The Bus Safety Standard was shortlisted and commended under the 'Most Innovative Transport Project' category at the 2019 London Transport Awards.



1,065

buses fitted with new Intelligent Speed Assistance technology, limiting buses to the posted speed limit

925

new buses are fitted with the Acoustic Vehicle Alerting System for quiet-running buses



971

new buses fitted with Camera Monitoring Systems

Figures correct as at June 2023

Bus Safety Standard – what next?

The 2030 Vision Zero target for zero deaths on, or by, a bus was the most immediate focus in the development of the Bus Safety Standard, with around 75 per cent and 50 per cent of the fleet respectively meeting the subsequent 2021 and 2024 iterations of the standard. It is anticipated that, given the rate of roll-out of new buses, by 2030 most of the London bus fleet will meet the 2019 Bus Safety Standard requirements. The aim is to address collisions and injuries in various scenarios involving a range of road users, the most advanced being primarily intended to reduce or mitigate collisions involving people walking.

The next iteration of the Bus Safety Standard will require further safety measures from 2027 in line with the three-yearly development cycle, and at that point there will be only three years until the 2030 Vision Zero target for zero fatalities on, or by, a bus. Given the rate of new buses entering the fleet, less than a quarter of all London buses will be expected to comply with the 2027 standard by 2030, which limits the influence it can have on the 2030 target. As such, the main 2041 Vision Zero target of no-one to be seriously injured on, or by, a bus becomes the main priority for the Bus Safety Standard beyond 2024.

As demonstrated in Chapter 4, when serious collisions are considered on their own, and the forecast benefits of the existing measures are taken into account, then in 2041 more than half of the remaining casualties involving people seriously injured would be bus occupants, unless further interventions are made, with people walking accounting for just 14 per cent. This demonstrates the estimated effectiveness of the strategy initially taken by the Bus Safety Standard and the need to continue to find ways to further reduce casualties among people walking. It is also very important to increase the emphasis on lowering the number of casualties involving bus occupants, and on reducing the risk to people cycling.

It is critical to keep the Bus Safety Standard relevant and up-to-date in a changing environment, reflecting technology development in the wider transport market. Monitoring the real-world performance of measures already implemented will form an important part of this, learning from what has worked well and what has worked less well to inform the continual improvement of standards.



Reducing collisions with people walking and cycling is a priority

The future development of the Bus Safety Standard will focus on the following areas:

- Developing new features and technology to prevent and mitigate bus occupant injuries, including reducing risk exposure across all bus occupant groups
- Investigating driver impairment, including looking further at bus driver fatigue and distraction, as well as drugs and alcohol. We will assess the potential for fatigue detection technology, which identifies if a driver is drowsy or distracted, and issues a warning to the bus operator. Fatigue detection technology aims to help reduce fatigue-related incidents and, importantly, support a more open culture within the bus industry on managing fatigue. We will also investigate the potential for alcohol interlocks and drug detection to be introduced on vehicles, which require a driver to blow into a breath-testing instrument before the vehicle can be used
- Looking at the bus driver cab design for opportunities to reduce driver distraction and cognitive overload, improve safety and ergonomics, and enhance CCTV in the driver cab. The new iBus and ticketing systems give us the opportunity to review the cab layout
- Investigating the potential to develop our requirements in the Bus Vehicle Specification, improving the use of telematics
- Making changes to the Bus Vehicle Specification and new features to reduce and mitigate pedal application error. This will include looking at the potential for an acceleration suppression system, as well as considering the pedal layout, standards on regenerative braking and the introduction of Pedal Acoustic Feedback
- Assessing the potential for the evolution of standalone Advanced Driver Assistance Systems into a comprehensive driver assistance package. In isolation, Advanced Emergency Braking reacts only when a collision is imminent, in order to avoid annoying, confusing or distracting an alert driver who was in control. It could also evolve to detect more objects such as e-scooters, and respond in different collision circumstances, such as vehicles crossing the path of the bus at higher speeds than pedestrians. It could even link to fatigue detection technology, so that if a driver's inattention is identified and there is a risk of a collision, it could intervene earlier. In some circumstances, it could improve the ability to avoid collisions; in others, it will reduce the braking deceleration needed to avoid a collision. This would benefit people outside the bus and bus occupants alike
- Investigating ways in which connected and autonomous technology can be used to improve bus safety
- Assessing whether there is the potential for gender or demographic biases in the level of protection offered by buses, both inside and outside the bus. In passenger car crash testing, the use of average-sized male test dummies has led to sub-optimal protection for women, as well as small or tall occupants

Action I

- a. Continue the roll-out of the Bus Safety Standard on new vehicles, with all existing measures mandated by 2024. Retrofitting safety features to bring forward the benefits resulting from a reduction in the number of casualties, and continuing to incorporate evidence-based safety measures
- b. Research and develop new measures and requirements for inclusion in the Bus Safety Standard beyond 2024
- c. Continue to investigate how improved connected and autonomous vehicle technology can further help our Bus Safety Programme

Bus fires

Bus fires, and any injury that occurs as a result, are not counted towards our Vision Zero target unless the cause of the fire is initiated from a collision. However, to ensure a systematic approach is taken to address the actual and potential risks of fire within our changing bus fleet, we are developing a new workstream on bus fires.

While bus fires are already a risk with diesel-powered buses, electric and hydrogen vehicles introduce new fire risks, while also eliminating others. For example, lithium-ion batteries can suffer a problem known as thermal runaway, and with the amount of energy stored they can burn very hot – resulting fires can spread easily to nearby objects, give off toxic fumes and need a lot of water over a long time to cool them down. A fire that appears to be extinguished can re-ignite a significant time later.

Hydrogen fuel cell vehicles will usually also have a lithium-ion battery. In addition to this, hydrogen is very easily ignited, can detonate explosively if allowed to collect in an enclosed area and burns with a near-invisible, colourless flame. It also dissipates quickly in ventilated areas and quickly rises, so a flame can move rapidly upward and away from the vehicle, endangering other at-risk objects or people at ground level.

Strict regulations already exist to minimise the likelihood of a fire, but as an industry we need to learn how to adapt our processes, checks and balances to deal with the different risks from zero-emission buses.

We are working with bus operators, manufacturers, suppliers and the London Fire Brigade to develop a new programme of activity to address the risk posed by bus fires. This will look at the current and future fleet profile, at areas including battery safety, battery fire suppression systems, charging arrangements, fire escape equipment and procedures, incident alerting systems for controllers and engineers, and the integration of bus fire incidents into wider TfL fire safety processes and reporting. The bus industry, including manufacturers, is fundamental to developing and implementing measures to address the risk posed by bus fires.

Action 2

Continue to develop and implement a bus fires workstream during 2023 to ensure a systematic approach to address the actual and potential risks of fire within our changing bus fleet.

Pedal application error

Pedal application error (also known as pedal confusion) is where drivers of any vehicle mistakenly press the accelerator in the honest belief that they are pressing the brake, resulting in unintended and uncontrolled acceleration, with a high collision risk. Drivers may also mistakenly press the brake pedal instead of the accelerator, which may contribute to passenger injuries.

We first commissioned research in 2011 to identify potential solutions to pedal application error. This research pre-dates the Bus Safety Programme and only draws from diesel buses, which were the only bus type in London's fleet at the time, although pedal application error was later researched as part of the development of the Bus Safety Standard. This research sets out five safety measures to be implemented within the standard to try to prevent pedal application error, to assist the driver to recover before a collision occurs, or to intervene to prevent a collision.

More recently, we commissioned AECOM to undertake further research into the frequency of pedal application error occurrence and the number of incidents that potentially go unreported by bus drivers, along with the possible causes and solutions. This report sets out several recommendations that we are taking forward, working closely with bus operators, to build upon our existing work to explore pedal layouts, acceleration rates, enhanced driver training and Pedal Acoustic Feedback for quiet-running buses. The development and implementation of new measures to address pedal application error also relies on bus manufacturers and suppliers.

Action 3

Implement the pedal application error workstream to further research and identify measures to avoid and mitigate the potential for pedal application error by 2024.



Pedal Acoustic Feedback

Quiet-running buses, which include electric, hydrogen and hybrid buses, do not have an engine sound when the accelerator is pressed, unlike diesel buses. Pedal Acoustic Feedback, a requirement in our Bus Safety Standard roadmap, is a system fitted to quiet-running buses that provides an audible cue to a driver about acceleration, with the aim of helping the driver recover from an incidence of pedal application error.

We are developing a bespoke Pedal Acoustic Feedback sound that will provide a consistent sound across the bus fleet in London. We have engaged with bus drivers to help inform its development and we are now planning to undertake a small trial of the Pedal Acoustic Feedback on route 100 with Go Ahead.

Through this trial, we will seek feedback from the unions, bus drivers and other bus operator teams, including engineering, safety and operational managers. This will inform our performance requirements for Pedal Acoustic Feedback in our Bus Vehicle Specification, which new buses entering the London fleet will be required to meet.

Retrofitting existing buses in the fleet – what we are doing

Retrofitting Bus Safety Standard technologies onto existing buses allows their casualty reduction potential to be achieved much faster than relying only on new vehicles entering the fleet being compliant with the Bus Safety Standard. This is a particular advantage in respect of achieving the 2030 Vision Zero target.

Retrofitting existing buses in the fleet is however more expensive than introducing measures for new buses through the Bus Safety Standard. Not only does it bring forward an investment that would otherwise be spread over around seven years into a much shorter period, there are installation costs that can be significantly higher than a process integrated into a manufacturer's new-build line; it also requires buses to be taken out of service, incurring vehicle downtime costs.

The effective service life of the systems in London can also be less, depending on the age of the vehicles that are retrofitted. Depending on the technology, it may also be harder to integrate new systems into an existing vehicle than on a newly built bus. There is a careful balance to strike therefore in the technologies and buses that are selected to be retrofitted to ensure good value for money.

Intelligent Speed Assistance technology has been a requirement for new buses since the launch of the Bus Safety Standard, but we have also worked to activate a similar version of the technology on some existing Volvo buses in the fleet. Since 2021, we have additionally retrofitted 1,200 buses with Intelligent Speed Assistance. This means that around one third of the bus fleet is fitted with Intelligent Speed Assistance.

Retrofitting existing buses in the fleet – what next?

We will prioritise the retrofitting of technologies that provide the greatest potential to reduce road danger and provide value for money. The following retrofits have been identified as priorities:

- Intelligent Speed Assistance – while 1,200 buses have been retrofitted to date, there are approximately 1,800 buses, which will remain in the fleet until 2030, that do not have Intelligent Speed Assistance. The priority is therefore to retrofit these remaining buses. This will ensure the majority of buses in the fleet have this speed-limiting technology by 2030
- Acoustic Vehicle Alerting System – while this has been a requirement for new buses entering the fleet since 2019, there are a number of existing quiet-running buses (including electric, hydrogen and hybrid buses) in the fleet that do not have this technology. This lack of audible cues on these quiet-running buses therefore presents a risk, particularly to blind or partially sighted road users who may rely on this feature more than most of the population to identify the presence of a bus. A key priority is therefore to retrofit existing quiet-running buses with the Acoustic Vehicle Alerting System

- It is also our ambition to upgrade buses that already have the Acoustic Vehicle Alerting System to the new responsive system, which provides greater acoustic conspicuity in busier locations, while reducing the potential for noise nuisance in quieter locations
- Camera Monitoring Systems have been a requirement for new buses entering the fleet since 2021 and have significantly reduced drivers' blind spots, and improved visibility in poor lighting and adverse weather conditions. They have also importantly removed the risk of bus wing mirrors hitting someone walking or infrastructure. The majority of the bus fleet however does not have Camera Monitoring Systems, and it is therefore an ambition to retrofit existing buses

In the future, there may be other technologies that would be suitable for retrofitting, such as fatigue detection technology or vulnerable road user collision alerting systems.

