Clean Vehicles Partnership

Technical Note 8

The Business Case for Electric GSE

Prepared for Heathrow Airport Limited by Sustainable Transport Solutions (STS)

STS

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1 Introduction

Previous work undertaken through the CVP has identified electric GSE as potentially a key technology for reducing vehicle emissions and improving air quality at Heathrow. This technical report provides further work on assessing the business case for electric GSE at Heathrow. The analysis was conducted using vehicle performance data from selected GSE manufacturers and operational data reflecting the British Airways and Dnata GSE fleets.

The analysis looks at the whole life cost (WLC) of electric vs. diesel in relation to four types of standard GSE used at the airport: hi-loaders, mobile steps, belt loaders and small aircraft tractors. The analysis took account of:

- Capital cost (but not financing)
- Operating costs – fuel, maintenance and vehicle apron pass
- Battery replacement costs
- Charger costs

Overall the analysis suggests that on a WLC basis electric GSE can provide financial savings over diesel GSE, but not in all situations. As part of the work some sensitivity analysis has been carried out to illustrate the potential cost effectiveness break point under different scenarios.

2 Top level analysis assumptions

There were a number of top level assumptions that were used in the analysis:

- The vehicle life was assumed to be 15 years for the all types of GSE, however, this did vary across the fleets being considered from 12-20 years.
- A standard electric battery pack was assumed to last 5 years and so would be replaced twice during the vehicle lifetime.
- One charger unit is assumed for each piece of electric GSE and a basic cost of £5,000 per charger is assumed. No upgrading of any supply infrastructure is assumed.
- A vehicle apron pass is assumed to cost £75 per year for all vehicles, however, this could be varied in the analysis to differentiate between electric and diesel vehicles.

Also two main fuel price scenarios have been used in the analysis:

- *Scenario 1* – diesel price excluding duty and VAT of 70p/litre and electricity price of 18p/kwh. This essentially reflects the current situation.
- *Scenario 2* - diesel price excluding duty and VAT of £1/litre and electricity price of 16p/kwh. This scenario is to explore a greater price difference between diesel and electric fuel prices, reflecting a potential increase in diesel prices.

As well as these two basic price scenarios some wider price sensitivity analysis has been carried out.

3 Hi-loader analysis

This analysis is based on data for the JBT commander as the dominant hi-loader being used at Heathrow and one used extensively by BA and Dnata. The cost, performance and operational data used for the Hi-loader are shown in Table 1 below.

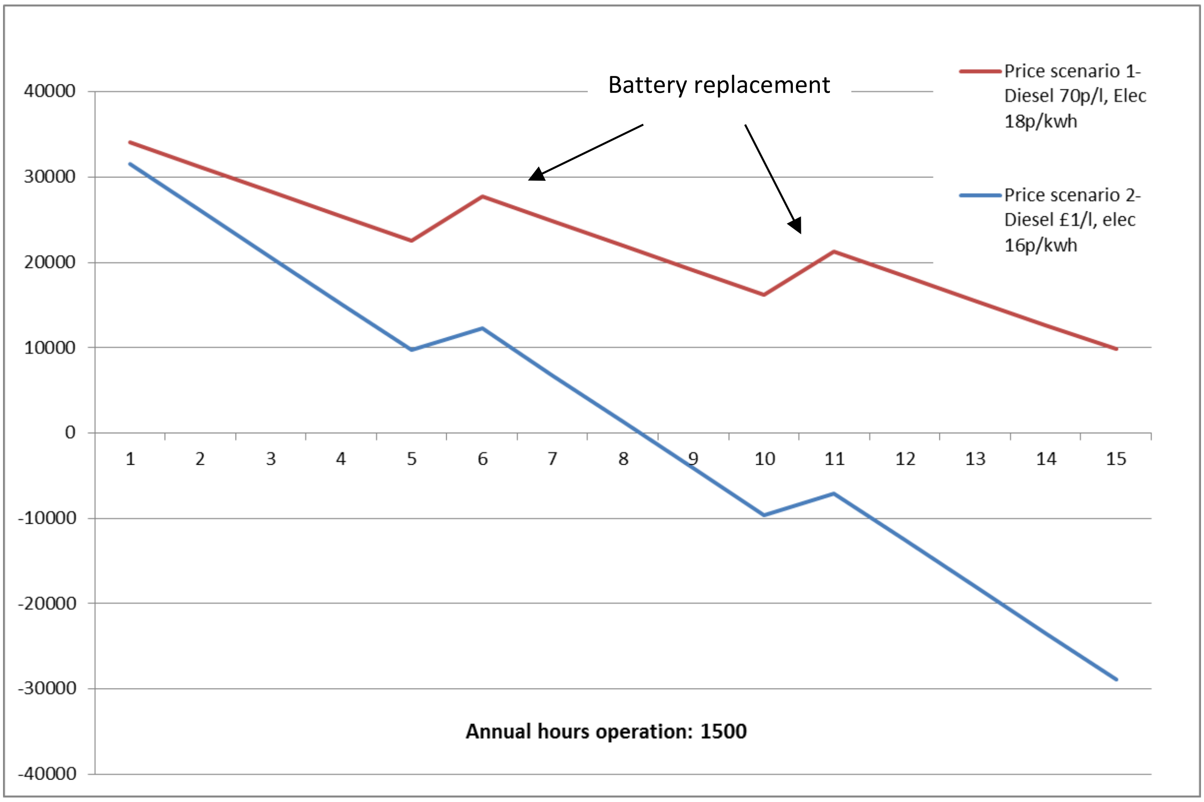
Table 1 Performance data used for the Hi-loader

