

Transition of public transport fleet to low emission vehicles

Briefing Note to the UTRAP Steering Group

1 Introduction

NTA was requested to provide a briefing note to the Urban Transport Related Air Pollution Steering Group. This note sets out the road map for transitioning the public transport fleet to low emission vehicles and provides an update of current status as at Q1 2020. The note considers PSO Bus services and rail fleet.

2 Medium Term Fleet Technology Pathway for the Public Bus Fleet

2.1 Background

Action 85 of the Government's Climate Action Plan, published in June 2019, requires the "*Adoption of Medium Term Fleet Technology Pathway for the Public Bus Fleet*" by the end of 2019.

A decision was taken in early 2019 to purchase diesel-electric hybrid buses as an interim solution pending developments in relation to double deck electric fleet and other technologies. Given various recent technology developments, it does not appear prudent to make final fleet decisions until some of those technologies have advanced further. In particular the potential for hydrogen powered vehicles has emerged during the last year or so as a viable option, but no hydrogen double deck bus is yet in service. Similarly, only a very small number of double deck electric buses have gone into service in the UK.

Therefore it is appropriate to set out the "Pathway" for the technology decision in relation to the public bus fleet, rather than determine at this point in time the final technology solution.

2.2 General Policy

NTA recognises the need to decarbonise transport in order to mitigate the impacts of climate change. As outlined in Project Ireland 2040 National Development Plan 2018-2040, there is a commitment to "*transition to low emission buses, including electric buses, for the urban bus fleet, with no diesel only buses purchased from July 2019*". This is reinforced within the NTA Statement of Strategy 2018-2022 where a key milestone to delivery under Priority 3 is to "*Acquire 300 low emission buses for the operation of subsidised bus service*".

In making this commitment, NTA reviewed all available double deck low emission vehicles and determined that, in the context of Ireland, the appropriate proven technology to pursue initially is diesel-electric hybrid buses.

In June 2019, the Government of Ireland launched the Climate Action Plan, which sets out 183 actions to achieve the targets to tackle climate breakdown. In support of each action there are steps to necessary for delivery identified. Action 85 relates to Low Emission Buses and the full text of the action items is set out in Figure 1.

Action 85: Transition the urban PSO public bus fleet to LEVs			
Steps Necessary for Delivery	Timeline by Quarter	Lead	Other Key Stakeholders
Initiate tender process for a framework contract for the purchase of double-decker hybrid buses (diesel/electric)	Q3 2019	NTA	
Complete Low Emission Bus Trial	Q3 2019	DTTAS	
Public Consultation on alternatively fuelled buses (part of a wider public transport policy consultation)	Q3 2019	DTTAS	
Award framework contract for the purchase of double deck hybrid buses and place first orders	Q4 2019	NTA	
Adoption of Medium Term Fleet Technology Pathway for the Public Bus Fleet	Q4 2019	NTA	
First 100 low emission buses enter the urban bus fleet	Q4 2020	NTA	

Figure 1: Extract from Climate Action Plan 2019 – Annex of Actions

Separately, in June 2019, Directive (EU) 2019/1161 concerning the promotion of clean and energy-efficient road transport vehicles was published. That directive is required to be transposed into Irish law by mid-2021. It identifies two low emission vehicle categories:

- **Clean Vehicles** being vehicles using alternative fuels including electricity, hydrogen, biofuels, and natural gas (including biomethane) and liquefied petroleum gas; and
- **Zero-emission Vehicles** being vehicles without an internal combustion engine or with a very small internal combustion engine emitting a minuscule level of carbon dioxide.

Diesel-electric hybrid buses with an external charging capability are classified as “Clean Vehicles” under this directive. The hybrid vehicles to be purchased by the NTA in 2020 will be within this classification.

A key tenet of the directive is the setting of minimum targets for procurement of Clean Vehicles and Zero Emission Vehicles in relation to buses for each member state. The targets for both categories are summarised below – the target for Zero-emission Vehicles is a sub-set of the Clean Vehicles target.