Action 4

Bring forward the safety benefits from new vehicle technologies by retrofitting existing buses in the fleet with technologies that provide the greatest potential to reduce road danger and provide value for money.

20 Safe speeds

The speed at which a vehicle travels is a major factor in the level of danger it poses to its occupants and to other road users

Safe speeds – what we are doing

Collision data from around the world is very clear. It shows that, the faster a vehicle is travelling, firstly the more likely it is that a collision will occur because the driver has less time to react, stop or avoid the collision; and secondly the more severe an injury resulting from the collision will be. Reducing vehicle speeds is the single most important determinant of both the likelihood of a collision occurring and the severity of any injuries sustained.

Through our Lowering Speed Limits programme, we have already introduced a new 20mph speed limit on many roads making up the TfL road network, including those roads within the central London Congestion Charging Zone and other key locations. We are planning to have a 20mph speed limit on more than 220km of our network by May 2024. Currently, more than half of London's roads are subject to a 20mph speed limit, of which 142km is on the TfL road network. Around one third of London's roads are used by buses.

Lower speeds can also smooth traffic flow, reducing the amount of acceleration and braking between traffic signals and junctions. This can improve bus passenger safety and comfort on board, especially for those standing. Fewer collisions also mean less disruption to the bus network, ensuring that it remains the most attractive means of travel by road for longer distances.

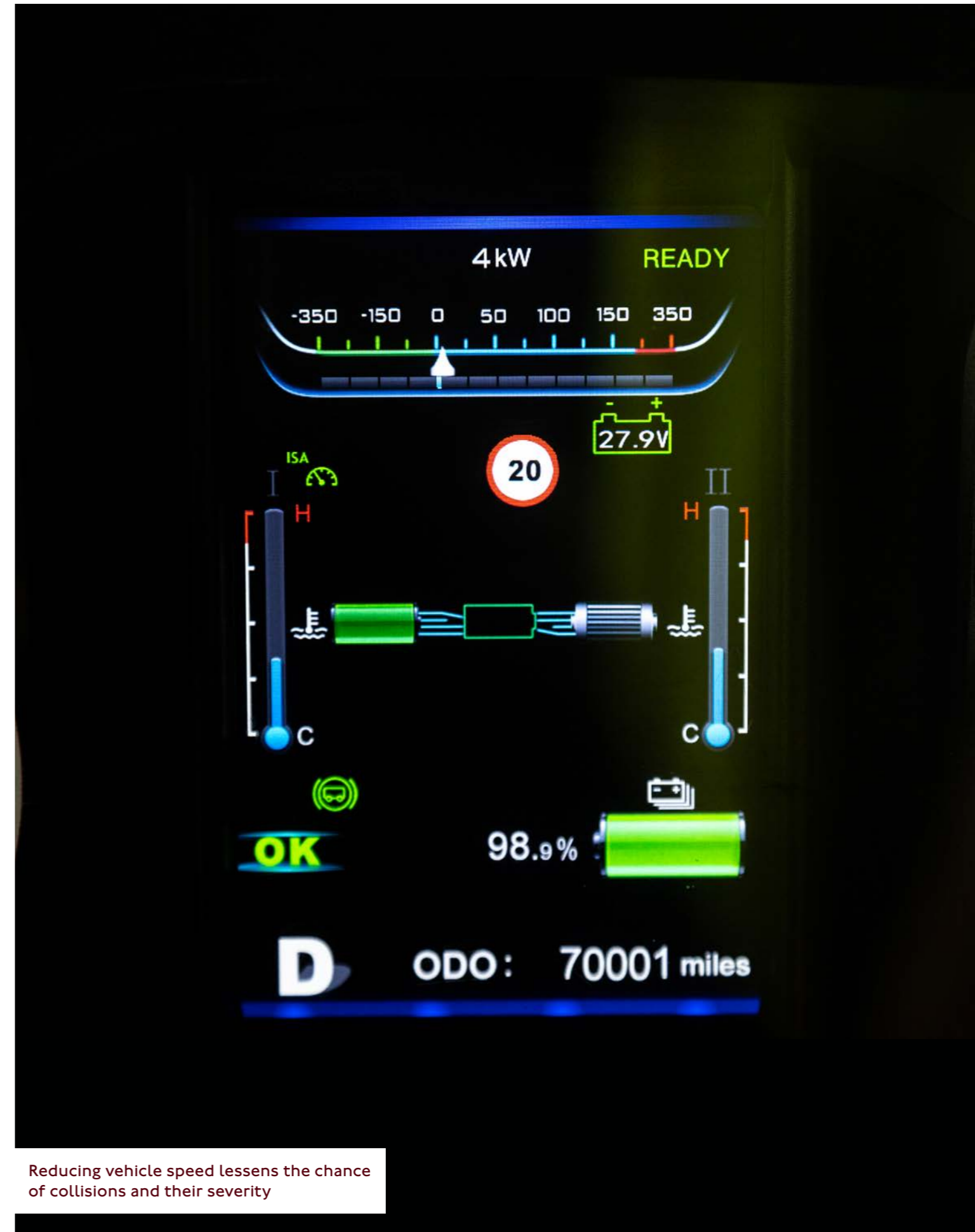
We have also developed an optimum gradient for speed tables and raised crossing points where they have been installed as part of our programme.

Intelligent Speed Assistance

Intelligent Speed Assistance keeps bus speeds to the posted speed limit (through acceleration retardation), thereby preventing buses from exceeding the limit, which will also mean that other safety technology and features we include on buses will be more effective. A requirement for new buses since 2019, we have also retrofitted this technology to 1,200 existing buses in the fleet. Currently, around one third of the fleet has Intelligent Speed Assistance technology. The European Transport Safety Council has used our roll-out of this technology to demonstrate how it can be adopted on buses, and we were shortlisted and commended for the delivery of Intelligent Speed Assistance in the Road Safety category at the 2022 national Chartered Institution of Highways and Transportation awards.

Speed Compliance Tool

The Speed Compliance Tool has been developed to help provide strategic and route analysis of bus speeds across London. The tool has been provided to all bus operators and is being used proactively to analyse the performance and compliance of their bus routes.



Safe speeds – what next?

To deliver safe speeds, we will continue to roll out Intelligent Speed Assistance which limits buses to the posted speed limit. The roll-out of the Lowering Speed Limits programme will also continue across London.

We are closely monitoring the performance and implementation of Intelligent Speed Assistance via the Speed Compliance Tool, which accesses bus speed data through iBus. The operation of the system may be influenced to some degree by forthcoming European legislation if it is implemented in the UK, and it is likely that the system will evolve over time. Ultimately, systems that adapt speed not only to the prevailing speed limit but also to other risk situations – such as effecting slower speeds in heavy rain, for example – may become possible but these are not yet available.

It will take several years before the entire London bus fleet is fitted with Intelligent Speed Assistance technology, and in the interim we will work proactively with bus operators to focus on improving speed compliance through additional scrutiny, communications and engagement with drivers, and training.

Action 5

- a. Continue roll-out of Intelligent Speed Assistance on new buses through the Bus Safety Standard, and retrofitting existing buses, subject to funding
- b. Work with operators during 2023 on proactive speed management, focusing on improving compliance on routes where buses do not have Intelligent Speed Assistance



Arriva telematics trials

Arriva is introducing MyDrive across its UK bus fleet during 2022/23. The system is designed to encourage self-coaching for drivers, with support from trainers, risk managers and local

management teams. The aim is a safer and smoother journey for customers, reduced incident rates and lowered vehicle emissions.



Safe behaviours

Supporting an open culture where safety is at the centre of decision making and day-to-day bus operations

Bus driver training – what we are doing

We work closely with bus operators to develop and deliver a range of bus driver training. This includes initial driver training as well as Certificate of Professional Competence courses – a licensing requirement of 35 hours of training over a five-year period. These courses cover many aspects of safety, including fatigue management, driver wellbeing and hazard identification.

Bus operator Abellio is trialling a Certificate of Professional Competence learning module that is focused on fatigue, and health and wellbeing. Following initial scoping, the module was presented to managers, union representatives and a sample of drivers in November 2022. The final content will then be agreed and submitted to the Joint Approvals Unit for Periodic Training for approval.



Destination Zero: Driver Certificate of Professional Competence course

We are currently delivering Destination Zero training for bus drivers. This course focuses on road risk and the management of common driving situations, with the help of virtual reality headsets. It encourages drivers to put themselves in the place

of other road users; for example, by experiencing how someone cycling feels as a bus passes them too closely. The delivery of this course is expected to be completed by summer 2023.

Bus driver training – what next?

We will build on the Destination Zero training to identify new areas of focus for bus operators for both bus drivers and those in other roles such as managers, supervisors and controllers. Training will cover all areas of our work on safe behaviours, including fatigue management, health and wellbeing and customer injuries. It will consider innovative approaches to the delivery of training content, such as the potential for bite-sized communications to reinforce key messages, as well as more in-depth classroom-based or e-learning courses.

We are now developing an Equality, Diversity and Inclusion course for bus drivers. Delivery will commence in 2023 and will be completed by all drivers as part of their Certificate of Professional Competence as well as by new drivers as part of their initial training. The course is being designed to increase driver awareness and empathy with customers, and to equip them with the skills, knowledge and behaviours to deliver an inclusive service.

Action 6

Build on the success of the Destination Zero programme over the period to 2024, to equip drivers with the skills to adapt to the changing streetscape and better support our vulnerable and diverse customers, and work to achieve Vision Zero.



Driver training includes safe behaviours and awareness of diversity

‘Working in close co-operation with Transport for London and other key stakeholders, we are committed to make an already safe form of mobility even more secure. From innovative bus design to technology that intervenes to control speed if required, Go-Ahead London have been early adopters’

Richard Harrington
Engineering Director,
Go-Ahead London

Understanding behavioural adaptation to new vehicle technologies

As detailed in this strategy, vehicle technology provides a substantial safety benefit by reducing risk. However, this technology is not automated driving and must work with the bus driver. Whenever a new technology is introduced, it carries some risk that it changes the behaviour of a driver. The change in behaviour may be positive, negative or irrelevant to safety but it is an important consideration for existing and future technologies such as Advanced Emergency Braking. It also has implications for those technologies with information components such as warnings, which may cause distractions or increase workload.

It is important to note that risk compensation theories have been put forward as arguments against safety technologies for a very long time. An example is a view that putting a spike on the steering wheel instead of an airbag is more effective because the safer we make the car, the more dangerously the driver will drive it.

In this simplistic form, risk compensation theory has largely been discredited. However, this does not mean that safety technologies have no effect on behaviour. More modern theories term the effects as behavioural adaptation and highlight that the potential for a change in behaviour varies depending both on the characteristics of the person and the system. The changes we are making to the bus fleet may give us the opportunity to research this in detail.

From the system point of view, key characteristics are:

- **Visibility of the measure:** how aware is the driver that there is a system or component doing something that improves safety
- **Type of system:** systems that reduce the frequency of collisions are more liable to behavioural adaptation than those that reduce the severity of injury
- **Experience:** where the system affects a risk factor where drivers have experience of other systems addressing the same risk factor and have previously adapted their behaviour, they are more likely to do so again
- **Magnitude of system effect:** the greater the perceived influence of a measure, the greater the probability of adaptation
- **Benefits:** a system will only lead to behavioural adaptation if it enables some perceived advantage to the driver

Most of the systems considered in the Bus Safety Standard are intended to prevent collisions and so carry some risk of behavioural adaptation. Intelligent Speed Assistance is very visible to the driver and, where triggered, so is its effect as it will be actively intervening on the bus speed. By contrast, when Advanced Emergency Braking works well, it is almost invisible to the driver and should only intervene when the vehicle is a couple of seconds away from an impact if the driver has not reacted. Therefore, the potential impact on driver behaviour is less.