	Electric	Diesel
Capital cost (£)	163,000	131,000
Annual service/maintenance cost (£)	5,100	5,700
Fuel consumption (kwh/hr or litres/hr)*	11	5
Annual operational hours	1500	1500
Replacement battery cost (£)	8,000	n/a

* Fuel consumption data based on 20% drive, 75% idle and 5% hi-idle

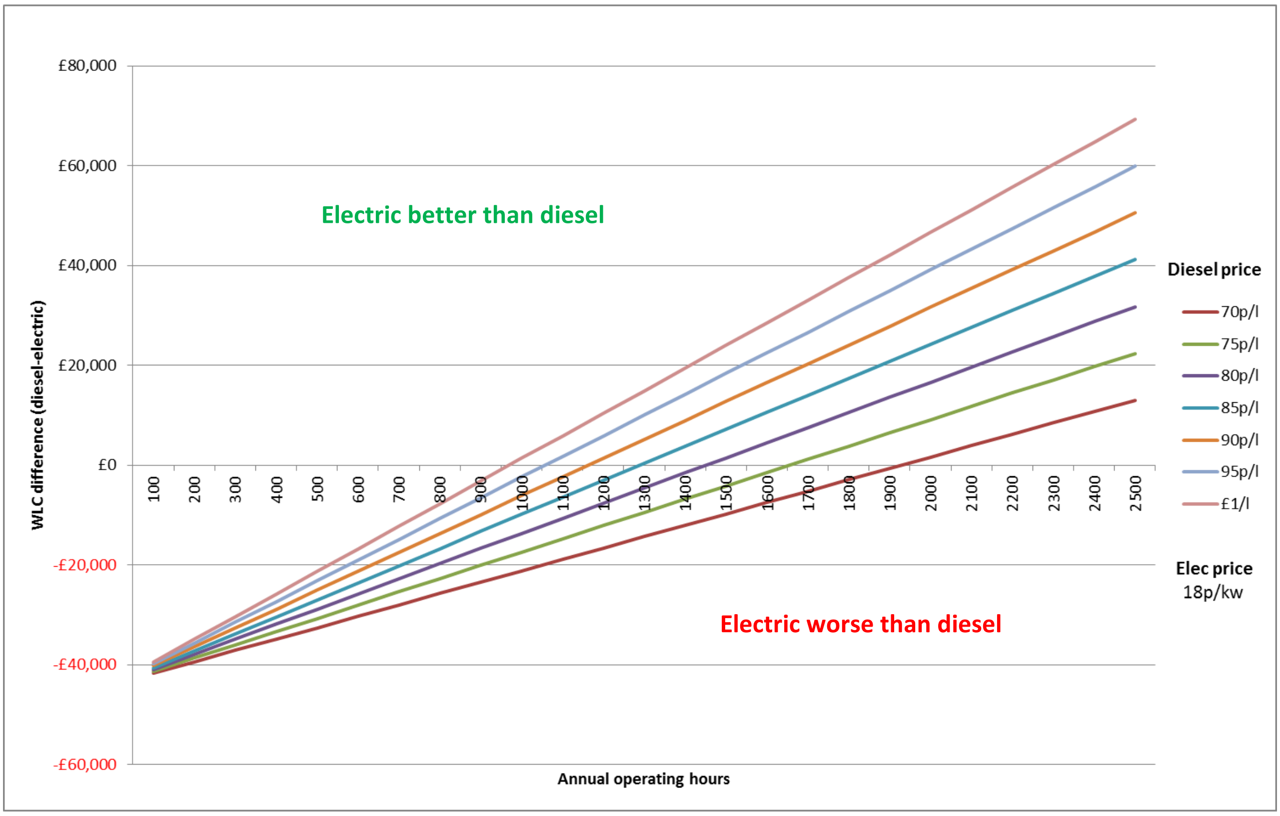
Using these data the cost per year of the electric and diesel hi-loaders was calculated and summed over 15 years to give a 15 year WLC. The cumulative price difference of the electric over the diesel version of the hi-loader is shown in Figure 1. This analysis suggests that over 15 years with the current prices the electric hi-loader has a slightly higher WLC than diesel. However, with higher diesel prices the electric loader will start to provide cost savings after 8 years.