	From 2nd August 2021 – 31 December 2025	From 1st January 2026 to 31 December 2030
Clean Vehicles	45% of bus fleet procured during this period	65% of bus fleet procured during this period
Zero-Emission Vehicles	One quarter of the 45% of Clean Vehicles	One half of the 65% of Clean Vehicles

Table 1: Summary Clean Vehicles Requirements for Class 1 vehicles

2.3 Proposed Technology Pathway

Rather than determine the longer term technology at this point in time, NTA has set out the technology roadmap to be followed in relation to the evolving technologies for buses.

Based on the Climate Action Plan 2019 and the Clean Vehicles Directive, it is necessary that 11.25% of all buses procured by the end of 2025 will be zero-emission vehicles. On this basis, NTA must consider alternatives to diesel-electric hybrid vehicles for procurement over the next 5 years.

The following sets out the key actions necessary to achieve the required targets for low emission and zero emission buses:

- Ensure that the diesel-electric hybrids to be purchased from 2020 onwards comply with the definition of Clean Vehicles;
- Undertake pilot studies in 2020 / 2021 on zero emission buses – both electric and hydrogen - to assess technology readiness level;
- Assess infrastructure requirements for charging / refuelling at depot locations and determine lead-in times for bringing zero emission vehicles into full service;
- Procure single deck electric buses for town services and commence operations in 2021, potentially in Athlone and Carlow as initial towns – these procurements will contribute towards achieving the 11.25% zero-emission vehicle target for 2025;
- Continue to monitor developments in new technologies and develop pilots and trials as appropriate to determine technology readiness levels;
- Following the above trials and pilots, make a determination in 2022 on the type of zero-emission double deck bus fleet to be procured, providing sufficient time to meet minimum target requirements by 2025;
- Procure zero emission double deck bus fleet starting in 2023; and
- Deliver fuelling / charging infrastructure at depots

The above action represents a roadmap to the selection of the optimal zero-emission public bus fleet for Ireland for the medium term, while ensuring the purchase of Clean Vehicles in the short-term.

3 Current Status of the transition of the Bus Fleet to Low Emission Vehicles

3.1 Purchase of Hybrid Double Deck Buses

In December 2019, NTA entered into a framework agreement with Alexander Dennis Limited (ADL) to supply up to 600 Double Deck Hybrid Buses. An initial order for 100 vehicles has been placed with delivery of first vehicle scheduled for October 2020. The ADL Hybrid Buses (Enviro400ER) represent the latest technology for Hybrid vehicles. Some facts and features of the new buses are:

- Series-hybrid double-deck bus with plug-in charging facility, i.e. it is effectively an electric bus propelled by an electric motor powered by a battery, but fitted with an on-board diesel generator to top-up the battery as and when required when the bus is in motion;
- Meets the relevant definition of a ‘clean vehicle’ under the EU’s ‘Clean Vehicles Directive’, which enters into force in July 2021;
- ‘Well-to-wheel’ greenhouse gas emissions 30% less than a Euro VI diesel bus of equivalent passenger capacity;
- Certified for continuous zero-tailpipe-emission operation over a distance of two and a half kilometres, with sufficient battery capacity (32kWh¹) to cater for operation over a distance in excess of five kilometres;

¹ The nine hybrid vehicle purchased by Dublin Bus in 2018 have a battery capacity of approx.. 1kWh.

- Geo-fencing capability enables automatic shut-down of the on-board generator so that the bus operates within defined geographical areas in zero-tailpipe-emissions mode;
- Ability to recover energy from the braking system

The hybrid bus technology is the same as those currently operated in Brighton & Hove. Information on these buses is appended to this note.

Delivery of all 100 buses is scheduled for Q4 2020 with the buses entering passenger service once all acceptance, commissioning and training activities have been completed by the relevant operator. At present, it is planned that 74 buses will be provided to Dublin Bus with 26 provided to Bus Éireann.