It is important to note that a change in behaviour is only a problem if the new behaviour represents an increased safety risk. Through monitoring the implementation of Bus Safety Standard features, we will investigate further the potential for behavioural adaptation, and build further consideration of this into the analysis of new potential technologies for buses.

Action 7

Investigate the potential for behavioural adaptation of safety technologies for buses and their impact.

Fatigue management – what we are doing

In 2019, we commissioned independent research by Loughborough University and the Swedish National Road and Transport Institute into the nature and extent of fatigue among bus drivers, the contributing factors to fatigue, and what solutions could be implemented to address fatigue. This provided the first in-depth research into fatigue among bus drivers, highlighting it as a key issue contributing to, or causing, a number of incidents and near misses. Working closely with London bus operators, we subsequently developed a programme to help tackle fatigue, and we continue to develop and coordinate a range of activities through our Fatigue Management Working Group.

One of these initiatives has been the delivery of Fatigue Management Awareness Training to all managers and supervisors across all bus operators in London. This training aimed to upskill front-line managers and supervisors, giving them the information and tools they need to promote an open culture, and have honest discussions with their staff around fatigue. Bus operators continue to deliver this training to new starters joining their organisation. Arriva has built on this training and developed a follow-up course on fatigue management, which is also being delivered outside London.

All bus operators in London now have a Fatigue Risk Management System which details how each operator will manage fatigue risk using tools including training, roster assessment, guidance, best practice in investigation, and innovative technologies.

We have developed fatigue branding and communications for bus operators to provide consistent messaging on fatigue management.

We also work with the pan-TfL Fatigue Management Programme to ensure we optimise our unified approach to achieving a better understanding, and thus more effective management, of fatigue risk. Under the governance and direction of the pan-TfL Fatigue Management Steering Group, the programme aims to:

- Increase awareness of fatigue issues
- Identify fatigue risk across TfL and priority areas for improvement
- Improve overall management of fatigue and wellbeing across TfL
- Develop awareness of, and embed, an open, fair and just culture
- Encourage adoption and development of evidence-based best practice

Lessons continue to be learned about fatigue through following this approach, enabling continuous review and improvement.

The programme has also delivered a codified approach to fatigue management across TfL. Our Fatigue Risk Management Plan, as part of the wider programme, allows us to apply a fixed framework to fatigue management, which ensures a company-wide standard in managing this risk. Areas of TfL can apply this framework flexibly, tailored to their needs and existing processes, ensuring that, where possible, efficiencies are optimised.



Fatigue management at Stagecoach

Stagecoach London, in partnership with TfL, has been working on a proactive approach to fatigue risk management since the publication of the Loughborough report in May 2019. Through initiatives like the Night Club by Liminal Space (funded through the Bus Safety Innovation Challenge), the company promotes fatigue management to its staff, producing targeted campaigns in areas such as lifestyle, healthy eating,

exercise and sleep, and using its internal communication platform, Blink, to showcase this work. These themes and workstreams form part of its Fatigue Risk Management System.

A Fitness to Work policy and 'pledge' was launched in September 2022 for all employees, explaining the responsibilities of both the individual and the company.

As part of Stagecoach's commitment, support is provided to anyone who comes forward feeling the effects of fatigue. For example, if a driver feels fatigued during their duty, they will call through to the iBus control using a code word, and the controller will follow a script and a flowchart to ensure the driver receives the support they require.

'The underlying thread through our fatigue work is that this is a joint and shared responsibility – we and our people must promote a culture that is fair and open, and people feel supported to talk about fatigue and understand the importance of alertness in our safety-critical business'

Simon Davis
Head of Operations,
Stagecoach London

Fatigue management – what next?

Working with bus operators, we will continue to develop our workstream on fatigue management. A key focus will be to build on the 2019 Loughborough University study to understand the nature and extent of bus driver fatigue through trialling fatigue detection technology on buses.

Bus operators have undertaken smaller trials of fatigue detection technology, which have provided important insight on the potential of this technology as well as on the process of engagement and follow-up with bus drivers following a fatigue incident, which encourages an open and supportive culture around fatigue management.

We will complete a larger trial on up to 450 buses over 12 to 18 months. This will enable early detection and intervention if fatigue is experienced, and improve our understanding of the extent of fatigue incidents and their contributory factors. The trial will help to evaluate the potential for this technology on new buses through the Bus Safety Standard.

As part of our review of training, which aims to build on Destination Zero, we will identify opportunities for further training on fatigue management. This will build on the Fatigue Management Awareness Training that was delivered in 2021 as well as learning from recent Innovation Challenge projects to identify new methods of delivering key messages and bite-sized reminders through audio and visual communications.

We commissioned the University of Surrey to undertake research on fatigue risk assessment tools. These tools are designed to look at rosters consisting of a sequence of shift start and end times and predict the risk of fatigue during each shift. The research is intended to support TfL and its stakeholders in understanding the suitability, limitations and potential for using fatigue and/or risk assessment scheduling tools to help manage fatigue, and to understand the potential for improving the existing interface and guidance of fatigue risk assessment tools.

The next steps for this work will be to develop guidance for bus operators to help support their use of these tools, including how they should be used, the limitations and strengths, and how to interpret the results. We will also look at developing training for bus operators, and ensure that future iterations of bus operator fatigue

risk management systems include details of fatigue risk assessment tools and how they should form part of the overall approach. The proposed trial of fatigue detection technology will also inform our understanding of the extent to which schedules and rosters impact on fatigue-related incidents, and the potential benefits of developing fatigue risk assessment tools further.

Action 8

- a. Work with operators to expand and deliver the Fatigue Management Programme for bus drivers, incorporate new communications with bus drivers and other frontline staff and continue to look at new ways to manage and prevent fatigue
- b. Trial fatigue detection technology on buses, subject to funding, and build upon the outputs of the trial by 2024
- c. Act on the recommendations of the Fatigue Risk Assessment Tool research during 2023, including developing guidance for bus operators to help support their use of such tools

‘Go-Ahead London have innovatively trialled various fatigue detection systems as we believe they make a valuable contribution to safety. Subject to its effectiveness, and funding, we will work with Transport for London to deliver fatigue detection technology across the entire organisation’

David Cutts

Managing Director, Go-Ahead London

Safety culture

To support safer behaviours, it is essential that we and the bus operators improve our safety culture to ensure it is just and fair. Many of the activities set out in this strategy will help to bring this about, and we are learning from other industries, such as rail and air, to see how we can make further improvements. We want to ensure that our people feel empowered to be part of the solution, encouraging good behaviours and promoting performance improvement. We are also rolling out a way of measuring our Safety, Health and Environment culture consistently across TfL, which will help us to identify improvements.

Action 9

- a. Improve TfL's safety culture through completing cultural measurement activities using TfL's Culture Maturity Assessment
- b. Build on the improvements to safety culture at bus operators and our suppliers, focusing on the cultural benefits being achieved through our fatigue, health and wellbeing programmes



Measuring our safety culture is vital to identify improvements

Bus Safety Innovation Challenge

We recognise the importance of continual innovation in achieving safety improvements. To stimulate innovation in the bus market, we introduced our Bus Safety Innovation Challenge. First launched in 2018, we funded eight innovative projects, including our first trial of fatigue detection technology.

In 2019, we supported projects that included a trial of a second fatigue detection technology, as well as an HCT Group bus operator trial to help reduce passenger injuries; a London Cycling Campaign course to encourage drivers to see the road through the perspective of someone cycling or walking, and to promote safer driving; and a Metroline bus operator trial of an audible and flashing alarm to alert vulnerable road users to approaching buses.

Fatigue, Health and Wellbeing Innovation Challenge

In 2021, we launched a combined Fatigue, Health and Wellbeing Innovation Challenge to trial measures to manage fatigue and improve the health and wellbeing of bus drivers, with a range of projects currently being trialled by bus operators. These include training initiatives, technology to assess fitness for duty, mental health support for managers and frontline staff, sleep pods and communication.

The outcomes of these trials will be evaluated and there is potential for future development and roll-out of innovative measures to address bus driver health, wellbeing and fatigue.

The Night Club

As part of the Fatigue, Health and Wellbeing Innovation Challenge, Stagecoach is working with the Liminal Space interactive walk-in installation to trial the Night Club, a transformational health and wellbeing programme that communicates evidence-based sleep health information to shift workers. It aims to help drivers realise the importance of sleep, how they can individually improve their chances of recovery and what changes they need to make to improve the quality of their sleep. It has been trialled at Bow and Catford bus garages.

Stagecoach is now looking at comparable data from garages not involved in the trial, including the review of absences, collisions and near-misses. It will follow up with a baseline survey in six months to see if change has been sustained.



Trials explore driver fatigue and how to improve health and wellbeing

‘The sleep pods are one of the best initiatives Metroline has introduced. They provide a quiet space where we can use our rest periods to physically rest and relax’

Driver
Willesden Garage, Metroline

Rest Space

Bus operator Metroline is working with Rest Space (a sleep pod provision company) to trial a physical resting space combined with science-backed educational content about resting. There will also be internal communication content to support the change in culture in the workplace.

Tenshi Senseye

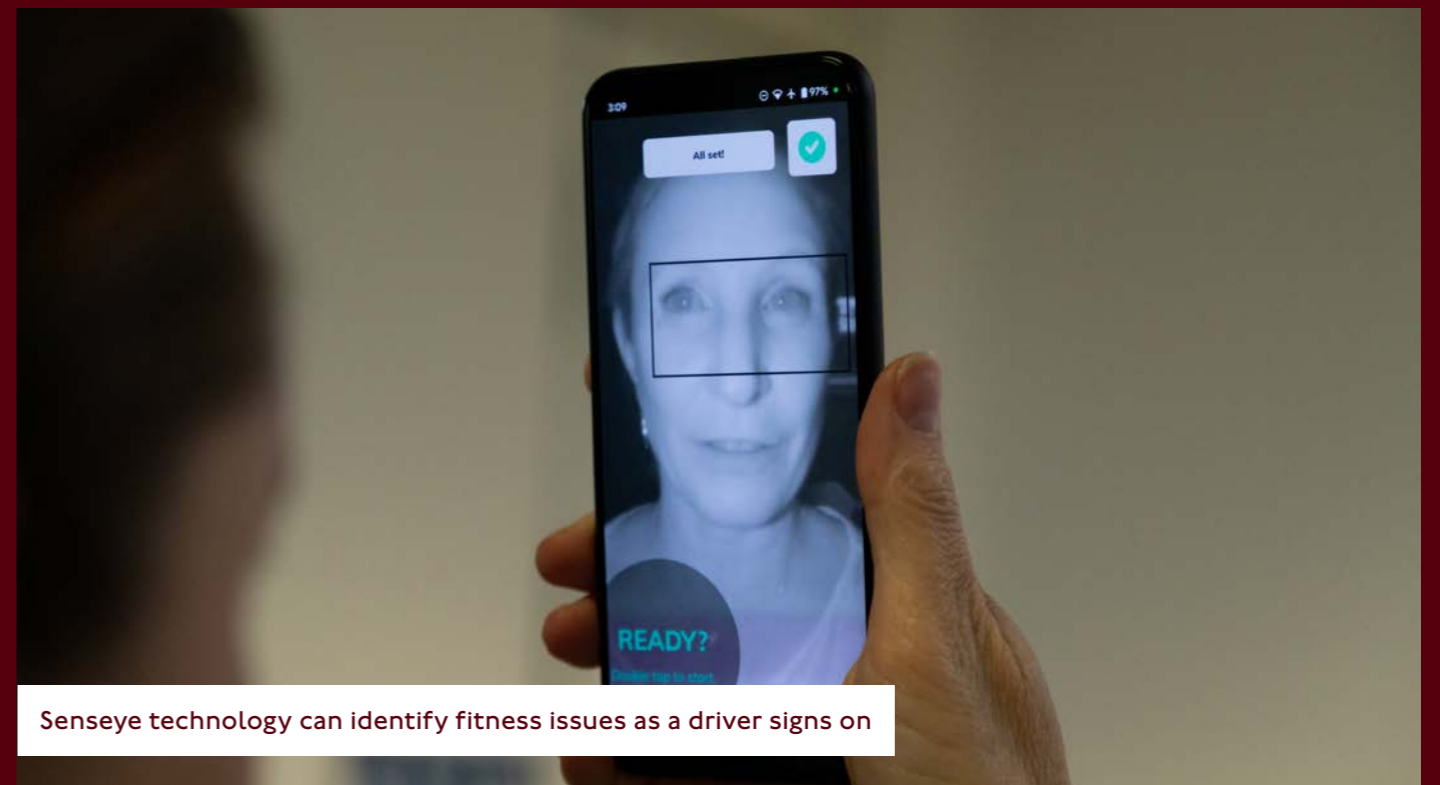
Bus operator Uno Bus is trialling Senseye technology with Tenshi Consulting, which uses both published and proprietary in-house neuroscience research to associate quantifiable cognitive insights with patterns of physiology within the eye that can detect and highlight ‘fitness for duty’ issues at the point of driver sign-on.