Figure 1 Cumulative price difference of electric over diesel for a hi-loader



The cost feature affecting the analysis most is the fuel cost assumptions in terms of hours of operation, fuel price and fuel consumption. Figure 2 below shows a sensitivity analysis varying hours of operation and fuel prices. The vertical axis shows the WLC cost saving of electricity vs. diesel, the horizontal axis shows different annual operating hours and the coloured lines show the relationship between cost saving and hours of operation for a given diesel price. This shows that with diesel priced at £1/l hi loaders operating 900 hours per year or more will be cost effective. Conversely if diesel is only 70p/l the electric hi-loaders are only cost effective if operating more than 2000 hours per year.

Figure 2 Hi Loader sensitivity analyses – diesel price vs. operating hours



Mobile steps analysis

The analysis for the mobile steps is based on a generic set of performance data derived from data provided by both JBT and TDL. The performance data used for the mobile steps is shown below in Table 2.

Table 2 Performance data used for the mobile steps

	Electric	Diesel
Capital cost (£)	69,000	65,000
Annual service/maintenance cost (£)	2,500	2,500
Fuel consumption (kwh/hr or litres/hr)	2.5	1
Annual operational hours	1200	1200
Replacement battery cost (£)	4,000	n/a

This data suggested the initial capital premium of electric over diesel is small at around £4,000. However, when the charger is included and 2 replacement batteries the total life time capital cost premium is £17,000. Being smaller vehicles than the hi-loader the fuel costs are significantly lower and so whole life fuel cost savings of electric over diesel are not as great. With these assumptions the electric steps are not cost effective on a WLC basis under either price scenario costing between £6,000 and £10,000 more over their lifetime as illustrated in Figure 3