3.2 Purchase of Single Deck Electric Buses

There are opportunities to transition a number of town services and suburban local routes within the cities to single deck electric bus. NTA is currently preparing tender documents for a framework agreement for the supply of the single deck electric buses. At present the available technologies for single deck electric bus can facilitate daily duties of approximately 200km based on overnight charging. It should be noted that for some existing electric bus services operating in Europe this range can only be achieved where heating and cooling of passenger areas is powered by biofuels.

The Pre-Qualification Process will commence towards the end of Q1 2020. The volume of buses within the initial order for this framework is yet to be determined. The initial order will include sufficient buses to service the Athlone and Carlow town services. In addition, a full analysis of the revised Dublin Area bus network is being undertaken to determine which routes could be transitioned to electric in the short term. This may include new routes such as the O-route and local suburban routes as highlighted in green in Figure 2.

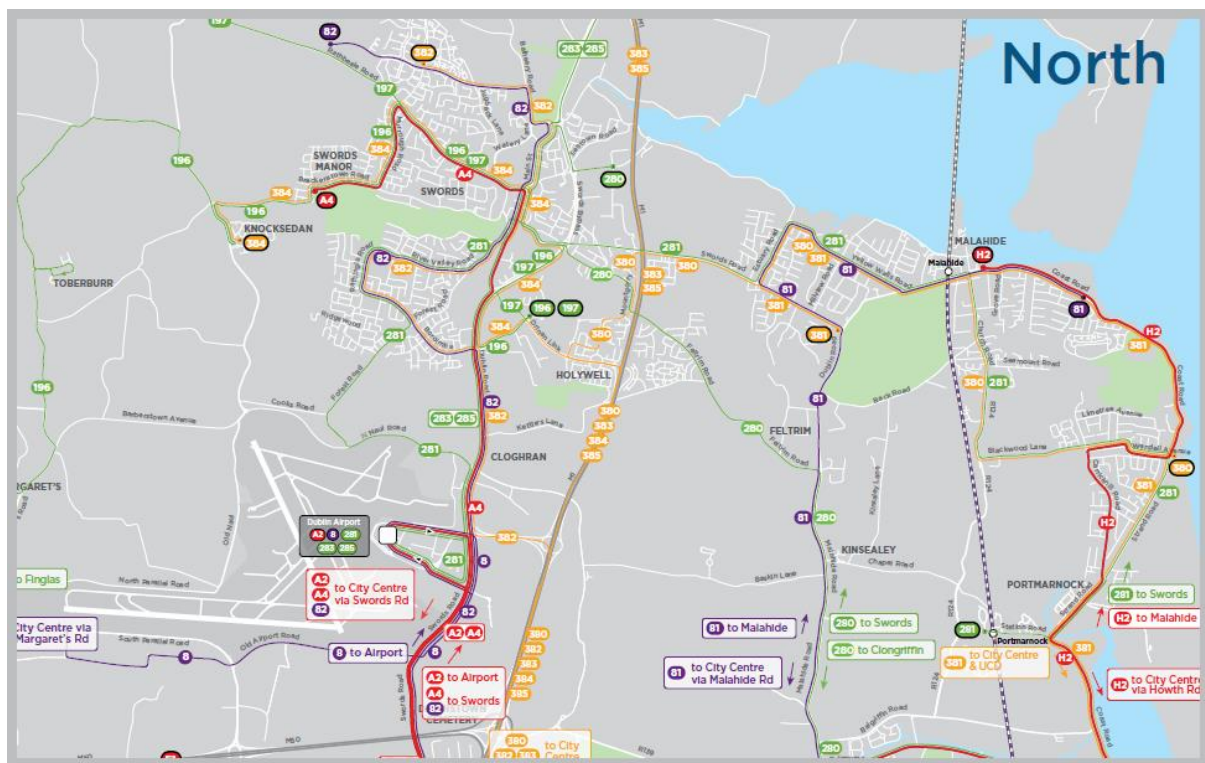


Figure 2: Extract from BusConnects Revised Bus Network 2019 Big Picture Map

3.3 Pilot of Hydrogen Double Deck Buses

Following consultation with market suppliers, NTA has entered into an agreement with Wright Bus to purchase three double deck hydrogen buses. The three hydrogen buses are scheduled to be delivered in Q3 2020. A pilot scheme is being developed that will see the buses move from initial trial running to passenger service. Discussions are on-going with both Bus Éireann and Dublin Bus on developing the pilot.

