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Advisory | Transportation

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Procurement of Zero-Emission Buses in the UK and Associated Infrastructure

Procuring zero-emission buses (ZEBs) involves complete system procurement and requires a fundamentally different approach to that taken in respect of new diesel or petrol buses. In this first of two GT Advisories, Richard Hughes of Greenberg Traurig LLP looks at the key considerations for the procurement of ZEBs and associated infrastructure, including some of the challenges and opportunities resulting from the significant contribution ZEBs are expected to make to decarbonisation.

Procuring ZEB Fleets

Replacing internal combustion engine (**ICE**) buses is a key plank of the UK government's strategy to decarbonise transport. Each fully loaded double-deck bus can remove up to 75 cars from the road,[1] although buses and coaches are still responsible for approximately 2.5% of transport greenhouse gases in the UK.[2] Through a combination of encouraging increased use of public transport and decarbonising the buses themselves, there is a significant opportunity to reduce emissions from the transport sector.

The UK government has launched consultations on ending the sale of new ICE buses in England and will set a legal end date (along with an expectation for when the entire bus fleet should be zero-emission). Subject to consultations, 2040 is currently expected to be the backstop by when every new vehicle on the

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[1] Department for Transport, Bus Back Better, National Bus Strategy for England, March 2021, p. 72.
[2] Department for Transport, Decarbonising Transport: Setting the Challenge, March 2020.

roads will be zero-emission. Given that the assumed useful economic life of an ICE bus is approximately 15-17 years, some bus operators have already announced targets which align with the 2040 backstop date. For example, FirstGroup has announced a commitment to operating a ZEB fleet by 2035 as well as pledged not to purchase any new diesel buses after December 2022. There are 40,000 buses in the UK (and almost 900,000 buses in Europe), so there is much work to do. With the majority of buses in the UK operating in England, the amount of work to do is emphasised by the fact that only around 2% of England's bus fleet is fully zero-emission as of 2021.

Procurement Strategy

Bus industry procurement teams will need to further develop their skillset, as procuring ZEBs is a move away from pure vehicle and fuel procurement towards complete system procurement. The traditional ICE bus systems will need to be replaced with either new hydrogen fuelling systems and modified maintenance regimes, or new battery charging infrastructure with enhanced grid connections, battery management systems and altered maintenance regimes.

The "*Known Knowns*"

When considering the procurement options available, a significant portion of the process will be familiar to bus industry teams experienced in ICE bus procurement. As with ICE buses, there will be a requirement to perform a whole-life cost analysis in respect of the vehicles. Determining the whole-life costs of running any type of bus includes analysis of both the required capital investment (capex) and operating costs (opex). Some ZEB capex and opex costs will be relatively straightforward to determine (the "***Known Knowns***"), for example:

(a) in respect of the initial capex costs:

   i. bus body and chassis (the "**husk**");

   ii. first set of batteries;

   iii. power and charging equipment (for electric vehicle buses, or "**EV Buses**") and/or refuelling equipment (for hydrogen fuel-cell buses, or "**HFC Buses**"); and

   iv. other costs of redeveloping depots for ZEBs (including the costs of enabling any other revenue-generating activities as described below); and

(b) in respect of opex costs (and in each case, based on current amounts and projected increases):

   i. driver wages and other operating employment costs;

   ii. vehicle maintenance and cleaning costs;

   iii. depot rental and depot maintenance costs;

   iv. costs of electric power (for EV Buses) and/or hydrogen fuel (for HFC Buses); and

   v. taxes on electric power and/or hydrogen fuel.

The "*Known Unknowns*"

There are, however, a number of items that cannot be accurately determined at the point of procurement (the "**Known Unknowns**"), for example:

(a) in respect of capex costs:

i. **Useful Economic Life of a Husk**. The actual useful economic life of a husk is important, as this is the time period on which the whole-life costs are based. From a practical perspective, the current assumption is that the useful economic life of a ZEB will be longer than the approximately 15-17 years for an ICE bus. Current thinking is that the useful economic life of a ZEB could be in excess of 20 years if properly maintained, with mid-life refreshes performed at appropriate times.[3] However, other factors may also determine the time period used by procurement teams in considering the useful economic life (e.g. accountancy rules, tax considerations, duration of any leases or loans and/or any passenger service concession requirements (i.e. a concession agreement may stipulate that a new ZEB fleet is to be procured that will replace a current ZEB fleet));