This is being trialled on a small group of volunteers, principally bus drivers, but will engage other members of the workforce too. This is a non-punitive trial that seeks to address the causes of fatigue and in the event of a ‘fatigued response’ would prevent us from allowing the driver to drive a bus until a set of agreed criteria and parameters has been met.

The project is being worked on alongside the involvement of Unite the Union.



Sleep pods provide a quiet space for drivers to rest and relax



Senseye technology can identify fitness issues as a driver signs on

The Sound Doctor

Bus operator Go-Ahead London is trialling the Sound Doctor, which will provide bus drivers with a ground-breaking programme of audio interventions that will help them fight fatigue and keep them alert during their shift. The Sound Doctor:

- Increases alertness
- Reduces fatigue incidents
- Improves self-management
- Reduces cases of high blood pressure and acute back pain

It includes a device that has been programmed with unique and specially commissioned audio material, to increase alertness during the working day and to reduce driver fatigue. Developed with one of the UK's leading sleep experts, a short audio warning is triggered in the vehicle cab when a driver needs to immediately improve their alertness.

Alongside this, an online education package has been designed that explains to bus drivers the reasons why fatigue can be a problem and offers practical solutions across a range of areas, including simple exercises they can use to combat tiredness. This interactive programme is based around user-friendly films and animations and is intended to motivate and engage, while ultimately seeking to deliver effective behaviour and lifestyle changes. Optional education courses designed to improve long-term health, with a specific focus on back pain and hypertension, have also been developed.

Driver's Mate

Bus operators Arriva and RATP Dev are working with AA Drivetech on a trial of Driver's Mate, a series of 90-second videos that aim to help bus drivers learn about fatigue and their wellbeing. The videos aim to encourage people to change their behaviours and talk openly about safety issues.

Mind and Hestia

Ash Grove and Walthamstow bus garages, now part of bus operator Stagecoach London, have been working with Hestia, a domestic violence charity, to see how we can better support in this area. Both of these garages previously worked with Mind to provide mental health support to managers and frontline staff, concentrating on improving manager awareness of mental health issues and knowing how to support themselves. Stagecoach Group also has a commitment to increase the number of its mental health first aiders. TfL is planning to see how this work can be further developed.

Compass UK

Abellio is working with Compass UK to deliver three inter-connected courses that aim to get people talking, without shame or fear of negative consequences, about mental and physical health and feeling fatigued. The courses include topics such as managing fatigue, mental health and wellbeing for line managers, mental wellbeing and alertness for all staff, and driver wellbeing and alertness.

Gro Health

Metroline is trialling Gro Health, a digital behaviour change intervention that takes a holistic approach to health, encompassing four therapeutic areas: mental wellbeing, sleep, activity and nutrition. It uses behaviour change activities, personalised resources, coaching, peer-to-peer support and health tracking.

Health and wellbeing – what we are doing

TfL and bus operators are developing a Health and Wellbeing programme for bus drivers that focuses on the longer-term improvements to bus drivers' health and wellbeing. This is to address the underlying health concerns set out in the University College London TfL-commissioned study into driver deaths as a result of coronavirus – the Phase 1 report was published in July 2020 and Phase 2 in March 2021.

This research highlighted a need to focus on driver health and wellbeing in the longer term, in addition to the short-term actions required as a result of the pandemic; with an emphasis on being more proactive in understanding existing health conditions of bus drivers, supporting better health and identifying those most at risk.

Our work was initially focused on the TfL and bus operator response to the coronavirus threat in relation to bus drivers' health, such as improving the separation between the driver's cab and the saloon, and providing an independent supply of fresh air to the driver's cab. We have since expanded this to look at how we can implement a strategic and targeted approach to health and wellbeing in the London bus industry.

The study highlighted the need to be more proactive in understanding existing health conditions of bus drivers, supporting better health and identifying those most at risk.

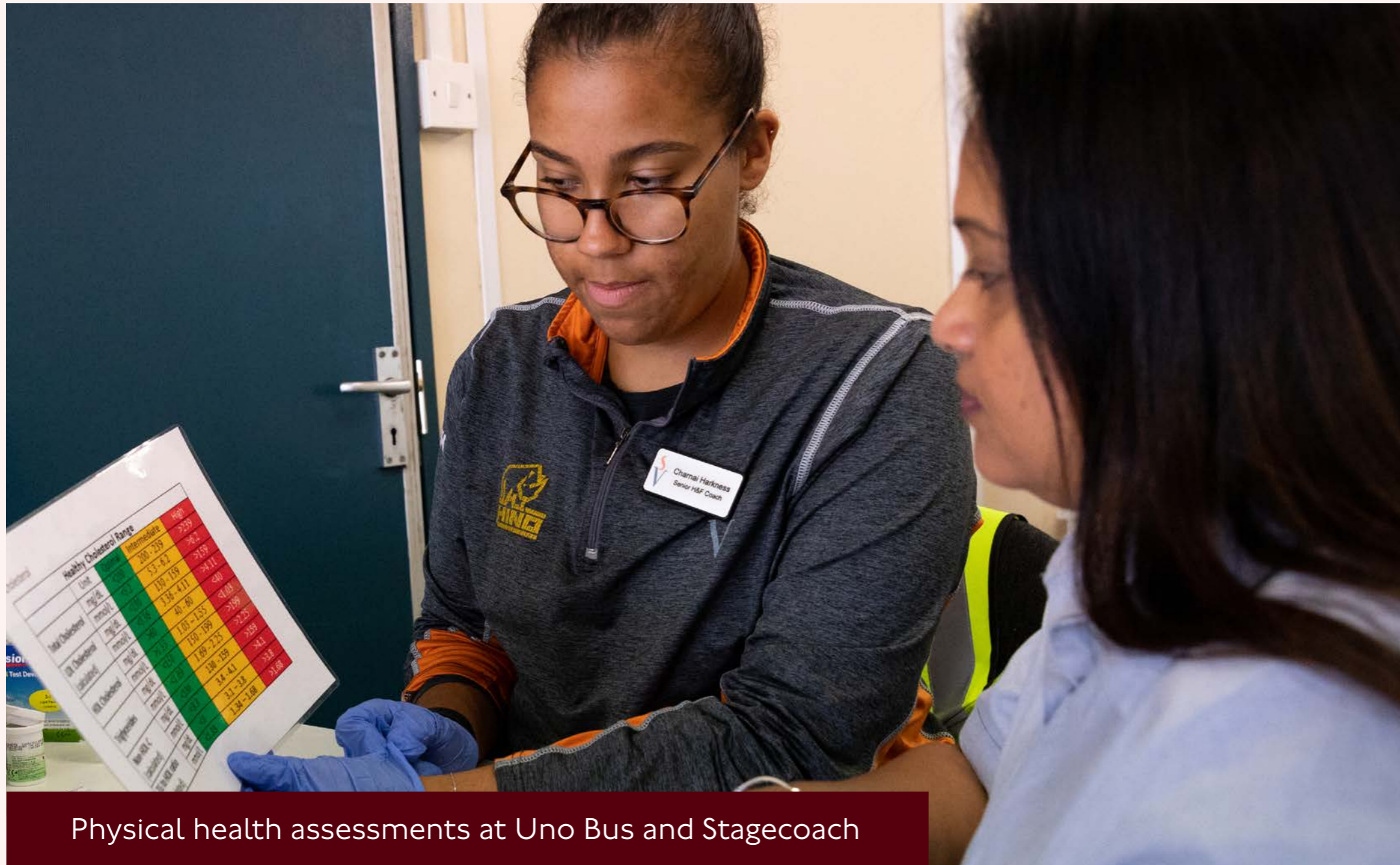
Driver health and wellbeing is recognised as a contributing factor to road incidents. Identifying concerns earlier and providing support to drivers could reduce the number of incidents and in turn improve the perception of the bus as a safe mode of travel. Improving driver health and wellbeing will also contribute to the retention of drivers by reducing stress and fostering a supportive working environment.

Since the publication of the study, TfL and the bus operators are offering more frequent optional bus driver health assessments. Traditionally, drivers take a medical (health assessment) upon recruitment in order to obtain their Passenger Carrying Vehicle licence, and again at age 45 and every five years until 65 years old (and yearly thereafter). However, there is a lack of visibility of drivers' health outside these assessment points.

Introducing more frequent voluntary health assessments for drivers could help detect potentially serious health conditions earlier, such as hypertension, diabetes and heart disease, and enable bus operators to assist drivers in getting the help they need, building on the open culture work of the fatigue management programme. This would in turn encourage drivers to take more responsibility for their own health and wellbeing. Bus drivers are being offered free health assessments, access to health kiosks or online health assessment questionnaires.



Voluntary health checks support wellbeing and identify drivers at risk



Physical health assessments at Uno Bus and Stagecoach

Bus operators Uno Bus and Stagecoach are working with Herts Sports Village, part of the University of Hertfordshire, to deliver face-to-face Health MOTs. The idea of the scheme is to assess basic levels of bodily fitness, weight and mass, and to promote and prescribe interventions to enhance health and wellbeing.

The body mass versus age comparison is popular with drivers; it can bear surprising results, and encourages interest and discussion, particularly in terms of age profile results.

We are currently working with the Design Council and Guy's and St Thomas' charity on an Employer Health and Innovation Fund. This aims to help Lambeth- and Southwark-based employers to strengthen the work conditions and health and wellbeing support for people with health conditions on low incomes. We are looking at the best way to deliver bus driver health and wellbeing assessments and how to maximise the benefits of these assessments across bus operators. The project will help identify solutions to improving bus drivers' health and wellbeing and increase understanding of their needs and what their employers can do to support them.

The challenge at the core of the project is to raise awareness of the ways in which drivers can take responsibility for their own health by suitable lifestyle adjustments, and to provide early detection of potential health problems. The project will deliver research to help us understand different ways in which visibility and ownership of drivers' health and wellbeing can be increased in this environment. It aims to provide analysis of the effectiveness of various interventions in health and wellbeing checks, and the key parameters of driver health and wellbeing engagement and participation at work.

Health and wellbeing – what next?

We will continue to work closely with bus operators to help support their development of driver health and wellbeing initiatives. The key areas of focus will be the delivery and evaluation of the Fatigue, Health and Wellbeing Innovation Challenge trials. After completion, we will be working with bus operators and the selected independent assessors evaluating the trials to understand the outcomes and learnings from the projects. This will inform the potential development and roll-out of successful trials, dependent on funding.

We will deliver the project with the Design Council on the Employer Health and Innovation Fund, which includes activities to support the health assessments and enhance their benefits.

Analysis of the high-level, anonymous data gathered through the health assessments and kiosks will be used to identify key issues and areas of focus for the health and wellbeing programme across the London driver population, informing bus operators as well as helping to develop our strategy for maintaining and improving bus driver health and wellbeing. This will include exploring the frequency and suitability of the required medical health assessments, ensuring all bus operators have health and wellbeing policies, and continuing improvements to driver facilities, including to toilets and rest areas.