Separately, NTA along with CIE group are discussing opportunities for the supply of hydrogen to fuel the bus services.

The vehicle technology will be the same as those to be used by Translink in Belfast in the recently announced purchase of hydrogen double deck buses.²

4 Rail Fleet

4.1 DART Expansion

Within the Greater Dublin Area, NTA are responsible for the strategic planning of transport. The DART Expansion programme is a key element of the transport strategy for the GDA. The initial elements of the DART Expansion programme comprises the provision of high frequency electrified rail services on the Dublin Commuter routes extending to Drogheda to the north, Maynooth and Celbridge to the west and Greystone to the south.

Initial plans as set out in the Project Ireland 2040: National Development Plan included for the purchase of Diesel Electric Multiple Units (DEMU) to facilitate increased frequency of rail services in advance of electrification of the existing lines. Following an extensive fleet strategy study it has now been determined that the appropriate fleet is a mixture of Battery Electric Multiple Units (BEMU) and Electric Multiple Units (EMU).

Iarnród Éireann has completed a Pre Qualification process for a framework agreement for up to 600 BEMU / EMU fleet. In December 2019, the next stage of the tender process commenced with tenders due in May 2020. It is anticipated that Iarnród Éireann would be in a position to place an initial order in Q3 2020.

4.2 Hybrid PowerPack Pilot

Inter City Railcars (ICRs) operate on the majority of the Iarnród Éireann network. ICRs are diesel multiple units (DMUs). In order to reduce the emissions associated with ICRs Iarnród Éireann has commenced a pilot study with MTU to replace the existing diesel power train with a hybrid electric power train³. The hybrid power packs have the potential to reduce fuel consumption by 33% with associated reductions in emissions. The pilot is likely to be completed in 2021 and decisions on the wider rollout will be informed by the pilot.

² <https://www.rte.ie/news/ulster/2020/0129/1111764-hydrogen-bus-translink/>

³ <https://www.rolls-royce.com/media/press-releases/2018/19-09-2018-rr-and-irish-rail-bring-mtu-hybrid-drives-to-the-emerald-isle.aspx>

Appendix A: Brighton and Hove Hybrid Bus

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Up to 24 buses an hour run on the 5 group of services and when in the ULEZ, the Enviro400ERs run as pure electrics. **ANDY IZATT**

ZERO-EMISSIONS DELIVERED WITH PASSION

The team at Brighton & Hove Buses talk to **Andy Izatt** about their new fleet of ADL Enviro400ERs which are capable of delivering a zero-emissions solution where it matters

Brighton & Hove Buses is the first customer for the Alexander Dennis Ltd (ADL) Enviro400ER electric range hybrid unveiled by the manufacturer in September. The operator was closely involved in the development of the new model, which combines zero-emissions technology with geofencing to deliver an effective solution for tackling city pollution hotspots. Buses can run for up to five miles in electric mode with the exact distance dependant on factors such as travel time and route profile. Charging infrastructure isn't required and daily operational range is not limited. The busy 5/5A/5B group of services serving Hangleton, Hollingbury, Hove, Patcham, Preston Park and Brighton city centre has been chosen to receive 30 of the new buses, most of which are now in service. Around 7.6m journeys are taken on these routes annually, covering 133,104 miles within Brighton's Ultra Low Emissions Zone (ULEZ) encompassing Castle Square, North Street, Western Road and Palmeira Square. That's up to 24 buses an hour and when in the zone, the Enviro400ERs run as pure electrics. A fully electric drive utilising a 32kWh energy storage system comprising third generation lithium nickel manganese batteries is topped up by a small Cummins Euro VI generator and regenerative braking. BAE Systems supplied the hybrid technology developed to another level from what is already powering over 1,400 ADL buses in the UK.