Figure 3 Cumulative price difference of electric over diesel for mobile steps

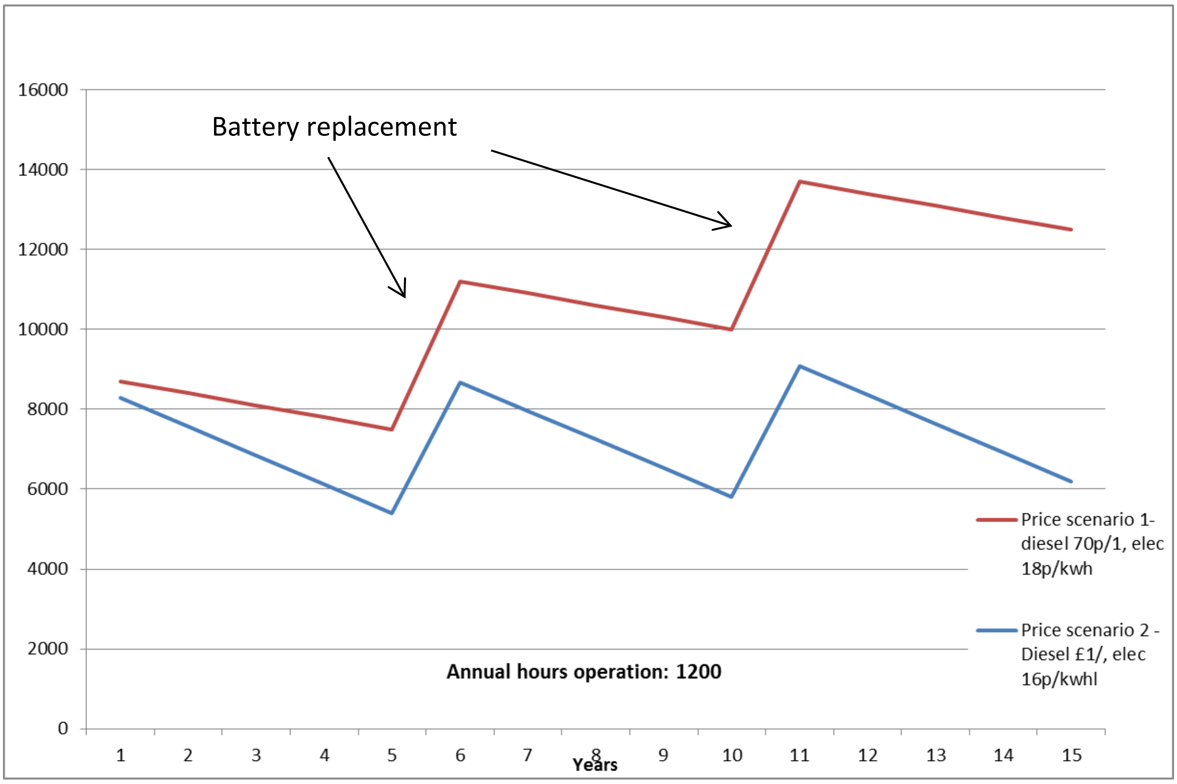
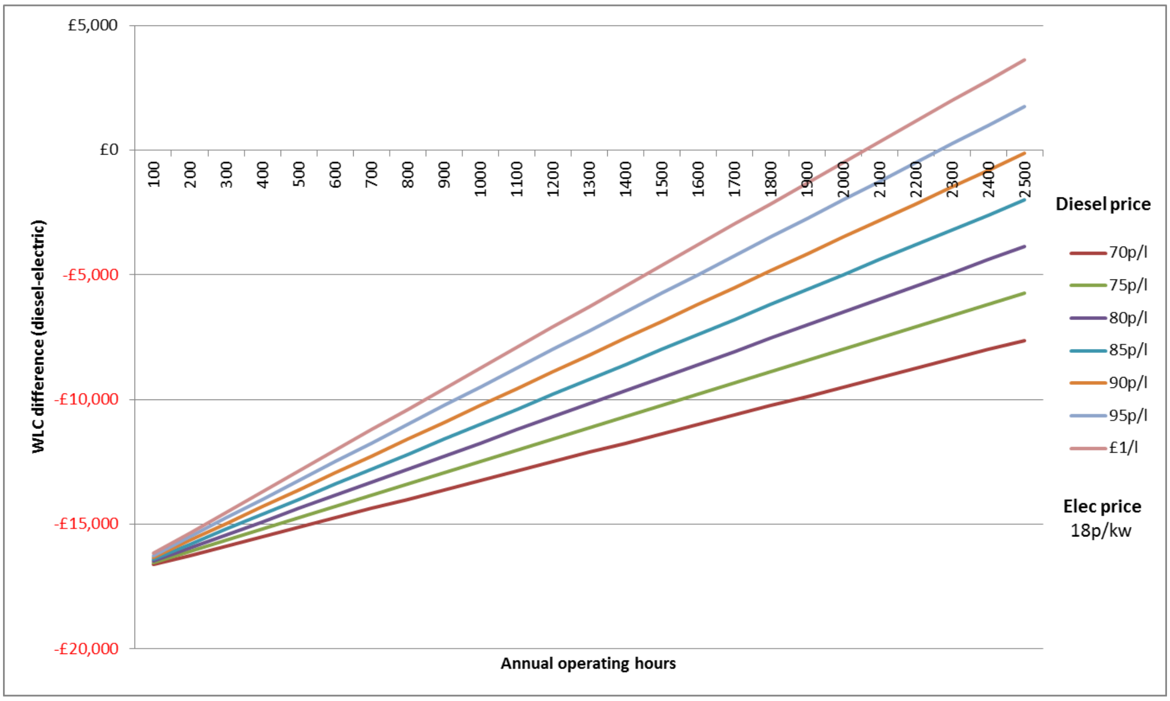


Figure 4 Mobile sensitivity analyses – diesel price vs. operating hours



A sensitivity analysis was carried out of hours of operation vs. diesel fuel price, as shown in Figure 4 above. This shows that even for the higher price scenario diesel at £1/l the mobile steps would need to operate for 2000 hours per year of more to be cost competitive with diesel.

