

The future is electric



As operators bid to be ever more sustainable, electric buses are becoming an increasingly important part of the airport mix, reports **Emma Kelly**

Airports across the globe are replacing their diesel buses with the latest electric technology, with even greater improvements in environmentally friendly technology promised by vehicle manufacturers in the future.

While the initial outlay for an electric bus is more than traditional diesel buses, airports are benefiting from reduced fuel and maintenance costs in addition to the environmental benefits, while passengers are welcoming the change.

Electric buses have become a familiar sight at airports throughout the United States as operators initiate wide-ranging sustainability measures, often encouraged to do so by government support such as the US Federal Aviation Administration's Zero Emission Vehicle Funds.

Popular in the US

Electric vehicle manufacturer BYD (Build Your Dreams) has its electric buses operating throughout the country, including Kansas City International Airport, Atlanta's Hartsfield-Jackson International Airport and Los Angeles

World Airports, the latter being the company's biggest airport customer with 20 of its electric buses in operation. Most recently, Tampa International Airport in Florida ordered four BYD K9M electric buses to transport airport employees.

The battery-run, zero-emission K9M has 37 passenger seats, a range of 155 miles and can be rapidly charged in two to three hours, making it ideal for airport operations, according to BYD. The company's transit bus range also includes the smaller K7M and K8M and the larger K9M and K11M. Replacing diesel buses, BYD estimates that each of its zero-emission buses eliminates approximately 1,690 tons of CO₂ over a 12-year lifespan.

US automotive and energy storage company Proterra also has a growing airport business. Its latest electric bus, the ZX5+, features a 450kWh battery that delivers between 154 and 216 miles of service per charge. The bus is charged via a 150kW high-capacity charger that can complete the job in less than four hours.

Predecessor to the ZX5+, the Catalyst E2 electric bus features 27 seats and luggage racks, with a range of 231 miles and a full

charge taking less than 4½ hours. The Catalyst is in service at San Francisco International Airport, for example, where a six-strong fleet was expected to yield \$4.5m in savings during a 12-year lifespan thanks to reduced fuel and maintenance costs as well as the elimination of more than 23.7 million lbs of greenhouse gas emissions over their lifetime compared with the diesel buses they replaced, according to Proterra.

Most recently, Washington Dulles International Airport committed to a transition to all-electric buses with the purchase of five ZX5+ with a 29-seat layout and three Proterra 150kW charging stations, due for delivery in early 2023. The all-electric buses will replace five diesel buses as part of the transition of all airport operational vehicles to electric and hybrid models.

From China to the world

Chinese bus manufacturer Yutong is optimistic of future growth in the aviation sector, with more than 200 of its electric buses already in operation at airports in the United Kingdom, Spain, Morocco and at the



Above: The e.COBUS 2700 features LTO lithium-titanate batteries, making it suitable for temperatures ranging from -30° to 50°C **COBUS**

Below: The first Yutong ABe13 to enter service in the UK is in use at Newcastle International Airport **Yutong**



AIRPORT BUSES



Kansas International Airport's K7M buses were built at BYD's Coach & Bus factory in Lancaster, California **BYD**

majority of airports in China. "The electric bus is the right product they [airports] are looking for," said the manufacturer. "Most European airports are planning to renew at least 50% of their fleets from diesel to electric units." Yutong added that airports in the Middle East and Africa are also looking to renew their fleets with electric versions.

Yutong's single-deck, electric, zero-emission bus developed for airport airside and landside operations is the ABe13. It is designed to carry 110 passengers and has six doors for fast embarking and disembarking. It

features a front-mounted single electric drive motor, with a maximum power of 350kW. The 281kWh lithium iron phosphate battery allows it to operate for up to 14 days without charging, according to the manufacturer, with charging possible in under two hours from a DC charger. The battery management system is unique to Yutong and constantly monitors temperature, voltage, current and capacity, the company says.