A new light blue-based livery with Live & Breathe branding has been adopted emphasising the environmental credentials of the vehicles. Andy Izatt

Right solution

"The Enviro400ER best meets our challenges right now because this city has very locally specific air quality problems especially on this particular thoroughfare, which is why there's a ULEZ there," explained Brighton & Hove Commercial Director Nick Hill. "In many parts of the city there isn't an air quality problem. We would have loved to have fully electric buses, but the biggest single issue is their limited range. Most of our buses are out for the bulk of our commitment to making Brighton and Hove a clean air city with zero emissions by 2030."

(L to R) Brighton & Hove Buses' Neil Miles, Martin Harris and Nick Hill proud of their new acquisitions. **ANDY IZATT**

A new light blue-based livery with Live & Breathe branding has been adopted emphasising the environmental credentials of the vehicles. **ANDY IZATT**

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the day so are covering on average of over 250 miles. There isn't an electric that comes near to being able to do that. What's more, these buses charge themselves as they go along so when they get back to our Conway Street, Hove depot, they're ready to go out again."

"The vehicle knows where it is geographically and understands it needs to generate enough electricity to be able to go through the ULEZ in zero emission mode," said Brighton & Hove Head of Engineering Neil Miles. "Without compromising the overall environmental benefits, it will load the generator a little more so that it increases the charge to the batteries as necessary, but regenerative braking plays a key part as well. More electricity is generated through that than you might realise."

"While the bus is always preparing itself for the ULEZ, it will switch to zero-emission mode opportunistically when the state is right, particularly at bus stops. At the moment we can't guarantee any other targets such as outside a school or hospital, but the data analysis is ongoing that should give us the confidence to go fence other key areas. We have seen enough to suggest we may get even more than what we're getting now. That's the aim."

"This whole concept is a stepping stone towards zero emissions for us. These buses are a bold statement and they're performing better than I could have hoped. When I first started researching what might be possible in 2015, my desire was for a vehicle that would just go through the zone at zero emission. I never dreamt that now it would be possible to operate in electric mode at other times, which further reduces fuel consumption as well as helping the environment. To have the solution we've got is incredible."

"I started working on buses in 1984 when it was all about mechanical engineering. Now we're replacing that knowledge with something new and it's a really good time to be involved in buses. We're passionate about doing the right thing, not just for this business, but for the environment and public health."

Environmental investment

"The scale of the investment at £9.9m is massive," said Martin. "These buses are 50% more expensive than the Euro VI diesel buses we bought last year. It's a big statement about our intent."

"While we're keen to keep them on the 55, Monday to Saturday, we don't need the full allocation on Sundays so we've been using them on other routes as well, mainly the 7 (Brighton Marina to Hove). We would rather have buses out keeping the air clean, but we'll keep them in town where we can maximise the benefit."



Inside the lower deck of one of the new Enviro400ERs. ANDY IZATT



Wheelchair users have now got their own next stop display facing them at eye-level. ANDY IZATT



Live & Breathe branding extends to the staircase. ANDY IZATT

"The ULEZ in Brighton requires Euro VI compliance by 2024. It is buses only so we're clearly hopeful of the same standard being applied to other types of vehicle as well. What we've previously had is a Low Emissions Zone which stipulated Euro V by 2020. We operate around 260 buses that already comply with that and almost all are on routes that go through the zone."

"We have benefited from some government funding to help with retrofits. Previously we've had some help taking Euro III and IV buses up to V and we're applying for more to upgrade Euro V to Euro VI, but the Enviro400ERs are 100% paid for by our customers. That's an important message we're trying to get across to people."

"Each year we make a solid profit. It's the sign of a successful and strong business

and it's what we have to be if we're going to continue to invest in what the city needs. Over time we have probably been one of the biggest investors of any local business."