Action 10

- a. Promote innovative bus driver fatigue, health and wellbeing initiatives through delivery of the Bus Safety Programme and leading the Fatigue, Health and Wellbeing Innovation Challenge jointly with bus operators. Develop an open culture around health and wellbeing and understand key focus areas for drivers
- b. Work with operators and the Design Council to use the Employer Health and Innovation Fund to develop a bus driver health and wellbeing programme that analyses the effectiveness of interventions by 2024
- c. Continue to develop and deliver new initiatives that support driver health, wellbeing and fatigue management



Go-Ahead London pods

Bus operator Go-Ahead London has developed 'pods', electronic tablet-based focal points across all premises, designed to encourage proactive colleague feedback on fatigue, mental health and other related matters. Pod engagement is a multi-way process: the company communicates on a range of relevant topics, the workforce privately shares their thoughts and the issues raised ensure managers have a greater, more accurate, awareness of trends, which

in turn feeds into policies designed to improve wellbeing.

Since the trial was launched at Orpington Garage in 2019, pods have been introduced at Go-Ahead London's 16 other main facilities, as well as at its head office. To date, they have been used on 13,000 occasions, with each interaction providing valuable intelligence that contributes to colleague and user safety.

Bus customer injuries – what we are doing

Of all the surface transport modes in London, buses have one of the lowest rates of death and serious injury – taking the bus is one of the safest ways to travel, with buses carrying more people than any other transport mode in London. However, in terms of casualties on, or by, a bus, occupants (bus passengers and the driver) accounted for the highest proportion of serious injuries at 42 per cent from 2017 to 2021.

Through our Bus Safety Standard, we introduced Level 1 Bus Occupant-friendly interior safety measures in 2021. These include requirements for the staircase, seat positions, handrail construction and installation, and guards for exposed seats. Level 2 Bus Occupant-friendly interior measures, which push for more challenging safety changes, are required for new buses in 2024, which will further improve the safety of bus occupants. These measures aim to mitigate and reduce the number of serious and fatal bus customer injuries.

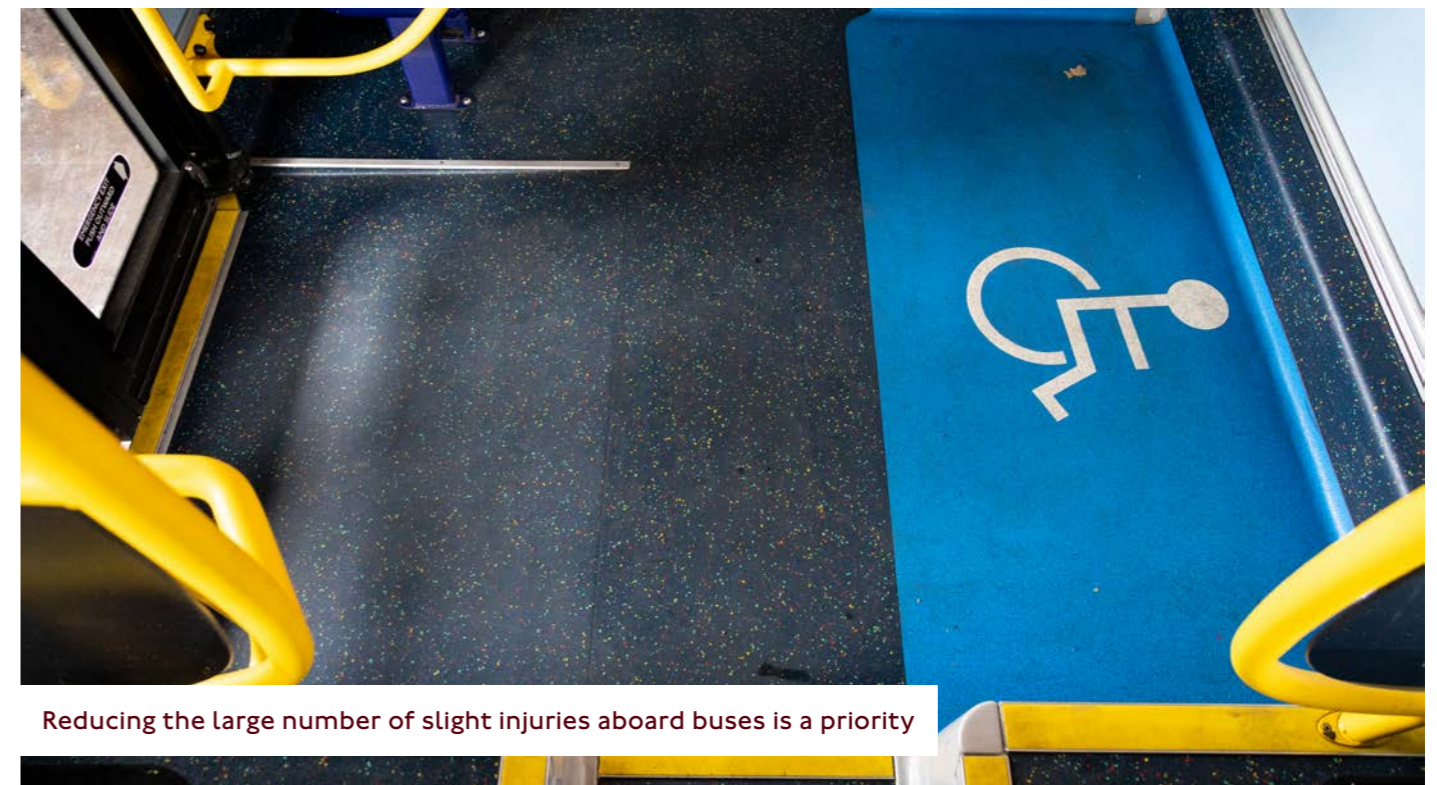
However, as set out in our section on future priorities for the Bus Safety Standard, our data shows that when serious collisions are brought more centrally into consideration

and the existing measures in the Bus Safety Standard are accounted for, then in 2041 more than half of the remaining casualties involving people killed or seriously injured would be bus occupants, unless further interventions are made. While new bus technologies have focused largely on reducing fatalities among people walking, given that these account for the highest proportion of fatalities and are the focus of the 2030 Vision Zero target for buses, a key aim of the next iteration of the Bus Safety Standard post 2024 is to explore new features and technology to prevent and mitigate bus occupant serious or fatal injuries.

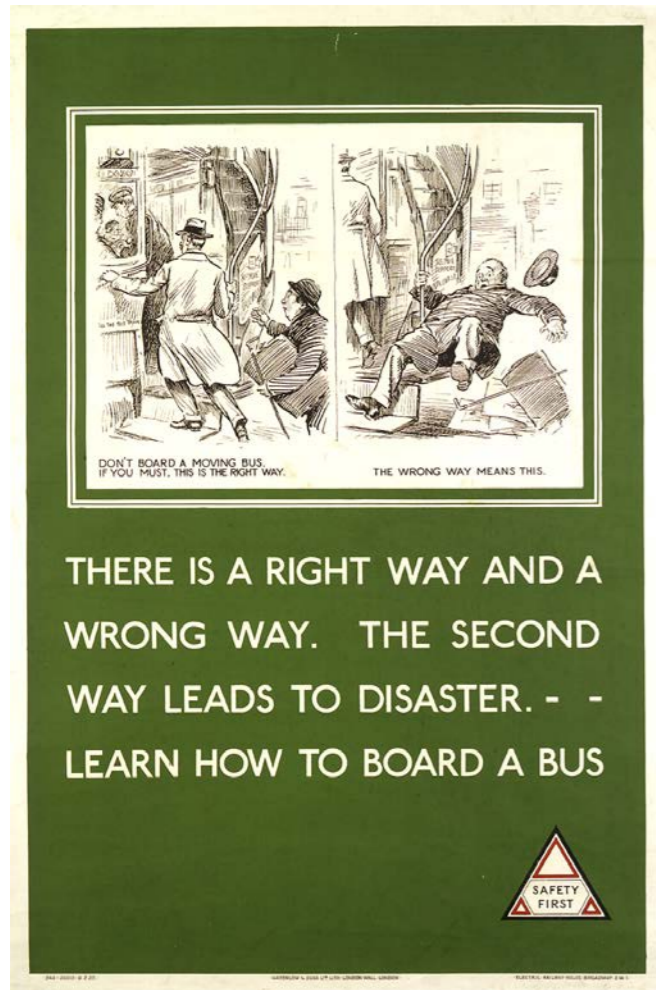
Bus customer injuries also include non-collision incidents where either the bus is stationary and bus passengers slip, trip or fall while boarding or alighting the bus, or where a bus is moving and bus passengers on board slip, trip or fall, often as a result of acceleration, braking or other manoeuvres. These 'slips, trips and falls' are often, but not always, less severe in their consequences than collisions. However, they exist in large numbers, and so reducing these slight customer injuries is also a key focus.



Bus interiors are designed with both comfort and safety in mind



Reducing the large number of slight injuries aboard buses is a priority



Customer slips, trips and falls are not a new phenomenon and work to reduce and prevent non-collision events on buses has been happening for a very long time.

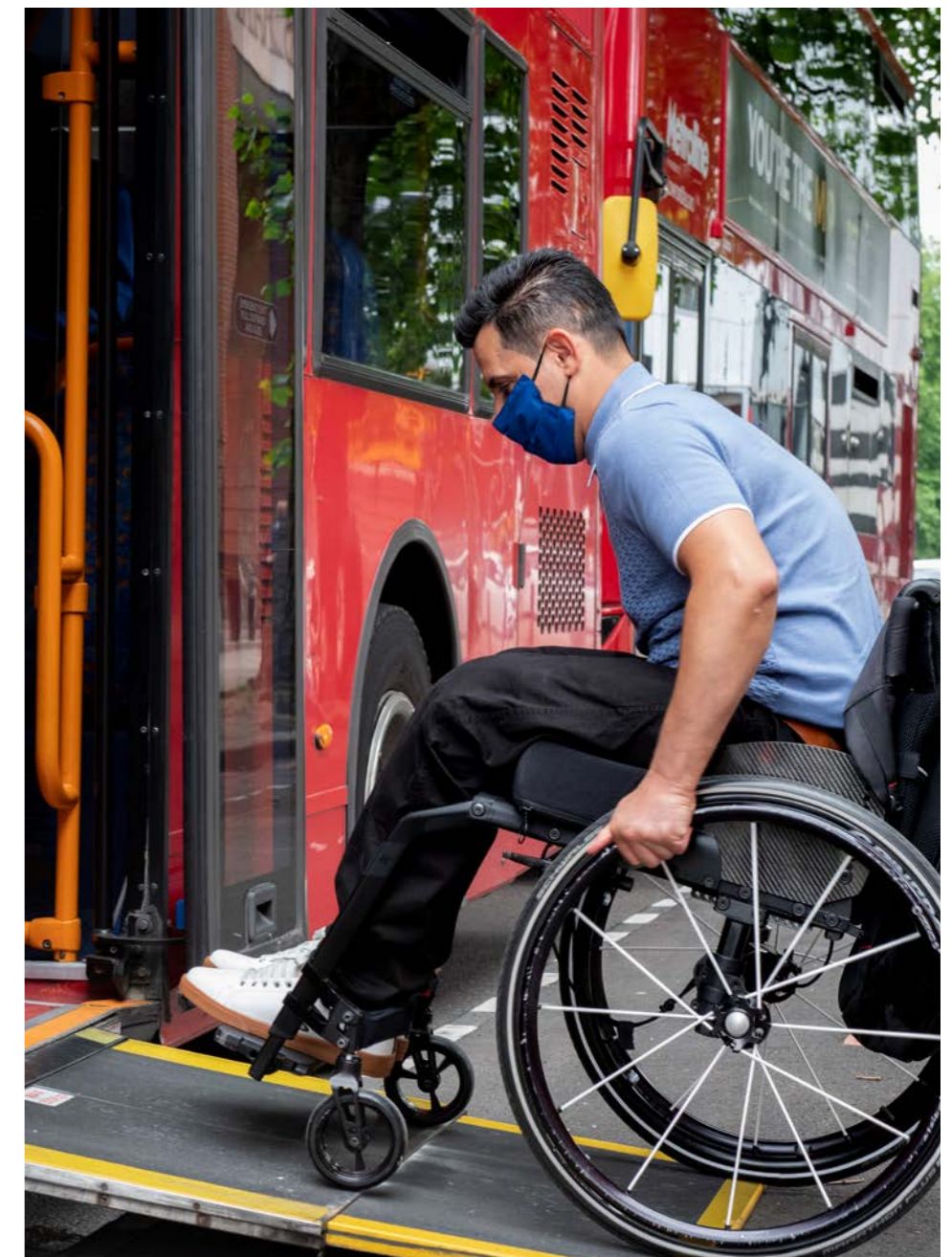
Reducing passenger injuries is particularly important for older bus passengers who are more likely to be seriously injured. A growing proportion of the general population, they account for a large number of our regular bus customers. In addition, a slight injury can significantly affect passenger confidence in bus travel, particularly among those who are older or disabled.