If an operator did not have to incur the cost of the charger and the battery life can be extended than the electric steps would start to become competitive with diesel. With this equipment the purchase premium is low, but the additional costs of chargers and replacement batteries makes the business case difficult compared to diesel.

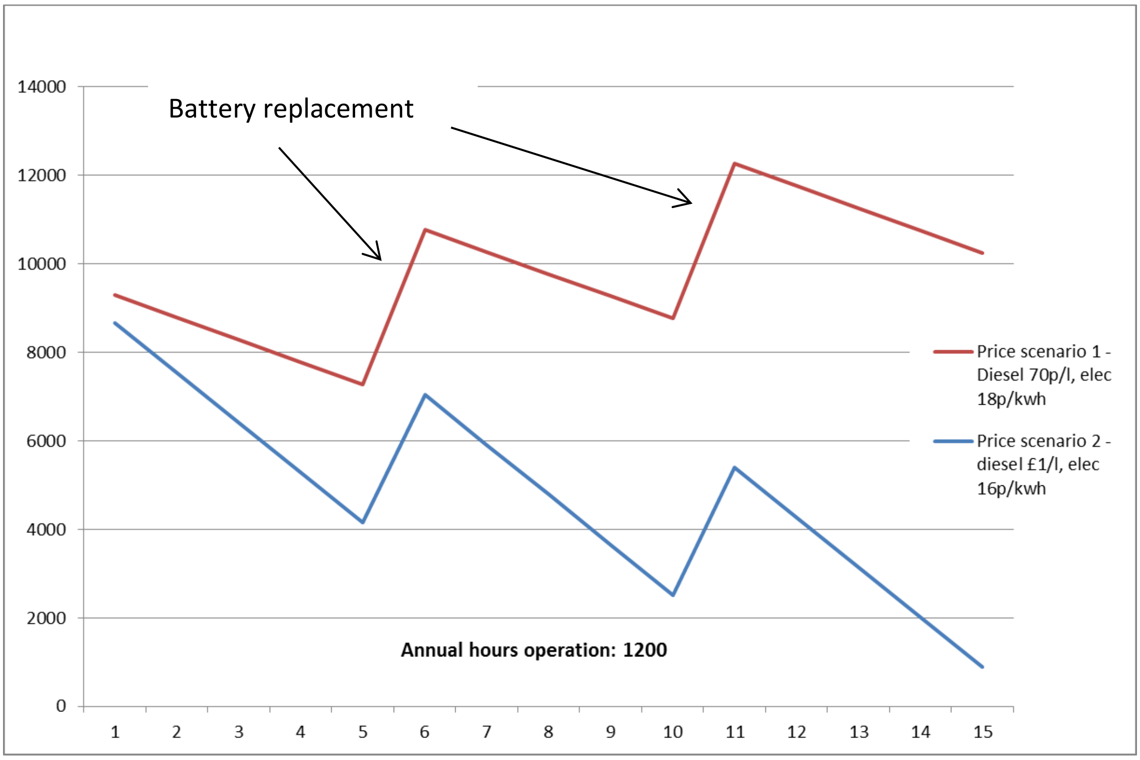
Belt loader analysis

The belt loader data is drawn mainly from information provided by TLD, and is shown below in table 3. This is the lowest cost piece of GSE with a price premium of less that £4,000 over the diesel equivalent and is perhaps the most commonly used piece of electric GSE other than baggage tugs.

Table 3 Performance data used for the belt loader

	Electric	Diesel
Capital cost (£)	37,800	33,00
Annual service/maintenance cost (£)	2,500	2,500
Fuel consumption (kwh/hr or litres/hr)	3.5	1.5
Annual operational hours	1200	1200
Replacement battery cost (£)	4,000	n/a

Figure 5 Cumulative price difference of electric over diesel for belt loaders



The WLC analysis shown in Figure 5 above is similar to that of mobile steps. Although the initial capital cost is not that much more than for a diesel version, the extra investment in chargers and replacement batteries are likely to make them unattractive. The business case is slightly better than for the steps as they have higher fuel consumption and so can generate slightly higher fuel costs savings. With the higher price diesel scenario the electric belt loaders would start to pay back when operating above 1,400 per year.