Said Nick: "One of the issues is it has not been easy persuading people that Euro VI diesels are as good as they are. It's possible to do a lot of marketing around that, but if diesel engines are running all the time in a location like North Street where there are high emission levels, there will always be the perception that it's not enough."

"As you will gather from Neil and Nick, we all share a passion to do the right thing for the city and the environment," said Martin. "There's lots going on behind the scenes in this business on that theme, whether it's trying to cut down on packaging and plastics, the way we look after waste generally, or how we

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manage the use of energy at our premises.

"This whole area is a UNESCO World Biosphere so there's a lot of people engaged in the process of trying to produce a much lower carbon city with better air quality. It's something we've been working hard at for a number of years."

"What is important is to forget the politics and focus on the science. The scientists are telling us we need to get a move on and that's what we're trying to do to the best of our abilities. It's really important we introduce these buses to show we're taking a lead and that's really why we gave them a different look so they're noticed."

"We're involved in a lot of community engagement and that includes reaching out and working with children. For example, it's children's voices that make on-board announcements explaining you're going into or leaving the zone and thanking passengers for choosing to travel sustainably. People like it. It's working."

"We had already been talking to an organisation called Little Green Pig that does a lot of writing work with school children. Our Head of Marketing and Communications, Vicky Doyle, is running a poetry competition on the environment and the plan is to intersperse some of the on-board next stop announcements with snippets they have written. We're also working on the publication of a book where the children talk about the environment issues they're facing, about sustainable travel and making choices. We want to make sure that buses are part of that conversation."

"The Enviro400ERs are about the city and for the city, and the feedback we're getting is everyone loves the whole concept. That's exactly what we set out to achieve."

Live & Breathe

"Our Live & Breathe branding was created for us by a Hove-based agency," Martin continued. "A lot of ideas came from our own team to bring it to life and the agency understood what we were trying to achieve. The choice of colours is trying to mirror the seaside feel of the city and coming up with something that's easier on the eye."

"The branding seems to have got colleagues across the business engaged and there's a lot of pride in it. We do a lot of work on getting our people to realise what a brilliant job they're doing and I think this has helped give a new focus to that. Our kiosk in Churchill Square is going to be rebranded accordingly."

"Through no fault of ours, we sometimes have a wall of red and cream buses on North Street where there are pedestrian areas either side. The main problem is the complex junction at

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If we can be 100% emissions free everywhere, that would be fantastic, but if we can't get there just yet, these electric range hybrid buses are a phenomenal step forward”

the Clock Tower where buses are allowed either to come out or go into Western Road separately. We're saying to the council if there was a better flow of vehicles, there wouldn't be that wall."

"We have shown we can get articles past each other at the junction without a problem and it's still safe for cyclists and pedestrians. We're pushing to have the traffic light sequences changed because it would be a really big gain for everyone, but in the meantime we think the Live & Breathe livery will help make North Street feel less impenetrable."

"As they have no route branding, the new Enviro400ERs have offside destination displays so intending passengers know what route they're operating on."

"Each of the buses also has a different ampersand as part of the Live & Breathe branding on each side," said Nick. "That means there are 60 different ones and it's all local photography featuring interesting local locations. We had great fun looking through all the different options and we've deliberately chosen places that aren't always obvious. People notice them, but we want to inspire and nurture their curiosity. Click on the ampersand of interest on our website and it will tell you where it is and a journey planner will show how to get there by bus."

Said Martin: "We've also brought the livery and messaging inside the bus. All of our Brighton vehicles have someone's name on the front, but what we've done is extend that to telling their story on panels inside, which hasn't really been done before here. All of the names have been suggested by the community to celebrate people who did something great during their lifetimes for Brighton and Hove. Displaying their stories brings them to life."

"Our ambition for the next stop display screens is that they will show additional travel information, but everywhere you look inside the saloon, we're talking about environmental objectives and benefits for the community. Even little things like supporting local initiatives like Table Talk, which encourages people to meet at different cafes, we support, and there's a notice



Social seating has been specified at the rear of the upper deck. ANDY IZATT



The buses have high-definition cameras relaying pictures to monitors inside the driver's cab instead of mirrors. ANDY IZATT



A clear, well laid out dashboard tells the driver all he or she needs to know. ANDY IZATT

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promoting it at our top deck table. It's adding another layer to how buses can help tackle loneliness and social isolation."