Slips, trips and falls have been happening on buses for many years



Above images – ©TfL from the London Transport Museum collection

We have been working with disability groups to develop changes to the on-bus access ramp design that aim to make it safer and more accessible to use.



Improving our bus ramp design will make it safer and easier to use

Bus customer injuries – what next?

We are developing a new workstream that aims to reduce customer injuries. This will focus on innovative features and technology that can be introduced on new buses through the Bus Safety Standard as well as initiatives focused on safe behaviours, including bus driver training and customer communications. Our upcoming Equality, Diversity and Inclusion training for bus drivers, for example, will cover bus passenger injuries and the need for drivers to allow time, particularly for vulnerable customers, to find a seat or safe standing position. Bus driver training is also being enhanced to cover how bus driver behaviour and driving styles can affect passengers and contribute to injury.

Understanding the reasons why customer injuries occur is imperative in finding solutions to reduce these incidents. An in-depth data collection exercise is currently under way, looking at the CCTV from slips, trips and fall incidents on buses to gain more insight into why they are happening, including influencing factors and trends.

Another project soon to begin will look to repurpose CCTV collected from the bus braking analysis work completed as part of our work on Advanced Emergency Braking, to understand why harsh braking occurs. These activities will enable us to better understand the issues and inform an evidence-led approach to reducing customer injuries.

Exploratory work is under way looking into how we can reduce passenger exposure to risks when travelling on buses in London. Using a range of data to understand the demographics of passengers most at risk is key. Once this is understood, technology and human factors experts will be involved in researching and shortlisting interactive pieces of technology aimed at influencing passenger behaviour. The new technologies decided upon will be trialled in-service and fully evaluated to assess their effectiveness in reducing customer injuries before work begins to add to the bus fleet.

There are several other smaller changes that we may implement on buses to reduce customer injuries. These include improving the ways in which drivers can use CCTV to see where passengers are in the bus, enhancing lighting at entry and exit points, and introducing a new message to be played to encourage passengers standing to hold on, potentially trialling at hotspot locations.

We are also planning undertaking engagement activities including a workshop with disability groups to understand the concerns and challenges faced by these passengers when travelling by bus in London. This should provide us with good insight into the issues and improvement opportunity ideas to ensure that buses are accessible and safe for all passengers.

We will make customer safety the focus of our next Bus Safety Innovation Challenge. This will involve working with operators and innovators in the field to shortlist, trial and fully evaluate pioneering technologies, with the aim of influencing passengers to carry out safe behaviours while travelling on London buses. Pre-trial research into human factors and how best to influence passenger behaviour will be key in informing what technologies are chosen to be trialled.

Action II

- a. Implement a strategic data-led approach to reducing passenger injuries, particularly due to slips, trips and falls, involving the evaluation of a variety of technical, behavioural and procedural interventions in 2023
- b. Address customer injury incidents through a future Bus Safety Innovation Challenge in 2023
- c. Explore further distinct bus user groups to ensure equality and inclusion across the safety measures implemented



Safe streets

The way we design and use our street spaces has an impact on safety, and encourages people to lead more healthy and active lives

Safe streets – what we are doing

Tackling road danger is integral to creating Healthy Streets that put human health and experience at the heart of city planning, and help people use cars less, and walk, cycle and use public transport more. By making our streets human-centred, pleasant, safe and attractive, we will encourage people to make healthy lifestyle choices as well as reduce carbon emissions and help clean up London's air. Creating safe, healthy streets is fundamental to achieving the Mayor's Transport Strategy targets for 80 per cent of journeys to be made by sustainable modes by 2041.

We work with boroughs and delivery partners to implement on-street changes, with the aim of creating Healthy Streets where all collisions, including those involving buses, are reduced. These initiatives are not managed under the Bus Safety Programme – they are part of wider infrastructure programmes developed and led by multi-disciplinary teams within TfL. They include our Safer Junctions and Healthy Streets programmes.

Safer Junctions and Healthy Streets schemes

The Safer Junctions programme was launched in 2017 with the aim of significantly reducing personal injury collisions, reducing road danger for London's most vulnerable road users and making some of London's most hostile junctions a more pleasant place for people who live in, work in and visit these areas.

Not all projects have to be expensive to make a difference to Londoners. TfL has also implemented relatively low-cost projects that have improved the experience of those using our network – these are collectively termed 'Healthy Streets' schemes. Measures include widening footways near bus stops to improve pedestrian comfort levels, and widening and extending bus lanes to promote safer and unimpeded bus passage.



Safe streets put people first by creating attractive and healthy spaces

Safe streets – what next?

A safe streets workstream is being developed as part of the Bus Safety Programme. A key component of this will be research and analysis into the safety benefits and/or risks to both road users and bus customers.

We need to ensure that any risks are looked at in depth, and appropriate mitigations are established as a result. We will firstly analyse and review available datasets, and then collect new data to fill any gaps. In the longer term, mitigations to any risk identified will be established and trialled, including assessing the impact on road user behaviour.

TfL receives route risk assessments from bus operators at least every two years. We are in the process of data-mining these and other associated information to determine what details can inform the development of risk-led street design and the wider Bus Safety Programme. A process by which useful information can be shared and used by internal stakeholders and bus operators will also be established as part of this work.

We will aim to help inform guidance and best practice for infrastructure schemes to ensure that bus safety is considered at the earliest opportunity when new schemes are being developed. Training and guidance documentation for key stakeholders around the business will also be established and developed.

Action I2

- a. Research and develop best practice guidance into on-street bus infrastructure and road danger risk to ensure that bus safety is considered at the earliest opportunity when on-street schemes are being developed
- b. Use existing data to establish risk and hotspots by 2024 to inform future infrastructure projects, and the wider Bus Safety Programme



Bus safety risk analysis is a major part of the safe streets workstream

Stakeholder challenge

‘People stepping out in front of buses due to distractions from technology’

In the workshops we undertook while developing this Bus safety strategy, a large number of ideas and suggestions of key activities within the industry’s direct control were identified. Some challenges were pinpointed, however, in areas we have less control over. We frequently heard, for example, that a perceived problem with people walking was that they were too distracted by their phones or other electronic devices to see a bus before stepping out.

However, people have been stepping out in front of vehicles since long before these devices were present. In 1991, for example, when mobile phones were the size of a house brick and still required a separate battery, there was a total of 217 fatalities among people walking in London. In 2021, with ubiquitous smartphones and electronic devices, there was a total of 36 deaths of people walking.

Research undertaken into pedestrian crossing behaviour and the use of phones showed that, while device use was prevalent, people walking did tend to adapt their behaviour to reduce risk when crossing. There is little doubt that distraction by electronic devices is a factor and should not be ignored; however, data suggests it is not a dominant factor.

Stakeholder challenge

‘Behaviour of other road users’

During the development workshops, the behaviour of other road users outside the bus was highlighted as a key factor threatening the achievement of Vision Zero for buses. Examples include a person on a motorcycle overtaking a vehicle and moving directly into the path of an oncoming bus; and a car driver hitting the rear of a bus.

Historically, interventions on road safety tended to focus on restrictive infrastructure, such as guard railing, and education and marketing campaigns. However, research has shown that removing guard railing has safety benefits for people walking and cycling, and there is limited quantitative evidence that marketing campaigns reduce casualties.

Conversely, these interventions also reinforce a sense of motor vehicle supremacy, which may encourage dangerous driving and increase perceptions of danger for vulnerable road users. The Safe System philosophy accepts that road users are human and will make mistakes, but the system needs to work to ensure that these mistakes do not lead to a fatality, with the focus on addressing the sources of road danger.

Asset management

Asset management does not sit within the Bus Safety Programme, but there are clear links between the maintenance and provision of good facilities – such as for bus driver welfare – and improving bus safety. The activities to improve our facilities are set out in detail in the Bus action plan.

Welfare facilities

TfL is working to improve welfare standards at work, with a focus on increasing and improving toilet provision for our bus drivers. This is particularly aimed at attracting more women to the role and retaining older drivers. Ensuring there are appropriate rest facilities, such as mess rooms and quiet areas at bus stations and stands, for bus drivers to take their breaks is also a priority. These make it easier for drivers to take a better-quality break, and may also help to combat fatigue.

Maintenance of roads and bus stations

Ensuring appropriate road maintenance supports a safer road network. Our roads are regularly safety inspected in most locations. We have an annual road renewal programme and one of the UK’s best records for managing asset-related injury due to our comprehensive approach.

Our bus stations are also safety inspected at regular intervals for everything from water to electrical testing, but also to make sure bus decks and footways are in good condition, not only to improve bus customer experience but also to reduce the risk of passenger slips, trips and falls. We will continue to work with the Health and Safety Executive to improve the safety of our infrastructure and facilities for our staff, contractors and customers where needed.

Station fire safety improvement programme

Over the last four years, TfL has been running a fire safety improvement programme, with updated risk assessments and new fire strategies for all bus stations. Produced by fire engineers, these strategies address all aspects of fire prevention and on-site equipment.

Roll-out of defibrillator machines

TfL decided to install defibrillator devices at all our major bus stations and stands. With the help of the London Ambulance Service, we are now progressing through this roll-out to 70 locations – the defibrillators will save lives and have been added to the national register for 999 call use. While medical emergencies are not included in our Vision Zero casualty statistics, if someone were to be injured in a collision and needed a defibrillator, then having such equipment on site could help improve the post-collision response and outcome.



We are installing defibrillators at 70 major bus hubs across London



Post-collision support and investigation

Post-collision support and investigation – what we are doing

Assurance

We work closely with bus operators, liaising on day-to-day safety, health and environment issues, assisting in resolving and escalating issues where necessary. We aim to support a fair and just safety culture and embed improvement among bus operators.

This includes regular meetings with representatives from bus operator safety teams, to share learning from significant incidents, and discuss emerging risks or topical issues. We review investigations into major incidents to ensure root causes are identified and appropriate corrective actions implemented. We also share salient learning from investigations among bus operators and ensure these are fed into the development of the Bus Safety Programme.

We carry out assurance of bus operator safety, health and environment arrangements, reviewing adherence to TfL requirements, and monitoring trends and progress over time, seeking to achieve continuous improvement on the journey towards Vision Zero.

We also host (jointly with the bus operators) and support a programme of site visits and engagement events at hotspot incident locations around the bus network, to gather first-hand understanding of location-specific issues, interact with staff, raise the profile of Vision Zero and share knowledge and insight. This includes senior manager safety, health and environment tours that aim to promote awareness, as well as listening and responding to employee questions and concerns, and initiating improvement actions.