ii. **Battery Life (Initial and Replacements) and Replacement Cost**. Current battery warranties are typically for periods ranging between five and seven years, and it is therefore known that at least one battery replacement will be required during the operational life of an EV Bus. However, it is not known (i) how long each replacement battery will last (which depends in part on how battery technology develops, increasing battery life and vehicle range), (ii) accordingly, how many battery replacements will be required during the operational life of a husk, (iii) the cost of each battery replacement, and (iv) whether the cost of each replacement battery can be offset in part by any potential revenue from a secondary battery market. Equivalent considerations may also apply to HFC Buses;

iii. **Pools of Spares**. ZEB technology is in its relative infancy compared to the mature technology of ICE buses. Determining the extent of the spares pool required for a ZEB fleet will therefore be difficult until ZEB fleets have accumulated sufficient mileage to provide accurate maintenance data. Procurement teams will need to assess the extent to which stores of replacement parts should be purchased as part of the initial investment (or at least to have price certainty in respect of key parts), perhaps also considering the risks of future supply chain delays and costs; and

iv. **Disposal Costs**. While disposal will be required at some point, accurate costs for disposal costs will not be available for some time, especially where it is not known what secondary markets will be available in relation to ZEBs, batteries and other major component parts. As things currently stand, absent a buoyant secondary market the responsibility for appropriate disposal will attract a cost that needs to be included in the financial model.

(b) in respect of opex costs:

i. **Maintenance Costs**. It is assumed that a ZEB will require less maintenance over its operational life, as there are fewer moving parts and less vibration. However, the labour

[3] European Bank for Reconstruction and Development, Going Electric: A pathway to zero-emission buses, June 2021, p. 41.

costs for specialised engineers may be higher. Transport operators will need to assess the proportion of maintenance being performed in-house (if any) and the extent of additional training required (the Institute of the Motor Industry has assessed that there will be a shortage of 37,500 technicians by 2030 in respect of electric vehicles, and such shortage may also impact ZEB maintainers); and

ii. **Cost of Electricity (EV Buses) and Hydrogen (HFC Buses)**. While the likely consumption and costs at the point of procurement can be calculated, the future cost of electricity and hydrogen (including the associated taxes) is less predictable. The current availability of hydrogen is also very limited which has a significant impact on the price. Bus operators are familiar with forward purchasing hydrocarbon fuel, and a similar strategy may be implemented in relation to ZEBs; and

(c) in respect of opportunities for additional revenue streams:

i. **Secondary Market for Batteries**. While it is not currently possible to determine with accuracy the value of batteries on the secondary market, batteries deemed no longer suitable for ZEBs could be utilised for other purposes (e.g. static battery arrays which are charged at times of low demand/pricing and then used to either charge EV Buses or return electricity to the grid at times of peak demand/pricing (battery-to-grid, or B2G));

ii. **Sharing Charging Infrastructure with Other Zero-Emission Vehicle Users**. In addition to the practical issues relating to sharing of infrastructure (priority of use, certainty of availability, risks of equipment damage, invoicing, etc.), the procurement team will need to factor in the investment required to develop any desired shared infrastructure; and

iii. **Selling Electricity Back to the Grid**. In addition to possible B2G solutions used in respect of the charging infrastructure installed at an operator's sites, the vehicles themselves could be used to sell electricity to the grid at times of peak demand/pricing (vehicle-to-grid, or V2G). EV Buses may not be as well-suited to V2G as other EV fleets, as times of peak grid demand (and accordingly the times when V2G would yield the greatest revenues) tend to coincide with (or follow too soon after) peak rush-hour bus demand.

In relation to both B2G and V2G, these may be better suited to procurement models where a specialist third party is managing the batteries and taking the risks in relation to their performance, sharing with the operator the additional revenues generated. Operators can then take a degree of comfort that a specialist battery operator is managing these assets in an appropriate way – and should also be responsible for replacing any batteries which suffer performance degradation as a result of such additional activities.

For the purposes of developing whole-life cost models, transport operators need to determine appropriate assumptions for those "known unknowns". While acknowledging that the initial investment in respect of a ZEB fleet is significantly higher than an equivalent ICE bus fleet, applying even conservative cost assumptions shows that the current whole-life costs of a ZEB fleet are not significantly greater than the equivalent for an ICE bus fleet. Further, the whole-life costs of a ZEB fleet will likely reduce, as it is generally accepted that (i) a ZEB husk will prove to have a longer useful economic life than their ICE equivalents; (ii) the cost of batteries and hydrogen will decrease over time along with an increase in battery life and range; and (iii) as highlighted above, less maintenance may be required compared to ICE equivalents.

