

## HOW TO | KEEP PACE WITH EVOLVING

**B**AE Systems (BAE) is a world-leading developer of electric propulsion systems for buses. Extending on its range of powertrain products that cover a variety of use cases from hybrid to full-electric, it has now added the capability of plug-in charging and options for higher power-density batteries launching in the next few years, further extending bus zero emission travelling range. Together with bus maker Alexander Dennis Ltd (ADL), BAE is now delivering these technologies to bus operators in the UK and Ireland.

Series-ER (Electric Range) is the latest development of BAE's proven hybrid electric propulsion system, over 13,000 of which are in operation worldwide. Comprising a highly efficient electric motor and generator, an enhanced battery, and smart electronic controls, Series-ER enables buses to run for as much as three miles (approx. five kilometres) at a time with the engine turned off. For towns and cities this provides a significant tool in the fight to improve local air quality, as well as reducing carbon emissions by more than 30% when compared to a diesel-only vehicle.

Another key feature of the Series-ER propulsion system is its new plug-in capability. Where electric charging infrastructure is available, these vehicles will immediately be able to benefit from external power



sources such as the grid to replenish their batteries. This further increases the air quality improvement and carbon emissions reduction potential of what are already ultra-low emission vehicles.

These vehicles are also capable of supporting the ever-increasing demands for zero-emission driving. BAE plans further growth in battery capacity, meaning that in the future, Series-ER enabled vehicles will be

capable of driving significantly greater distances with the engine turned off. In some instances, this could mean an entire route can be operated on grid power, just as soon as the challenge of installing the necessary charging infrastructure has been met.

This zero-emission capability is already being used by Go-Ahead Group in Brighton & Hove, which ordered 30 Enviro400ER buses from ADL featuring the Series-ER powertrain (see also [www.is.gd/umatab](http://www.is.gd/umatab)). Through the centre of the city, for about one and a half miles, the buses travel on only battery power. The transitions between engine-off and engine-on modes occur automatically and without driver intervention, thanks to newly integrated geo-fencing capability. Operations have

# EMISSIONS REQUIREMENTS IN PUBLIC TRANSPORT



reinforced in September when ADL received certification for the Enviro400ER as an 'Ultra Low Emission Bus' from the UK Low Carbon Vehicle Partnership. The accreditation is awarded to vehicles that achieve greater than 30% well-to-wheel greenhouse gas saving compared to a conventional Euro VI diesel over the UK bus cycle.

### PLUG-IN

The next step in the world's hybrid bus journey is being taken in Ireland. In January 2020, ADL signed a framework agreement with Ireland's National Transport Authority (NTA) for the delivery of up to 600 Enviro400ER double deck hybrid buses. The agreement included an initial order for one hundred 11 metre-long, 66-seat buses, which are now being delivered.

These models include the company's first ever plug-in feature for a hybrid bus, applying the 'Combo2' combined charging system (CCS type 2) plug, according to IEC 62196. Being able to charge the vehicles externally

supports operators in a number of ways.

First, the vehicle can be conditioned ready for immediate zero-emission operation, supporting green zones and air quality initiatives located in the vicinity of the depot. Second, it supports an incremental approach to a zero emission fleet, giving transport agencies and operators time to gradually update infrastructure and familiarise themselves with the operational challenges of a full electric fleet.

Adding the option of a plug-in connection moves the bus architecture one step closer to full-electric. In doing so, the hybrid bus is considered a clean vehicle under the EU's clean vehicles directive that comes into effect across the EU next year. The directive legislates that a certain proportion of public buses purchased must be either clean vehicles or zero-emission vehicles. The target proportion is 45% in the UK and Ireland between mid-2021 and the end of 2025, rising to 65% afterwards.

Series-ER is one of two hybrid driveline solutions from BAE. Series-E and Series-ER systems are both Euro VI-compliant and incorporate on-board energy storage to provide reduced emissions transport (and, in the case of the Series-ER, to support zero-emissions travel within geofenced urban zones). While the Series-ER draws power from rechargeable lithium batteries, the Series-E uses, in relative terms, quick-charge, quick-drain ultracapacitors.


In addition, Series-H and

Series-EV powertrains provide continuous zero-emissions travel. In the first case, the H stands for hydrogen fuel cell. In the second case, the Series-EV's on-board batteries provide all of the bus's power.

All four models share a similar architecture and components, including traction motors, power control systems and auxiliary power systems supplying hotel loads.

### IN CONCLUSION

BAE Systems, together with ADL, provides a variety of solutions to help local authorities and operators overcome the difficulties involved with transitioning away from fossil fuels for passenger service vehicles. While authorities want no-pollution options for buses providing accessible public transport, they cannot necessarily afford the investment required to introduce a full-electric fleet, either in terms of the rolling stock or the upgrades in the station infrastructure required to power the fleet.

From a single technology platform, BAE Systems and ADL can offer zero-emission transport within a geofenced urban zones, hybrid operations in between the zones and range sufficient to cover longer inter-urban routes. (For more information, download the new brochure, pictured at left, via [www.is.gd/ayekas](http://www.is.gd/ayekas)). As operators' requirements and infrastructure capacities evolve, ADL and BAE Systems can provide the optimum mix of technology to meet their needs. 

also been proven in Boston, Massachusetts, USA, where MBTA's fleet turns off the engine at stops and also at low speeds, and in San Francisco, California where engine-off running improves emissions in nine low-income neighbourhoods.

The zero-emission capabilities of the Series-ER system were further



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