While the initial cost for one of its electric buses is more than a diesel equivalent, Yutong says operators can



Every bus can and should be electric by 2030

*Morgan Folger,
EnvironmentAmerica*



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save £15,000 (\$19,600) per annum in fuel savings, as well as paying £1,200 less in maintenance costs. Yutong says it tries to deliver environmental improvements throughout the design, by making its buses as modular as possible in order to reduce the adhesive materials used, for example.

Widespread appeal

European manufacturer COBUS Industries has almost 100 of its electric eCOBUS in operation worldwide, at airports in Canada, the US, Europe and China, said Laila Engler, sales manager and head of marketing. "Compared to diesel buses, electrically driven buses are the step to zero emissions at airports," she explained. Airports aren't just looking at electric buses, however, with hydrogen fuel cell buses and those powered by synthetic fuel also of interest to operators, said Engler.

The eCOBUS is available with different battery specifications, including lithium titanate batteries with 99kWh and 126kWh capacity and fast recharging, as well as lithium iron phosphate batteries with 280kWh and 350kWh capacity for longer operation. Both types of battery have an expected life of 12 years. COBUS will offer a lithium magnesium cobalt battery-powered version in the future. The manufacturer provides a variety of charging solutions, including fast chargers.

While electric technology might have a higher purchase cost, COBUS can supply a total cost of ownership comparable to diesel buses, according to Engler. In addition, the manufacturer offers the e.START scheme whereby it can convert its diesel buses to electric vehicles to extend the life of the bus. "Any COBUS can be recycled 100%," added Engler.



Above: The body of the Dancer prototype is made of composite material containing recycled PET plastic and is extremely light in weight *Lithuanian Airports*

Testing times

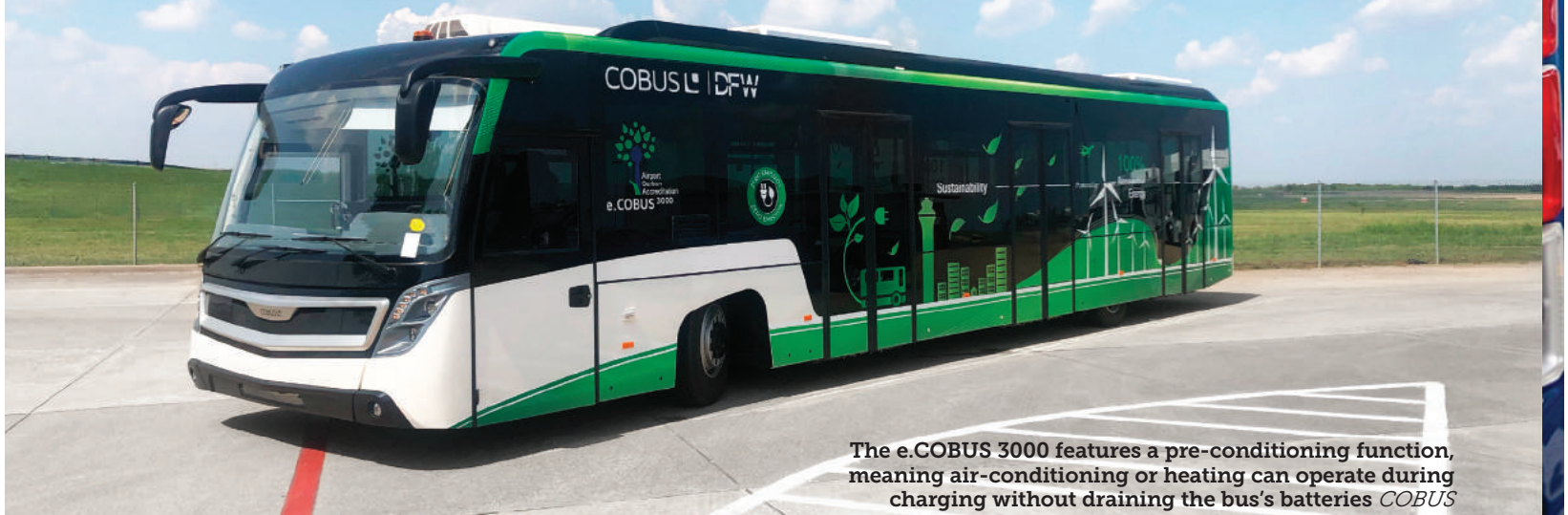
Airports have become willing partners in testing electric vehicle prototypes. Lithuanian Airports, for example, recently tested several different electric buses with a view to operating an all-electric fleet in the future. Its ground handling companies, Litcargus and Baltic Ground Services, currently have eight buses operating at its airports, only one of which is an electric vehicle, manufactured by Yutong and in service since 2020.

