

Induction charging diesel-electric hybrid buses for London

Clean Fleets case study

- World's first diesel-electric hybrid double deck buses with induction charging infrastructure
- Aims to operate in zero emission electric mode for 80% of its operation
- Annual savings of 580kg NO_x and 33 tonnes CO₂ for each bus compared to a standard Euro V model.



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Contract tendered

- Design, manufacture, supply and maintain three induction charged double deck buses
- Single supplier to deliver the entire requirement including all associated third party requirements

Targets and planning considerations

TfL is responsible for running the buses in London and has made it a policy to introduce and operate green buses throughout its vast bus network. Overall, London has Europe's largest fleet of green buses and is looking to increase its green fleet. As of 2012 all new buses entering the fleet are expected to be hybrid. A number of hydrogen buses are currently in the fleet, with electric buses also being purchased and trialled. By 2016 there will be more than 1,900 hybrid buses in service in London, of which 3 will be the new ZeEUS buses. Overall, hybrid buses will represent 22 per cent of the total London bus fleet (8,500 buses). The Zero Emission Bus Systems Project (ZeEUS) aims to demonstrate the potential for electric buses as urban public transport in eight cities across Europe. The project includes a large consortium of partners, co-ordinated by the International Association of Public Transport (UITP) and part funded by the European Union FP7 grant programme. A range of pure electric and hybrid vehicle technologies are proposed across the consortium, including different charging technologies and techniques.

Transport for London (TfL) is one partner in the consortium representing the city of London in delivering up to 3 range-extended diesel-electric hybrid double deck buses and associated wireless (induction) charging infrastructure. The buses will be operated for a period of at least 12 months on the London bus route 69 between Canning Town and Walthamstow operated by Stagecoach.

The demonstration of the buses will enable detailed evaluation of their performance with the ultimate aim of enabling TfL to make an informed decision regarding the wider rollout of electric buses on a significant scale across the bus fleet.



Procurement approach

TfL set up a cross functional project team consisting of subject matter experts from Commercial, Engineering, Operations, Project and Programmes, Legal, Finance, Strategy and Planning. The project team would collectively manage the commissioning of the contract, the build, delivery and operation of the buses throughout the trial period.

As TfL had limited knowledge and experience of both the technology available and any capable suppliers, a prior information notice (PIN) was issued in September 2013. The PIN asked for any interested supplier to declare their interest in the project and provide a high level overview of the technology which they propose would be suitable and/or /capable of delivery TfL's requirement. Seven expressions of interest were submitted from bus manufactures to management consultancy companies.

TfL wished to award a single contract to a bidder who was able to manage the entire design, manufacture, supply and maintenance including the management of any third parties necessary to deliver the requirements.

As the buses being procured were not available on the market, TfL was able to exercise an exclusion from the Utilities Procurement Directives – 6N Research and Development. TfL conducted a competitive tender in March 2014. The exclusion enabled TfL to conduct a one cycle competitive tender where we asked for interested suppliers to submit their proposal on how they would be able to provide TfL with a complete service.

TfL issued an invitation to tender (ITT), which included a performance specification to which bidders were required to submit their proposal against the top level outputs TfL required. Three suppliers who declared their interest in the PIN confirmed to TfL that they wished to submit a proposal. ADL, Optare and Wrightbus were all invited to attend a supplier briefing with TfL prior to submitting their proposal. After the supplier briefing, Optare decided to withdraw from the tender.

As part of the competitive tender, bidders were asked to submit a written proposal of their overall solution and then invited to present to TfL on how they would deliver the entire requirement including how they proposed to manage all third party suppliers necessary to deliver the requirement. The presentations formed part of the scoring criteria of the final technical tender submissions.

Bidders were also required to provide a comprehensive pricing matrix which was specifically designed to provide TfL with a Whole Life Cost (WLC) of the buses and associated charging infrastructure. The contract was to be awarded to the bidder who provided TfL with the most economically advantageous tender (MEAT) submission.

After extensive evaluation and negotiation, ADL was awarded the contract in September 2014.



Results

- Two submissions were received, both providing TfL with a solution to deliver the complete requirement. This was deemed a successful tender due to the maturity of the requirement.
- The costs of the entire project will be delivered within the approved budget. However, as already stated, the cost of the bus and all charging infrastructure is higher than a convention hybrid bus, but this was expected due to design and development costs.
- A public launch event of the buses and charging infrastructure will be held in London in November 2015.
- TfL are looking forward to demonstrating this technology and letting the results of the trial inform TfL wider dissemination plans for alternative fuel buses.

Costs

TfL does not normally purchase buses, as this is the responsibility of the bus operators contracted to operate the routes. However, as this requirement is demonstrating the potential for induction charged electric buses in an urban public transport network, TfL decided to purchase the buses and lease them to Stagecoach for operation on route 69.

TfL Surface Transport board approved a budget of £3.1m for the entire delivery and operation of the requirement, of which £650k was funded by the European Union FP7 ZeEUS programme. TfL Commercial was able to deliver the entire requirement with making a saving in the region of 25% against the approved budget. Although TfL Commercial was able to negotiate a significant saving against the projects budget, the acquisition cost for the buses was considerably higher than a standard hybrid double decker bus.

As the buses were not available as an 'off the shelf' purchase, TfL expected and budgeted for significant development costs. This was in part shared between TfL and ADL as they were fully appreciative that both ADL and TfL were investing in each other to be able to demonstrate this technology.

Environmental impacts

The environmental potential of plug-in (externally-rechargeable) electric buses – those utilising grid electricity, whether pure electric or range-extended / plug-in hybrid as the ZeEUS configuration have the potential currently to yield around 50% CO₂ savings – and even more as the energy grid is further decarbonised.

A relatively small environmental benefit will be seen during the demonstration period due to a reduction of CO₂ and NO_x associated with operating the three ZeEUS buses. Compared with a Euro V diesel bus (the baseline), the ZeEUS buses should each save 580kg NO_x and around 33 tonnes of CO₂ per annum. However the project will also assess the suitability of wider environmental benefits across the entire bus fleet if the technology is rolled out in the future.

The vehicles should have the capability of achieving an accumulative 80% EV mode (traction energy) over a consecutive 7 day operating period. The vehicle operational performance and testing model will provide a range of parameters and technical specification data to enable TfL to validate the vehicle performance results.

Real time operational acceptance testing will also include the following:

Operating one compliant vehicle for 20 hours in any 24-hour period for a consecutive 7-day



timetabled period, meeting the published schedule. Additional testing undertaken by TfL will include:

- Laboratory whole-vehicle dynamometer testing to real world bus cycles, to derive realistic in-service energy & emission factors. This will include maximum and minimum energy storage conditions and EV range testing;
- Worst-case operational conditions, such as maximum passenger capacity, reduced (or zero) layover periods, recharging (ground stations) unavailable (either or both ends of route).

Lessons learned

- It is important to engage in vigorous soft market testing in order to get a better understanding of development costs and realistic programme timings.
- Further due diligence on supplier's ability to accept standard TfL contract terms prior to actual contract award would help reduce the time it takes to sign the contract after the preferred bidder has been notified.

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