Sources of Funds

Public transport operators will be accustomed to the traditional sources of funds available to them for the financing of ICE buses including (i) passenger fares; (ii) bank loans; (iii) UK government and local government grants or subsidies. When considering a ZEB procurement, it is important to consider whether there are any additional revenue streams or other financial incentives available. For example:

(a) specific ZEB grants or subsidies. Capital grants have been made available to some transport operators to cover the difference in cost between a ZEB and the equivalent ICE bus. This type of grant has the advantage of bringing down the initial capex required to be funded by the transport operator (reducing the loan-to-value ratio which in turn reduces the financing costs), but the grant is unlikely to include any funds which should be reserved for significant future opex (e.g. replacement batteries or mid-life refreshes);

(b) any tax incentives available in respect of purchasing and operating ZEBs;

(c) potential additional revenue streams (as described above, including B2G, V2G and making the charging and hydrogen filling infrastructure available to others); and

(d) whether there is any commercial appetite for risk-sharing in relation to the future costs of batteries, the secondary market for ZEBs (in particular, the batteries) or the disposal costs in respect of ZEBs.

Contract Structures

The most common contractual structures for the procurement and operation of ZEBs will have some form of service delivery agreement between the transport operator and the relevant transport authority. In addition to the service delivery agreement, the following contractual structures have been deployed in respect of ZEBs (and are reflected in the below structure diagram):

(a) **Separate Contracts** – the transport operator enters into separate contracts for the key elements of the system (e.g. (i) a "**Bus Supply Contract**" for the supply of the husk; (ii) a "**Battery Supply Contract**" for the supply of the batteries (this could take the form of a battery-as-a-service, or "BaaS" contract, where the battery is leased from a specialist battery financier and is provided as an ongoing service); (iii) an "**Energy Contract**" for the supply of power (in respect of EV Buses) and a fuel contract (in respect of HFC Buses); and (iv) an "**Infrastructure Contract**" for the supply of the charging infrastructure (in respect of EV Buses) and fuelling infrastructure (in respect of HFC Buses);

(b) **Partially Integrated Contracts** – the transport operator enters into a Bus Supply Contract, an Energy Contract and an Infrastructure Contract, but not a separate Battery Supply Contract, which is dealt with under a separate sub-contract between the husk supplier and the battery supplier. This reduces the number of interfaces that need to be managed by the transport operator and should transfer some risk in relation to the batteries over to the supplier of the ZEBs under the Bus Supply Contract;

(c) **Integrated Turnkey Contract -** the transport operator enters into a master agreement with a supplier in respect of the Bus Supply Contract, the Battery Supply Contract and the Infrastructure Contract (a "**Turnkey Contract**"). The Energy Supply Contract is likely to remain directly between the transport operator and the energy provider. The Turnkey Contract further reduces the number of interfaces to be managed by the transport operator and should transfer an increased portion of risk to the supplier of the Turnkey Contract. As the Turnkey Contract supplier manages the entire ZEB system, it is in the best position to leverage and manage the additional revenue opportunities available in respect of the ZEBs and the infrastructure. This in turn may reduce overall costs to the transport operator and the transport authority (which could potentially bring down passenger fares); and

(d) **Transport Authority Turnkey Contract** – the transport authority enters into the Turnkey Contract and also separately contracts with the transport operator for the provision of the passenger services (the agreement between the transport authority and the transport operator is likely to be some form of concession agreement). This gives the transport authority a higher degree of control over the assets while transferring a large degree of the risk to the supplier of the Turnkey Contract. The transport operator has no responsibility in respect of the Turnkey Contract and would therefore be receiving less by way of revenue from the transport operator. As above, the leveraging of the additional revenue opportunities could reduce overall costs to the transport operator and the transport authority.