In early 2022, the Lithuanian business, which owns and operates airports at Kaunas, Palanga, and the capital, Vilnius, tested a prototype electric bus, the Dancer, developed by local company Vejo Projektai Group as part of a project funded by the European Union Regional Development Fund, as well as a Scania Citywide electric bus.

The 12m prototype Dancer can carry 88 passengers of which 32 are seated and 56 standing. The bus body is made from composite material containing recycled PET plastic and, as a result, is lightweight and needs less power to drive, with an energy consumption of 0.72kWh per km travelled.

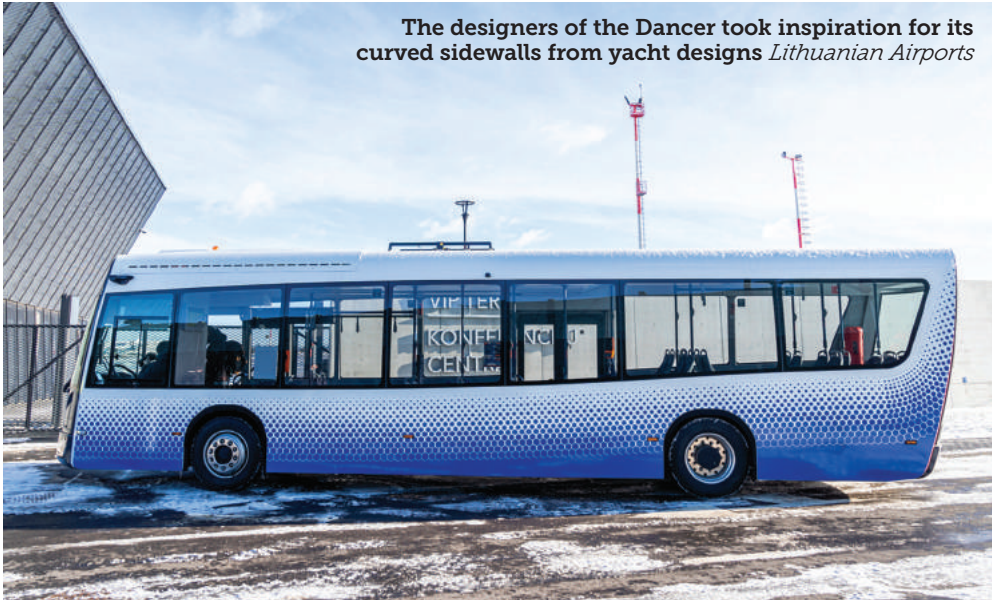
The Lithuanian trial was the first time the Scania Citywide LF 12m low-floor all-electric bus had been tested at an airport in Europe. It can carry up to 105 passengers – 35 seated and 70 standing – and features advanced safety systems, including a blind spot system and an advanced adaptive cruise control that helps keep it at a constant speed and a safe distance from other road users.