Said Nick: "So often on a bus, people don't go upstairs because they're concerned they're not going to be able to sit down. A vehicle's on-board CCTV monitor normally shows images from all round, but on these buses we have the display at the bottom of the staircase where it can let boarding passengers know what seats are available."

"Normally there are 18 cameras on a double-decker, but the Enviro400ERs have additional high-definition cameras at the front, relaying pictures to monitors inside the driver's cab instead of mirrors," said Martin. "Double doors have been our standard for the past couple of years because of our high passenger volumes. When you're trying to fight traffic congestion, saving a few seconds when passengers board and alight really matters."

"All our fleet are talking buses anyway, but from an accessibility point of view, we've used light colours on the floor this time because we know it helps some people with dementia. Wheelchair users have now got their own next stop display facing them at eye-level and there are hearing loops in and around the cab door area and where the priority seating is in the lower saloon. What's more, we've invested a lot of time and effort to make sure they work

correctly for the users.

"Victoria Garcia is our fulltime Accessibility and Communities Manager and she found out from passengers that the hearing loops specified on London's buses don't actually work properly. We spent two years developing ours to get to a point where Action on Hearing Loss, who we demonstrated it to, said we'd cracked it. There's no point specifying something like that if it doesn't work. We're passionate about doing it right."

"The new buses also have on-board recycling bins. We have a contract to carry Metro newspapers, but we don't on these vehicles because we don't think they're a good fit from an environment point of view. They generate waste and make the interiors untidy. It's a useful additional source of revenue, which contributes to keeping fares down, but we want to find out what our customers think about not having them on this service and seeing how effective we can be at recycling."

"Contactless tap on and tap off was introduced a few weeks ago in conjunction with Ticketar just as the first of the new buses was entering service. We've introduced it across all of our operation and on the data we have so far, it saves on average nine seconds compared with a conventional contactless payment where the passenger waits to receive a paper ticket. That's an important time saving,

"if someone forgets to tap off, they will be charged to the end of the journey, but in most cases it will be the same fare. It will only be different if they're on one of our longer distance out of town services which have graduated fares, but all they need to do is get in touch with us and we can put it right straight away."

"We've had less than 0.01% contacting us with any problems with the 100,000 of tap on and tap off journeys that have already been made. There's an advertising campaign across bus shelters and buses at the moment promoting it and there are announcements on the bus reminding people to tap off as well."

"Latest figures show tap on, tap off has taken cash transactions down below 10% from 17% in Brighton and Hove."

The Enviro400ERs seat 64 and there's space for 30 standees. Esteban Civic V3s with USB ports have been specified. "The weight of the batteries has affected the number of seats, but the positive is we've been able to have a table upstairs and there's more legroom," said Nick. "We've also got facing seats at the back upstairs, which we don't normally do, but means people can sit as a group and talk. It's social seating, the idea for which came about as a result of one of our team walkabouts. These buses really are quite spacious and that's helped by the standing space created by having dual doors."

"We've not had any complaints about the slight reduction in passenger capacity," said Martin. "We have a very high frequency service where the three 5 routes combine. There have been a few tweaks to improve reliability, but the frequency hasn't changed."

"Brighton and Hove has one of the highest load factors of any city in the country outside London - the highest bus usage per head of population."

"According to DfT (Department for Transport) statistics it's 177 journeys per person annually," said Nick. "Go to a meeting in Brighton with senior business people and almost everyone will be using your buses. There aren't many places in the country where that happens."

"Councillors and officers also use the buses regularly," said Martin. "When the new ones started to arrive we took them and the local MPs out so they could see what we'd bought. We did the same for the local press and received very good coverage. We knew there was scope for people to ask why were we not going for 100% emissions free right now, but all the feedback we've had has been universally positive."