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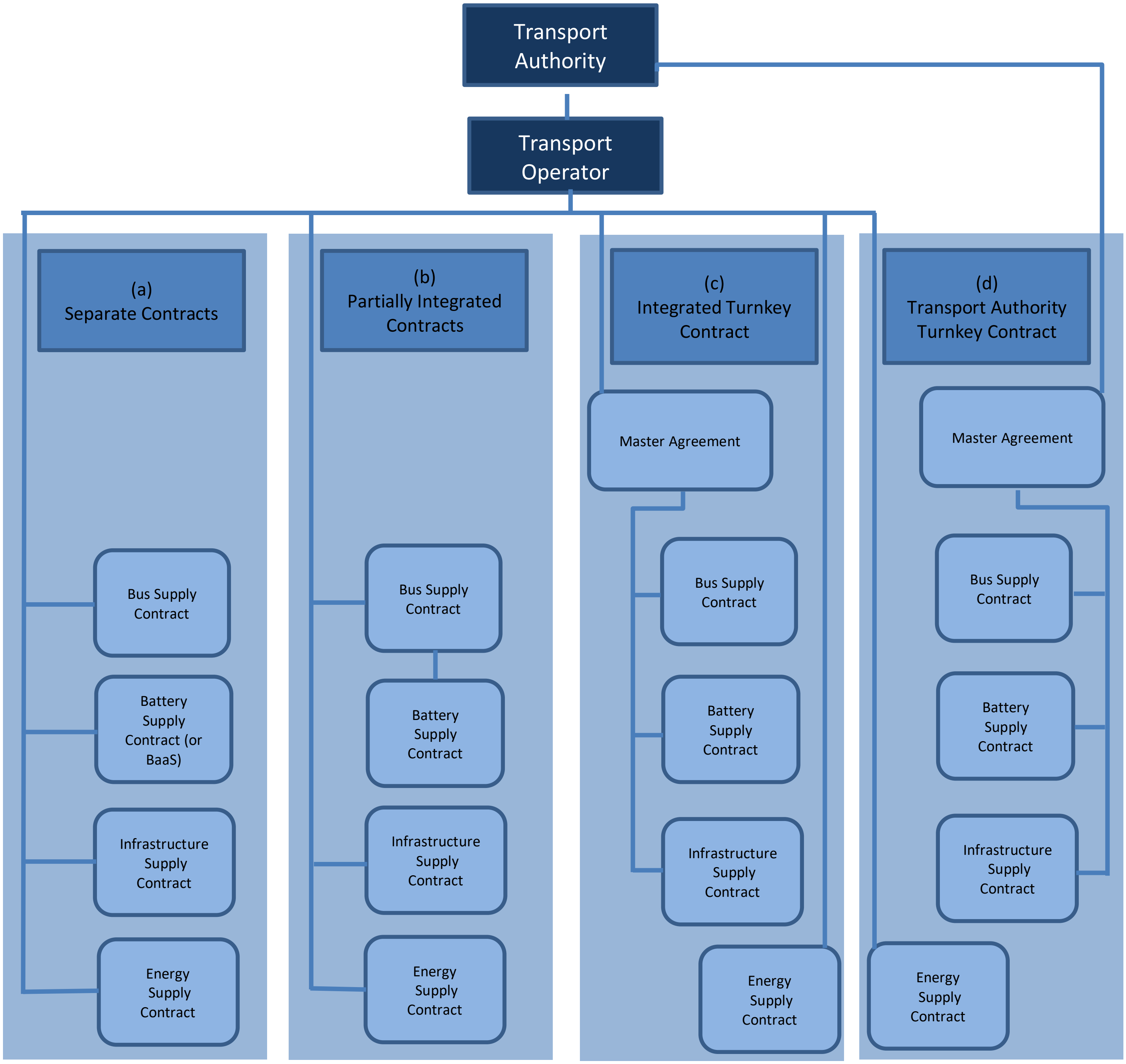
Transport Authority
Transport Operator
(a) Separate Contracts
Bus Supply Contract
Battery Supply Contract (or BaaS)
Infrastructure Supply Contract
Energy Supply Contract
(b) Partially Integrated Contracts
Bus Supply Contract
Battery Supply Contract
Infrastructure Supply Contract
Energy Supply Contract
(c) Integrated Turnkey Contract
Master Agreement
Bus Supply Contract
Battery Supply Contract
Infrastructure Supply Contract
Energy Supply Contract
(d) Transport Authority Turnkey Contract
Master Agreement
Bus Supply Contract
Battery Supply Contract
Infrastructure Supply Contract
Energy Supply Contract

Conclusion

Some procuring entities will have in-house departments familiar with the procurement of ICE buses. While a fundamental change of strategy is warranted for a complete system procurement of ZEBs, the core procurement skills required by the in-house procurement departments should not be dramatically different. However, there will be a steep learning curve for procurement departments when calculating whole-life costs (including the assumptions to be made), accessing all sources of funds available (including assessing the risks and rewards of any additional revenue streams) and putting in place the most appropriate contractual structure. Interested parties may wish to consult with external advisers to ensure that the most appropriate ZEB system is selected and implemented.

See previous GT Advisories related to this content: Financing EV Infrastructure in the UK and Batteries Not Included: Challenges and Opportunities for Electric Vehicles and Decarbonisation in the United Kingdom.

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