Aircraft tractor analysis

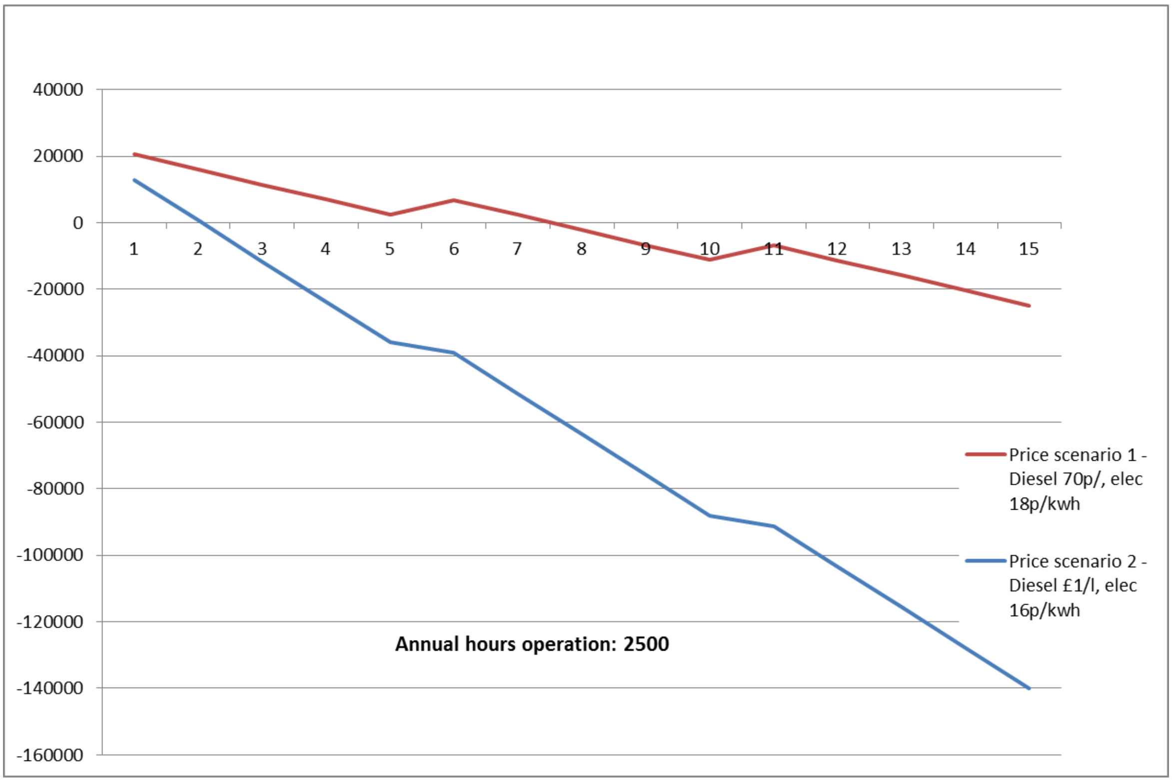
The aircraft tractor is the largest and potentially most heavily used piece of electric GSE. The analysis shown here is based on the JBT B400, which is very similar to the Schopf F110 electric. The performance data for the aircraft tractors are shown in table 4 below.

Table 3 Performance data used for the belt loader

	Electric	Diesel
Capital cost (£)	120,000	100,000
Annual service/maintenance cost (£)	4,000	4,000
Fuel consumption (kwh/hr or litres/hr)	23	8.5
Annual operational hours	2,500	2,500
Replacement battery cost (£)	9,000	n/a

The aircraft tractor is the most costly of the electric GSE costing £20,000 more that the diesel version, with another £23,000 in charger and battery replacement costs. However, it is heavily used and with high fuel consumption and so the fuel cost savings of the electric version make this potentially very cost effective as illustrated in Figure 6.

Figure 6 Cumulative price difference of electric over diesel for aircraft tractor



The analysis suggests that the electric aircraft tractor can start paying back after between 2 and 4 years. Over the life time of the tractor it would potentially save between £25,000 and £140,000 over a diesel model.