Licence for London

The Licence for London is a voluntary scheme between bus operators, TfL and Unite the Union. It was introduced in 2017 and enables drivers with the Licence for London to start work with a new bus operator at the open pay grade that is equivalent to their level of service, thus not having to start again as if they were a new-entrant bus driver. The licence can be withdrawn if a bus driver is dismissed under a disciplinary process, which can be as a result of driving standards. This provides an important assurance to bus operators that drivers are meeting the standards required.



Awareness, education and enforcement activity

We undertake a range of awareness, education and enforcement activity on the road network through our Compliance, Policing, Operations and Security directorate. This includes speed testing and safety cameras, as well as educational activities such as exchanging places, which encourages

bus drivers and people cycling to understand each other's perspective. We recently held a session at West Ham Garage to give drivers, driver mentors, safety managers and union representatives the opportunity to learn about the TfL e-scooter hire scheme.

Engineering Quality Monitoring

Engineering Quality Monitoring encompasses vehicle inspections for London Buses and rail replacement buses. The scheme also entails examination of regular maintenance service intervals, maintenance facility examinations if required and the production of trend analysis, which is documented and analysed via an online portal.

Engineering Quality Monitoring allows us to monitor fleet condition, spot trends and help deliver a safe and reliable service to agreed standards and specification. It also allows bus operators to identify vehicle defect trends, and deficiencies in garage processes, comparing their performance against other operators. Engineering Quality Monitoring gives us assurance that all bus operators are maintaining buses to the standard we contractually require and are operating in line with Driver and Vehicle Standards Agency (DVSA) regulatory requirements.

The service is contracted out to a provider, currently Logistics UK, which employs vehicle inspectors to carry out garage-based inspections at short notice. They are fully trained holders of the relevant vehicle class IRTEC Inspection Technician Licence (bus and coach), are wholly independent of the relevant operating companies and are fully conversant with DVSA roadworthiness standards.

Defect point scores are assigned during each inspection and these scores feed into our various performance monitoring and safety assurance processes, such as the Safety Performance Index and the new route contract evaluation process. The annual target for the number of vehicle inspections completed across the fleet is 25 per cent of all London buses (spread evenly across all bus operators).

Data collection and analysis

We undertake a range of monitoring and analysis of data and trends of bus-involved collisions and injuries as well as non-collision passenger injuries, culminating in the production of the Safety Performance Index. We publish this data on our website alongside annual reports more widely for Vision Zero, including an annual report detailing all collisions in Greater London. We proactively share data, insight and learnings with bus operators.

As part of the development of projects and workstreams within the Bus Safety Programme, we undertake in-depth studies. Learning from historic trends, identifying new risks and contributory factors to collisions ensures we have an evidence-led approach to the development of new measures. This includes a fatal files analysis, completed in 2018, which informed the development of the Bus Safety Standard measures, as well as ongoing independent research into specific issues and measures.

We also collect learning from Notifications of Investigations of Major Incidents and independent collision investigations. Incident reports completed by bus station controllers provide further insight on specific incidents.

We collect and review customer complaints data, focusing on identifying those that meet the criteria for Notifications of Investigations of Major Incidents – these include fatalities, serious injuries that result in a hospital stay overnight, safety-critical failures such as a bus fire, security failures such as drugs or alcohol involving a driver, and other incidents such as pedal application error. This is used to inform the Safety Performance Index.

The Confidential Incident Reporting and Analysis Service provides an independent and confidential reporting tool that bus drivers can use to report health, wellbeing and safety concerns. This aims to ensure that all employees are listened to, and can also overcome concerns about reporting issues.

Post-collision support and investigation – what next?

Assurance

We will continue to improve our safety monitoring and assurance processes among bus operators, which include enhancing our incident reporting and investigation arrangements as well as ensuring safety standards are applied consistently across all bus operators.

Road Safety Investigation Branch

The Government launched the Road Safety Investigation Branch in June 2022. This will investigate incidents on the country's roads and provide insight into what needs to change to help save lives. The Government will recruit a specialised team of inspectors, looking at how and why incidents happen, and providing insight into safety trends related to new and evolving technologies. It will investigate themes in the causes of collisions and provide independent safety recommendations to organisations.

This provides a key opportunity and benefit for Vision Zero in London and the Bus Safety Programme to inform new areas of research and insight, as well as investigations.

Action I3

- a. Investigate whether improvements are needed to Engineering Quality Monitoring processes to ensure new systems and technologies introduced through the Bus Safety Standard are maintained and kept up to date by 2024
- b. Improve safety monitoring and assurance processes among operators, and enhance incident reporting and investigation arrangements to aid identification of root causes and corrective actions
- c. Improve how near-miss data is recorded and monitored
- d. Expand upon and undertake an in-depth review of bus collision data, including analysis of fatal files and specific themes such as fatigue-related incidents by 2024. This will provide an important update to analysis completed as part of the early development of the Bus Safety Programme and enable us to monitor progress and identify new trends

Data collection and analysis

We will undertake an updated review of bus collision data to ensure our analysis remains current. This will include fatal files analysis as well as the review of specific occurrences such as fatigue-related incidents.

Identifying near misses remains a key gap in our data collection and analysis, meaning that potential unknown trends and risks are being missed. A key barrier to gathering data on near-miss incidents is the bus driver's ability to report them; as such incidents cannot be safely recorded while the driver is driving, they rely on the driver reporting the incident at the end of their shift. This poses challenges as the details of such an incident may be missed if many hours have passed, and the process is reliant on the driver taking the time to report the incident after their shift has ended.

We will explore opportunities to improve the reporting of near-miss incidents. This includes the potential to encourage drivers to report near misses as well as the installation of technology on the bus itself.

Action I4

- a. Work in partnership, including with the Metropolitan Police Service and the national Confidential Incident Reporting and Analysis Service
- b. Promote a culture of transparency, internally and across operators, proactively sharing learning opportunities and data wherever possible, for example at safety manager meetings or bus operator forums

Post-collision support and investigation

We committed to introducing the Sarah Hope Line in the Vision Zero action plan. Since its launch in January 2016, the Sarah Hope Line has offered comprehensive help and support to people who have been injured during, or affected by, a serious incident involving any of our services. It is a voice of kindness and compassion to help victims, their families and witnesses on their recovery. So far, more than 450 people have benefited from this assistance.

Further improvements are planned to ensure the service can support as many people as possible, including an internal review of case management process, refresher training for agents on the new case management process and customer pain points, and improved data capture and reporting.

We are increasing awareness of the Sarah Hope Line and the support services we offer through an ongoing public information campaign as well as a programme of events with the emergency services and first responders to ensure early intervention with people who need this vital support.



Engineering Quality Monitoring enhancement

DVSA roadworthiness standards are focused on legal compliance, and cover critical issues such as brakes, tyres and emissions. However, those legal roadworthiness standards are not always updated quickly enough to cover new technologies and the systems required through the Bus Safety Standard,

as our new vehicles go much further than the minimum legal standards. Through the Engineering Quality Monitoring process we will investigate whether improvements are needed and, if so, how they could be achieved. Our Engineering Quality Monitoring process will be enhanced to resolve these issues.

06

Monitoring and supporting delivery

Greater visibility of what we are achieving, and how or where we can make improvements, will help inform how we work together in the future



Monitoring and supporting delivery

Delivering Vision Zero will require close collaboration across the bus industry and within TfL, to deliver safe vehicles, safe speeds, safe behaviours and safe streets

Continuous improvement

Monitoring the outcomes and benefits from the Bus Safety Programme is fundamental to ensuring the measures we implement have the intended effect and contribute to the reduction in the number of people killed or seriously injured on, or by, a bus, as well as a reduction in customer slight injuries. This includes the need to continue to monitor and strategically analyse collision data, as well as to look in detail at the impacts and contribution of different measures within the programme on specific collisions. This monitoring will inform the development of future measures and priorities, helping us to make changes to existing measures and workstreams where needed.

The forecast effectiveness and impact of the measures in the Bus Safety Standard have been quantified, and a key priority now is to monitor the real-world performance of the measures already implemented to understand what has worked well and what has worked less well to inform the continual improvement of standards.

Initial monitoring of the impact of Intelligent Speed Assistance has shown an average reduction in speeding incidents of around 80 per cent where this is in operation. Further analysis is planned to understand the factors affecting the results. Limited benefits monitoring of other Bus Safety Standard measures has been undertaken to date as sufficient data does not exist from which to draw robust comparisons and conclusions.

As the number of buses that are compliant with the Bus Safety Standard continues to increase, with at least three years' worth of collision data now available, we are able to start benefits realisation work. It should be stated, however, that the coronavirus pandemic will affect this due to the significant disruption to travel demand, and these wider changes will therefore need to be built into monitoring.

There are significant opportunities to share data and learnings from the Bus Safety Standard measures with the wider transport industry. Many of the technologies that have been introduced or are planned, such as Intelligent Speed Assistance, Acoustic Vehicle Alerting Systems and Advanced Emergency Braking,

are also being introduced by the freight and car industries. Improving how we share data on the effectiveness and impacts of vehicle technology benefits both TfL as well as the transport industry in general. We are also keen to learn from other industries, including the car and freight sectors, on the safety impacts and outcomes that have been seen from the implementation of vehicle technologies.

There are other parts of the Bus Safety Programme where the forecast and actual effects on casualties cannot be quantified. This includes work on driver fatigue, health and wellbeing, training and wider impacts on safety and organisational culture.

Monitoring the effects of these workstreams relies on feedback from bus operators, including bus drivers, on specific initiatives and projects, as well as analysis of casualty trends. This includes, for example, the evaluation of the individual trials within the Fatigue, Health and Wellbeing Innovation Challenge. We also evaluate the impact of our training, such as the Fatigue Management Awareness Training that was rolled out to more than 1,700 managers and supervisors at bus operators in 2021.

‘TfL’s Vision Zero strategy and Bus Safety Programme has encouraged very positive changes across the bus industry and helps support our commitment to safety. Metroline works very closely with TfL, and we have partnered on several innovative safety initiatives’

Sinead Maguire

Head of Transport Safety,
Recruitment and Training, Metroline

Non-quantifiable benefits

The non-quantifiable impacts of measures in the Bus Safety Programme will become more important as the number of casualties on, or by, a bus reduces. This is because the ability to draw quantifiable conclusions on the trends and priorities will become less reliable due to smaller and smaller numbers.

The increasing importance of non-quantifiable benefits as the number of casualties on, or by, a bus continues to decrease also has implications for the development of business cases for investment. There will be challenges in terms of competing for investment with other safety interventions outside buses that may offer a better return, based on a forecast quantified casualty reduction, because other transport modes will be coming from a poorer baseline in terms of number of casualties, as well as other projects such as infrastructure renewals, which usually have strong business cases.

In addition, when a safety measure or technology is effective in reducing absolute casualty numbers or lowering risk, this may increase the risk of funding being reduced on the basis of the problem having been 'solved' rather than the need for constant suppression of risk (as we have seen in other advanced safety cultures).

Understanding the relative risk and benefits of interventions across the transport network to help access funding will therefore become increasingly important.

We will develop a framework to assess the qualitative risks and impacts of new measures and priorities. This will include work to understand the different levels of risk and impacts of the measures in the Bus Safety Programme for different demographic groups.

Action I5

Expand upon the implementation monitoring of the measures in the Bus Safety Programme, and specifically through the Bus Safety Standard, to understand the impact of new technology on casualties as well as on the behaviour of bus drivers, passengers and other road users outside the bus.



Monitoring safety measures will highlight the impact of new technology

From bus drivers to managers

We want to encourage and support more women to work in the bus industry at every level, from bus drivers and mechanics to engineers and managers. Unlike in UK rail and aviation, there is not a comparable national cross-industry network or an organisation specifically supporting and promoting women's participation in buses.