Colleagues engaged

"Our drivers have each had an hour and a half's training on the Enviro400ERs," said Martin. "That was essential because they needed to be familiar with the vehicle's systems and using those cameras instead of wing mirrors. They're safer because they get a clearer, wider view of the road, with a better depth of field and no blind spots. They come into their own in wet weather or in the dark."

Said Nick: "Initially there were some questions about having cameras instead of mirrors so we gave three driver representatives the opportunity to try a bus with them fitted before we ordered. If they had voiced genuine concerns we would not have gone ahead with specifying them, but after each had tried it, they couldn't have been more positive. It was a real endorsement. The fact is visibility is so much better."

"What is more, one of our accident costs has been as a result of people walking into mirrors and mirror damage. Introducing cameras will go a long way to reducing these costs and buses will spend less time off the road. So far we've not had a single camera failure, but if there is one, conventional mirrors can be easily mounted as a temporary substitute."

"Another important accident reduction benefit is cutting the number of falls inside the bus," added Martin. "Acceleration and deceleration is so much smoother, which is great for drivers and passengers alike. Some of our roads are challenging, but drivers have a more comfortable seat and a well thought out

cab. There's also cab air-conditioning. It's a big step forward."

David, one of Brighton & Hove's drivers, added his thoughts. "I really like the new buses," he said. "For me the biggest change is having cameras instead of mirrors. What you can see is much wider than would be possible with a normal mirror. It's also one less thing to worry about when coming into a bus stop!"

"The internal camera layout is also different. Normally they're centrally mounted so you're looking straight down the middle of the saloon and there are some seats you can't see because the view is partly obstructed. These are better,"

"The rubber fan we've had installed in the cab is what the drivers asked for," said Neil. "It's quieter, more efficient and safer. We ordered them in and had them sent to the factory to be fitted."

"ADL is here on a daily basis. That's not because there have been problems. It's trying to make these buses as perfect as they can be and its aftersales support and that of BAE has been excellent. Their technicians have been passing on their knowledge to my team so we can maintain the buses properly ourselves."

"Most of my people are trained diesel engineers, not hybrid or electric engineers, and I need them to ditch what they used to know and start learning. They're all really keen to understand and ADL has been great in helping with that. There have been some really good in-depth courses arranged which is great. Then we'll look at the training gap and see what needs to be done."

Future direction

Said Martin: "Within Go-Ahead we have to make a business case and get the support of the board for an investment on this scale. We tend to be given a lot of freedom to go and pursue something and we will then all share that learning between the operating subsidiaries,

which means we can move more innovations forward concurrently. Some will fall by the wayside while others will become big news. We think these buses will be big news and hopefully, if more operators around the country buy them, the price becomes more affordable."

"When we ordered the Enviro400ERs, we went into it with our eyes open. They represented such a big change and we knew the next question would be: where do we go next? What do we do long term? That's under review at the moment and the decision to order our next 24 buses will be taken before that process is complete. If we have more of the same, they will represent around a fifth of the fleet."

"We have high passenger loads, hills to contend with, terrible traffic congestion and long hours of operation. As we've said, there just isn't the electric bus out there that can cope with all of that yet. It would also cost £4m in cabling just to get the necessary supply to Conway Street and that's before internal infrastructure costs are considered. Buses on the 5s are out for at least 14 hours a day. We worked out that if we had electric, we would need an extra three buses and six full-time drivers on top of all the other costs."

"Neil is researching gas to see whether we should consider that as an option. We have experience of it within Go-Ahead and we know what works and doesn't work, but the scientists at the council aren't that enthusiastic from a CO₂ reduction perspective, and we must be very mindful of that."

"The other big option is hydrogen and we have funding for a hydrogen project between Crawley, Gatwick and Redhill that will require 20 buses. The money is in place and we're now looking at procurement."

"If we can be 100% emissions free everywhere, that would be fantastic, but if we can't get there just yet, these electric range hybrid buses are a phenomenal step forward." //