Both buses transported passengers between the aircraft and the terminal and passengers responded well, according



The eCOBUS 3000 features a pre-conditioning function, meaning air-conditioning or heating can operate during charging without draining the bus's batteries *COBUS*

The designers of the Dancer took inspiration for its curved sidewalls from yacht designs *Lithuanian Airports*



The new chargers featured on Proterra's electric buses use interoperable, universal charging technology *Proterra*



The environmentalist's viewpoint

Every bus can and should be electric by 2030, according to Morgan Folger, clean cars director at Environment America, a federation of state-based environmental advocacy organisations in the US.

"Shuttle buses with a fixed route and schedule are the perfect application for electric buses," Folger told *Airports International*. Environment America believes that every airport can make the switch to electric shuttle buses. "Electric buses are ready to roll and have seen success at airports across the US," said Folger, pointing, for example, to the Port Authority of New York and New Jersey, which has 36 electric buses and 19 chargers to shuttle passengers to and from LaGuardia, Newark and JFK airports.

US government financial incentives should be used to encourage the transition to electric, with the upfront cost of electric buses being a barrier to adoption, stressed Folger. The Federal Aviation Administration's Airport Zero Emissions Vehicle (ZEV) and Infrastructure Pilot Program and Voluntary Airport Low Emissions Program (VALE) have helped accelerate the move to electric buses and vehicles at airports across the country. ZEV supports the use of Airport Improvement Program (AIP) funds to purchase ZEVs and the required infrastructure at any public-use airport, while VALE allows commercial service airports to apply for AIP funds for air quality improvement initiatives, including low emission vehicles. In financial year 2021 alone, eight US airports received ZEV funding, while up to September 2021, VALE grants had funded 133 projects at 59 airports.

Electric buses have no tailpipe pollution, eliminating exhaust that is linked to asthma attacks, respiratory illness and cancer, said Folger. "Electric buses can immediately improve local air quality. They can also get cleaner over time as the grid they are charged on switches to solar, wind and other renewable energy," she added.

Environment America recommends electric technology over hydrogen fuel cells for buses as the former is readily available and more environmentally friendly. "Hydrogen fuel cell vehicles remain significantly more expensive and not all types of hydrogen are created equal," explained Folger, with the creation of hydrogen fuel being energy intensive and often reliant on fossil fuel or carbon capture.

Electric vehicles themselves have some downsides, she admitted, pointing to mining for the rare earth minerals that are needed for their batteries. "Those impacts must be weighed against those of mining, drilling and extracting fossil fuels to power traditional combustion engine vehicles. More research should be done to optimise battery recycling and reduce the need for minerals in batteries," Folger concluded.

AIRPORT BUSES

Proterra batteries are made with second-life applications and recycling in mind, with pack architecture that allows for a stackable design *Proterra*



Proterra's new charging systems can be configured with up to 1.5mW to power up to 20 vehicles simultaneously *Proterra*



to Lithuanian Airports. "Passengers are saying the main difference they feel is related to noise. There is almost none. There have also been lots of comments that those buses are much more convenient and [environmentally] friendly, with the USB charging ports," it added.

Charging changes

As bus operations are changing, so too are charging solutions. Kansas City International Airport last year committed to a wireless charging system for its BYD electric buses, becoming the first airport to do so. The charging system is part of the airport's \$1.5bn New Terminal project and will be operational when the new terminal opens next year.

The wireless, inductive charging system will be supplied by specialists in the field, Momentum Dynamics, and replaces the need for an above-ground charging station or taking the buses out of service in order to charge them. It will provide incremental charging to the airport's electric shuttle bus fleet, which operates a seven-mile loop to and from airport parking.

The system will consist of two 300kW wireless chargers located at shuttle bus stops, and charging will take place as passengers are loading and unloading, with the bus parked over a charging pad. The two chargers will support the entire parking fleet of approximately 28 vehicles. Initially, four existing BYD electric buses will be retrofitted with the wireless system.