The current workforce of the bus industry does not reflect the community it serves. The Labour Force Survey reported that, in 2020/21, only 16 per cent of bus and coach drivers were female¹⁹ (although this is significantly more than the seven per cent it was in 2019/20).²⁰ Across a sample of four London bus operators in 2020, 9-11 per cent of their total staff were female.²¹ As this includes management, where women are especially under-represented, it is likely that the proportion of female drivers is comparable to national figures. In comparison, more than half of bus passengers are female.

Building upon our commitment in the Bus action plan, attracting more women into the bus industry will also help to address the chronic workforce shortage and ease the pressure on frontline staff, contributing to improved health and wellbeing. The lack of women working in the industry can be considered a barrier itself, contributing to a perception that it is not a valid career choice for women. We must challenge and change this perception.

¹⁹ [gov.uk/government/collections/bus-statistics](https://www.gov.uk/government/collections/bus-statistics)

²⁰ [gov.uk/government/statistics/annual-bus-statistics-year-ending-march-2020](https://www.gov.uk/government/statistics/annual-bus-statistics-year-ending-march-2020)

²¹ Based on gender pay reporting data 2020 from Abellio, Go-Ahead, RATP Dev and Stagecoach

There are many other barriers preventing more women from joining the industry. This includes shift work (although this can in fact be a positive option for many employees, enabling them to fit work around family and other commitments), a lack of flexibility around shift patterns, and/or a lack of part-time options. Making the working environment more supportive, including reasonable adjustments for women's health in areas such as fertility treatment, pregnancy, pregnancy loss and the menopause, is also important for attracting more women to work in the bus industry.

We will establish a Women in Bus and Coach Network to help encourage and support more women to work in the bus industry at every level. As part of this, we will look at the barriers and opportunities for women working in buses, including at existing bus operator policies to inform guidance and training on women's health.

Action 16

Establish a Women in Bus and Coach Network in 2023, and continue to develop research and activities to support delivery of its aims.



Working in the bus industry should be a valid career choice for women

Continuous commitment

Working in partnership with the bus industry, we have implemented a range of interventions, from the development of the Bus Safety Standard – which has ensured new buses entering the London fleet have innovative technology to achieve the highest safety standards – to the launch of a fatigue management workstream that has included the delivery of Fatigue Management Awareness Training to all supervisors within bus operators.

Underpinning the Bus Safety Programme is an emphasis on safety culture within the bus industry to ensure it is front and centre of all decisions and day-to-day operations.

We would not have been able to achieve so much without the support of our colleagues across the bus industry and innovators in safety initiatives. In the future, continued commitment, ongoing research and a range of interventions consistently applied is crucial to ensuring we achieve Vision Zero on the London bus network and, importantly, maintain it.

We will continue to deliver across the Safe System pillars to ensure all parts of the system are strengthened, and will pursue more ways to work with bus operators, manufacturers and suppliers, and across TfL.

In Chapter 4, we set out how the totality of the activity that we already undertake in the Bus Safety Programme, as well as wider activities from across TfL as set out in the Vision Zero action plan, will help us get close to achieving our Vision Zero targets for the bus network. There remained, however, an element of uncertainty as some programmes were less easily quantified, and there likely remained a gap that needed to be addressed. Chapters 5 and 6 have set out how we will close this gap and achieve our Vision Zero targets for the bus network. This is summarised in our action plan in Chapter 7.

Our action plan brings together existing actions that we have already committed to under the Vision Zero action plan and Bus action plan, as well as setting out new actions arising directly from this strategy. We are confident that this robust strategy will help us to ensure that we keep on track, and demonstrates our commitment to do our utmost to reach our Vision Zero targets for a safe bus network.



Continued commitment is vital to achieve and maintain Vision Zero

07

Action plan summary

We will seek to achieve Vision Zero for the bus network through activities already committed to, and new actions as highlighted



Bus Safety Programme action plan (incorporating both new and existing actions from the Vision Zero action plan and the Bus action plan)

Action number	Action	Action type	Indicative timescale		
			Short term (Up to two years)	Medium term (Up to five years)	Longer term (More than five years)
Safe vehicles					
1a	Continue the roll-out of the Bus Safety Standard on new vehicles, with all existing measures mandated by 2024. Retrofit safety features to bring forward the benefits resulting from a reduction in the number of casualties, and continuing to incorporate evidence-based safety measures.	Existing			●
1b	Research and develop new measures and requirements for inclusion in the Bus Safety Standard beyond 2024.	New		●	
1c	Continue to investigate how improved connected and autonomous vehicle technology can further help our Bus Safety Programme.	Existing			●
2	Continue to develop and implement a bus fires workstream during 2023 to ensure a systematic approach is taken to address the actual and potential risks of fire within our changing bus fleet.	New	●		
3	Implement the pedal application error workstream to further research and identify measures to avoid and mitigate the potential for pedal application error by 2024.	New	●		
4	Bring forward the safety benefits from new vehicle technologies by retrofitting existing buses in the fleet with technologies that provide the greatest potential to reduce road danger and provide value for money.	New			●
Safe speeds					
5a	Continue roll-out of Intelligent Speed Assistance on new buses through the Bus Safety Standard for new buses and retrofitting existing buses, subject to funding.	Existing			●
5b	Work with bus operators during 2023 on proactive speed management, focusing on improving speed compliance on bus routes without Intelligent Speed Assistance.	New	●		

Action number	Action	Action type	Indicative timescale		
			Short term (Up to two years)	Medium term (Up to five years)	Longer term (More than five years)
Safe behaviours					
6	Build on the success of the Destination Zero training programme over the period to 2024, to equip drivers with the skills to adapt to the changing streetscape and better support the needs of our vulnerable and diverse customers, and work to achieve Vision Zero.	Existing	●		
7	Investigate the potential for behavioural adaptation of safety technologies for buses and their impact.	New		●	
8a	Work with operators to expand and deliver the Fatigue Management Programme for bus drivers, incorporate new communications with bus drivers and other frontline staff and continue to look at new ways to manage and prevent fatigue.	Existing		●	
8b	Trial fatigue detection technology on buses, subject to funding, and build upon the outputs of the trial by 2024.	Existing	●		
8c	Act on the recommendations of the Fatigue Risk Assessment Tool research during 2023, including developing guidance for bus operators to help support their use of such tools.	New	●		
9a	Improve TfL's safety culture through completing cultural measurement activities using TfL's Culture Maturity Assessment.	New		●	
9b	Build on the improvements to safety culture at bus operators and our suppliers, focusing on the cultural benefits being achieved through our fatigue, health and wellbeing programmes.	New		●	
10a	Promote innovative bus driver fatigue, health and wellbeing initiatives through delivery of the Bus Safety Programme and lead the Fatigue, Health and Wellbeing Innovation Challenge jointly with bus operators. Develop an open culture around health and wellbeing, and understand key focus areas for drivers' health and wellbeing.	Existing		●	
10b	Work with operators and the Design Council to use the Employer Health and Innovation Fund to develop a bus driver health and wellbeing programme that analyses the effectiveness of interventions by 2024.	Existing	●		
10c	Continue to develop and deliver new initiatives that support driver health, wellbeing and fatigue management.	New		●	
11a	Implement a strategic data-led approach to reducing passenger injuries due to slips, trips and falls, involving the evaluation of a variety of technical, behavioural and procedural interventions in 2023.	Existing	●		
11b	Address customer injury incidents through a future Bus Safety Innovation Challenge in 2023.	New	●		
11c	Explore further distinct bus user groups to ensure equality and inclusion across the safety measures implemented.	New		●	
Safe streets					
12a	Research and develop best practice guidance into on-street bus infrastructure and road danger risk to ensure that bus safety is considered at the earliest opportunity when on-street schemes are being developed.	New		●	
12b	Use existing data to establish risk and hotspots by 2024 to inform future infrastructure projects, and the wider Bus Safety Programme.	New	●		

Action number	Action	Action type	Indicative timescale		
			Short term (Up to two years)	Medium term (Up to five years)	Longer term (More than five years)
Post-collision support and investigation					
I3a	Investigate whether improvements are needed to Engineering Quality Monitoring processes to ensure new systems and technologies introduced through the Bus Safety Standard are maintained and kept up to date by 2024.	New	●		
I3b	Improve safety monitoring and assurance processes among operators, and enhance incident reporting and investigation processes to aid identification of root causes and corrective actions.	Existing		●	
I3c	Improve how near-miss data is recorded and monitored.	New		●	
I3d	Expand upon and undertake an in-depth review of bus collision data, including analysis of fatal files and specific themes such as fatigue-related incidents by 2024.	New	●		
I4a	Work in partnership, including with the Metropolitan Police Service and the national Confidential Incident Reporting and Analysis Service.	Existing		●	
I4b	Promote a culture of transparency, internally and across operators, proactively sharing learning opportunities and data wherever possible, for example at safety manager meetings or bus operator forums.	Existing			●
Monitoring and supporting delivery					
I5	Expand upon the implementation monitoring of the measures in the Bus Safety Programme, and specifically through the Bus Safety Standard, to understand the impact of new technology on casualties as well as on the behaviour of bus drivers, passengers and other road users.	New		●	
I6	Establish a Women in Bus and Coach Network in 2023 and continue to develop research and activities to support delivery of its aims.	New	●		

About us

Part of the Greater London Authority family led by Mayor of London Sadiq Khan, we are the integrated transport authority responsible for delivering the Mayor's aims for transport. We have a key role in shaping what life is like in London, helping to realise the Mayor's vision for a 'City for All Londoners' and helping to create a safer, fairer, greener, healthier and more prosperous city. The Mayor's Transport Strategy sets a target for 80 per cent of all journeys to be made by walking, cycling or using public transport by 2041. To make this a reality, we prioritise safety, sustainability, health and the quality of people's experience in everything we do.

We run most of London's public transport services, including the London Underground, London Buses, the DLR, London Overground, Elizabeth line, London Trams, London River Services, London Dial-a-Ride, Victoria Coach Station, Santander Cycles and the IFS Cloud Cable Car.

We manage the city's red route strategic roads and are responsible for the maintenance, management and operation of more than 6,000 sets of traffic lights across the capital. The London boroughs are responsible for all the remaining roads within their boundaries. The experience, reliability and accessibility of our services are fundamental to Londoners' quality of life. Safety remains our number one priority and we continue to work tirelessly to improve safety across the network for both colleagues and customers.

Our vision is to be a strong, green heartbeat for London. We are investing in green infrastructure, improving walking and cycling, reducing carbon emissions, and making the city's air cleaner. The Ultra Low Emission Zone, and fleets of increasingly environmentally friendly and zero-emission buses, are helping to tackle London's toxic air. We are also improving public transport options, particularly in outer London, to ensure that more people can choose public transport or active travel over using their vehicles.

That is why we are introducing the outer London Superloop bus network, providing express bus routes circling the entire capital, connecting outer London town centres, railway stations, hospitals and transport hubs.

We have constructed many of London's most significant infrastructure projects in recent years, using transport to unlock economic growth and improve connectivity. This includes major projects like the extension of the Northern line to Battersea Power Station and Nine Elms in south London, as well as the completion of the London Overground extension to Barking Riverside and the Bank station upgrade.

The Elizabeth line, which opened in 2022, has quickly become one of the country's most popular railways, adding 10 per cent to central London's rail capacity and supporting new jobs, homes and economic growth. We also use our own land to provide thousands of new affordable

homes and our own supply chain creates tens of thousands of jobs and apprenticeships across the country.

We are committed to being an employer that is fully representative of the community we serve, where everyone can realise their potential. Our aim is to be a fully inclusive employer, valuing and celebrating the diversity of our workforce to improve services for all Londoners.

We are constantly working to improve the city for everyone. This means using information, data and technology to make services intuitive and easy to use and doing all we can to make streets and transport services accessible and safe to all. We reinvest every penny of our income to continually improve transport networks for the people who use them every day. None of this would be possible without the support of boroughs, communities and other partners who we work with to improve our services. By working together, we are creating brighter journeys and a better city.

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