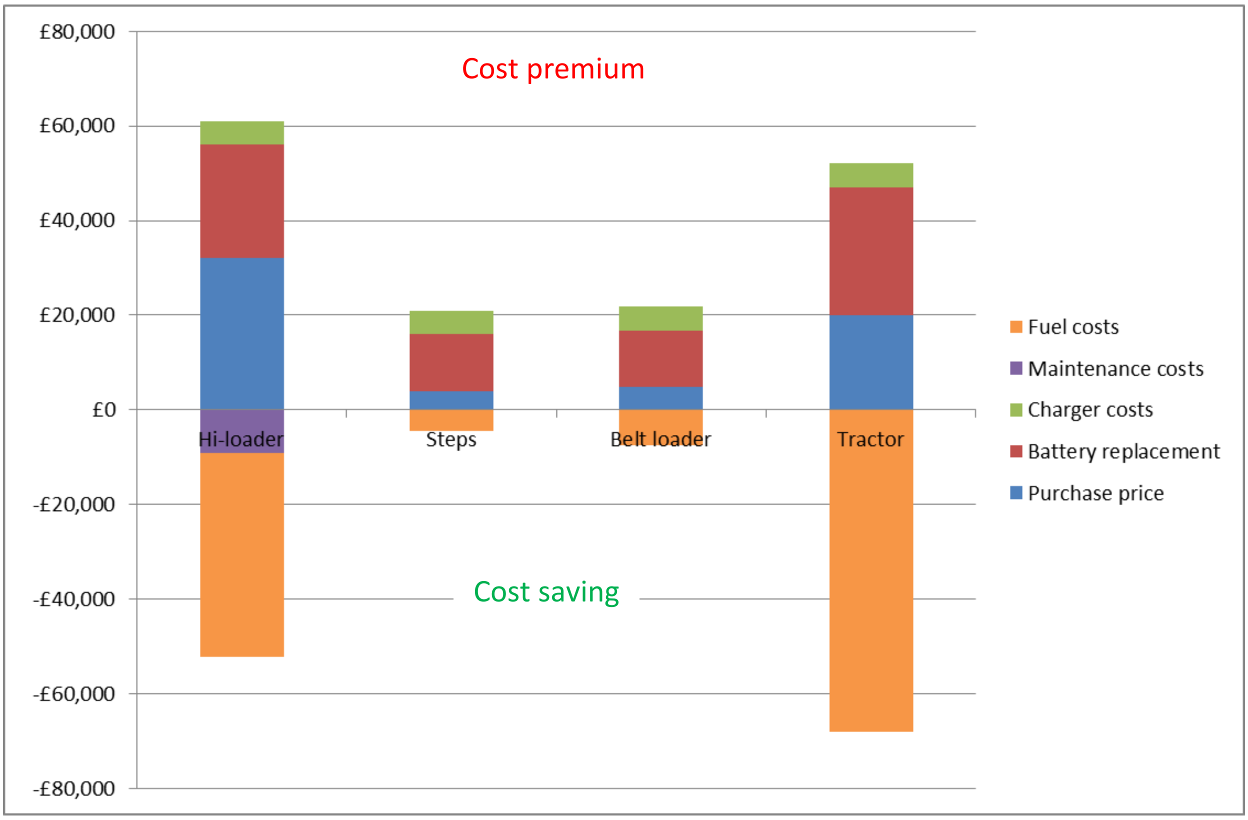
Summary

The initial capital outlay for electric GSE is some 15-25% higher than for the diesel equivalent. In addition there will be battery replacement costs over the life time of the GSE and potentially investment in recharging infrastructure. These higher capital costs need to be offset from lower running costs if there is to be a business case for the electric GSE. Therefore the operating hours, fuel consumption and fuel prices are critical to the cost effectiveness of electric GSE.

As described in the sections above and illustrated in figures 6 and 7 below the fuel cost savings from electric GSE are likely to offset the capital costs for the larger equipment such as the loaders and aircraft tractors which operate longer hours and have higher fuel consumption. Whereas with the smaller equipment the fuel costs savings are unlikely to be greater than the capital costs

However, for these smaller pieces of equipment the initial capital premium is relatively modest and so less of a barrier to investment than for some of the larger equipment. Also for the smaller equipment the additional cost of recharging infrastructure and replacement batteries are significantly higher than the initial purchase premium. If these additional costs can be reduced by use of existing recharging equipment and longer battery life the business case significantly improves.

Figure 6 Whole Life Cost difference of Electric over diesel for price scenario 1



Note: where the bars below the axis are greater than those above electric GSE is more cost effective

Figure 6 Whole Life Cost difference of Electric over diesel for price scenario 2