Each Citea SLFA-181 electric articulated bus has a battery capacity of 216 kWh *VDL*



Further efficiencies

Bus manufacturers are focused on further development of their products to continue to drive efficiencies, with the aviation sector an important and growing business sector. COBUS Industries, for example, is developing a full hydrogen fuel cell-powered bus which will be available to the airport market from 2023, said Engler.

“We are always looking at ways to make our vehicles more environmentally friendly,” said Yutong. “We have developed hydrogen, hybrid and compressed natural gas vehicles and delivered them to clients worldwide.” Yutong’s sales to date of more than 160,000 new-energy buses, not just in the airport sector, have reduced fuel consumption by 2.13 billion litres each year, delivering a cumulative reduction of carbon emissions of about 23.25 million tons, it says.

European bus manufacturer VDL has developed a new generation of Citea buses to deliver further environmental improvements. The new all-electric Citea features an all-electric drive train, improved energy management and a single-piece composite sidewall that results in reduced weight, less vibration, reduced noise pollution and improved insulation for better passenger comfort. The battery packs are integrated into the floor, creating more passenger space and lowering the centre of gravity to provide more stable road handling.

VDL’s earlier generation electric Citea, launched in 2013, are in operation at European airports including Oslo, Schiphol and Milan Malpensa. Oslo



From left: Solihull Councillor Ian Courts, Nick Barton of Birmingham Airport, and Henriette Breukelaar of Greater Birmingham and Solihull Local Enterprise Partnership with the Aurrigo driverless auto-shuttle Aurrigo

Airport’s electric bus programme, comprising eight vehicles, aims to halve the number of greenhouse gas emissions this year compared with 2012. The buses feature a 216kWh battery system, with charging conducted overnight in the depot at the gate via a Heliox rapid charger. At Milan Malpensa Airport, Citea buses operate between the car parks, terminals and cargo centre.

Meanwhile, next year Proterra will increase the amount of energy on board its ZX5 electric transit bus. The 40ft Proterra ZX5 Max electric transit bus will be offered with an enhanced 738kWh of onboard energy, delivering more than 300 miles of drive range on a single charge, while the 35ft and 40ft ZX5+ electric bus models can be equipped with up to 492kWh of onboard energy. Proterra is also refining its composite bus body design.

Autonomous options

The next development is set to involve autonomous vehicles, with some airports already in the process of trialling connected autonomous vehicles.

In early April, Birmingham Airport completed a six-week trial of Aurrigo’s ten-seater driverless, Auto-Shuttle. During the test period, the vehicle transported airport staff and later passengers. A safety operator travelled on board at all times, with the vehicle able to be manually driven using conventional controls when needed. “The trial at Birmingham went well,” said Ricky Raines, autonomous operations manager at Aurrigo. “The route itself was complex and presented many challenges that we are now building into the way the shuttle operates.”

The zero-emissions autonomous shuttle used a suite of sensors, including LiDAR, to safely move around. It was powered by a 43kW battery pack, delivering 50-80km depending on the gradient, load and speed. The vehicle can charge via different connections – either a type two charger or two 16amp CCS commando sockets – which are already widely used for various applications, including caravans, outdoor events and in commercial businesses, according to Raines. He added: “Autonomous technology is set to revolutionise the aviation industry, which has experienced little change over the past few decades. With many airports wanting to add additional runways, they must first prove they can lessen their environmental impact.”

The Coventry, UK-based manufacturer has worked with Singapore Changi Airport since 2019, exploring new solutions that improve the passenger journey, the efficiency of the airport and reduce the environmental impact of everyday operations. Changi used Aurrigo’s Auto-Sim software to simulate how autonomous vehicles could operate around its new terminal, T5.

Aurrigo is not the only manufacturer to go down this route. Yutong has also developed autonomous buses, with tests currently taking place at airports in China, where it says the product is to launch soon.

The company is also focusing on developments in intelligent connectivity, fuel cell technology and new material applications with a view to delivering further environmental benefits. **AI**