Pilot Green Transport Fund

Interim Report
On
Trial of Electric Buses for KITEC and MTR Kowloon Bay Station Shuttle Service (Trademart)

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(Trial Period: 1 November 2013 – 31 October 2014)

Executive Summary

1 Introduction

1.1 The Pilot Green Transport Fund (the Fund) is set up to encourage transport operators to try out green and innovative transport technologies, contributing to better air quality and public health for Hong Kong. International Trademart Company Limited (Trademart) was approved under the Fund for trial of two private buses for shuttle service with the associated charging facilities. Through the tendering procedures stipulated in the Subsidy Agreement Trademart entered into with the Government, Trademart procured two Shandong Yixing Feiyan electric buses for trial. They are referred to as EV-1 and EV-2, collectively as EVs, in this report.

1.2 PolyU Technology and Consultancy Company Limited has been engaged by the Environmental Protection Department as an independent third party assessor to monitor the trials and evaluate the performance of the green and innovative transport technologies under trial as compared with their conventional counterparts. Trademart assigned one diesel vehicle (DV) providing similar services as the conventional vehicle for comparing with the two EVs.

1.3 This Interim Report summarizes the performance of the EVs in the first twelve months of the trial and compares them with their conventional counterpart.

2 Trial Vehicles

2.1 Key features of the EVs and DV are in Appendix 1 and photos of the vehicles are in Appendix 2. These vehicles provided shuttle service between MTR Kowloon Bay station and Kowloonbay International Trade and Exhibition Centre (KITEC). Each EV can carry a maximum of 45 passengers. According to the manufacturer, each EV has a travel range of 280 km with its batteries fully charged and air-conditioning on.

2.2 Trademart has set up one dedicated 125 kW charger for each of the EVs at the KITEC car park at B1 level to charge the batteries of the EVs. It takes about 4 hours to fully charge the batteries. The EVs were only charged at this charging station overnight.

3 Trial Information

3.1 The trial started on 1 November 2013 and would last 24 months. Trademart was required to collect and provide trial information including the EV mileage reading before charging, amount of electricity consumed and time used in each charging, and operation downtime due to charging; maintenance records included cost and downtime associated with scheduled and unscheduled maintenance of the EVs and the charging facilities. Similar data from the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers were collected to reflect any problems of the EVs.

3.2 Table 1 below summarizes the statistical data of the EVs and DV. The fuel cost of the EVs was about $6.10/km (78%) lower than the DV.

3.3 EV-1 broke down in late September 2014 and was towed to the supplier's service centre. It caught fire en route and has since been stored at the centre pending insurance report. Preliminary investigation showed that the fire was unrelated to the vehicle being an EV.

Table 1: Key operational statistics of each vehicle (November 2013 to October 2014)

		Electric Buses		**Diesel Bus**
		EV-1	**EV-2**	**DV**
Total mileage/km		36,992	46,408	25,511
Average fuel economy	(km/kWh)	0.622	0.636	
	(km/litre)			1.62
Average fuel cost/($/km)		1.77	1.73	7.85
Average total operating cost/($/km)		5.61	4.48	10.7
By vehicle type	average total operating cost/($/km)	5.18		10.7
	average downtime [1] /day	104 [2]		117.5

[1] Downtime refers to the period the vehicle is not in operation, which counted from the first day it stops operation till the day it is returned to the operator.

[2] Including the last 32 days of the report period after EV-1 caught fire while being towed to service centre.

3.4 Apart from the fuel costs, the table also shows that average total maintenance cost which may include other indirect costs such as towing fee, vehicle replacement fee. In this report period, the EVs and DV incurred expenses on fuel and maintenance. Replacement bus cost is not included in this report because KITEC only provided some of the data in this area. It would cost a few thousand dollars per day to hire a bus. Since the EVs and the DV had similar downtime but the DV travelled shorter distances, if replacement cost was included, the EVs' total operating cost saving would be higher than $5.5/km from the figures in Table 1.

3.5 The average utilization rate of EV-1 and EV-2 was 72% and that of DV was 68%. The EVs were plagued by a number of problems that led to frequent maintenance. The major ones were the large temperature difference among the battery compartments, battery management system fault and front axle suspension failure. However, during the report period, about 50% of the EVs' total maintenance downtime was unrelated to their electric drive systems. Trademart has to wait for the insurance report for aforesaid fire accident before it could decide how to deal with the damaged EV-1. The insurance report was not yet out as of the end of this monitoring report period. Had EV-1 been towed to its supplier's service centre without the fire accident, the repair could probably be completed within a shorter time leading to a higher utilization rate for the EVs.

4 Summary

4.1 The average total operating costs of the EVs – including the nominal maintenance costs that were waived because the EVs were still under warranty – was 51% ($5.5/km) less than the DV. Their utilization rates were comparable to the DV, 72% vs 68%. However, about 50% of the EVs' maintenance downtime was unrelated to their electrical drive systems. The fuel cost of the EVs was nearly 78% lower, a significant reduction.

4.2 Majority of the passengers felt that the EVs were green and emitted no air pollutants but some were not certain about the power of EVs on slope climbing. They would like to see all vehicles changed to EVs. The drivers of the EVs did not have problems in operating the vehicles. They felt the EVs were quieter and had larger torque than their diesel counterparts. Overall, Trademart agreed that, in general, using electric vehicle is good because it provides a greener and quieter environment compared with the diesel vehicle. However, Trademart was not satisfied with the performance of the EVs as there were unexpected downtimes owing to the battery, charging as well as other problems. At this stage, Trademart was not prepared to replace the entire bus fleet with the electric vehicles.

4.3 The charging frequency as well as average fuel economy of the EVs did not indicate any deterioration in their performance of the batteries.

Appendix 1: Key Features of Vehicles Involved in the Trial

1. Trial EVs

Registration Mark:	**SF8209, SF8306**
Make:	Shandong Yixing
Model:	Feiyan
Class:	Private bus
Gross vehicle weight:	17 tonnes
Seating capacity:	driver + 45 passengers
Rated power:	150 kW
Travel range:	280 km (air-conditioning on)
Maximum speed:	over 70 km/h
Battery material:	Lithium iron phosphate
Batteries capacity:	360 kWh
Charging time:	4 hours (using 125 kW charger)

2. DV used for comparison

Registration Mark:	**SG5650**
Make:	MAN
Model:	18.310HOCL/R
Class:	Private bus
Seating capacity:	driver + 49 passengers
Gross vehicle weight:	17 tonnes
Engine capacity:	11970 c.c.
Year of manufacture:	2010

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial Electric Buses and Charging Facilities

	
EV-1 – front view	EV-1 – end view
	
EV-1 – side view 1	EV-1 – side view 2
	
EV-1 – Charging station	

	
EV-2 – front view	EV-2 –end view
	
EV-2 – side view 1	EV-2 – side view 2
	
EV-2 – Charging station	

2. Diesel Bus for Comparison

	
DV – Front view	DV – Odometer