Pilot Green Transport Fund

Interim Report On
Trial of Electric Light Buses for Hotel Guest Shuttle Service (ICON)

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The Monitoring and Evaluation Team's views expressed in this report do not necessarily reflect the views of the Environmental Protection Department, HKSAR.

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(ICON)

Interim Report
(Trial Period: 1 January – 31 December, 2017)

Executive Summary

1. Introduction

1.1 The Pilot Green Transport Fund (the Fund) is set up to encourage transport operators to try out green innovative transport technologies, contributing to better air quality and public health for Hong Kong. Hotel ICON Limited (ICON), a non-profit making organization which is exempted from tax in accordance with section 88 of the Inland Revenue Ordinance (Cap. 112), was approved under the Fund for trial of two electric light buses for hotel guest shuttle service. Through a tendering procedure stipulated in the Agreement, ICON procured two Wuzhoulong electric light buses for trial. They are referred to as EV-1 and EV-2, in this report.

1.2 PolyU Technology and Consultancy Company Limited (PolyU) has been engaged by the Environmental Protection Department (EPD) as an independent third party assessor to monitor the trial and evaluate the performance of the trial vehicles. ICON originally hired two diesel buses for similar services. With the EVs in operation, the services of the diesel vehicles were terminated and hence there were no conventional counterparts for comparison. Instead, historical data of the two formerly hired 24-seat (including driver) diesel buses (DV-1 and DV-2) with GVW of 5,300 - 5,600 kg were used for comparison purpose.

1.3 This Interim Report summarizes the performance of the EVs in the first twelve months of the trial as compared with historical data of the two formerly hired DVs.

2. Trial Vehicles

2.1 Key features and photos of the EVs and the charging facilities are in Appendix 1 and Appendix 2 respectively. The vehicles were used mainly for providing shuttle service to hotel guests from the hotel to Tsim Sha Tsui. Each EV has a seating capacity for 16 passengers (excluding driver) with gross vehicle weight (GVW) of 7,000 kg. Day-to-day travel for providing such service is about 100 km for each EV. According to the manufacturer, with fully charged batteries, each EV has a travel range of 180 km with the air-conditioning off.

2.2 Both EVs were normally parked inside the hotel. ICON has set up two DC quick chargers of 48 kW capacity each on the ground floor and the basement floor, respectively, to charge the

batteries of the EVs as well as to record the electricity consumption of each EV. During the reporting period, the EVs were only charged inside the hotel. Each EV was normally charged two to three times a day, including a long charge overnight and one to two topping up charges during daytime, for about half an hour each time

3. Trial Information

3.1 The trial started on 1 January 2017 and will last for 24 months. ICON was required to collect and provide trial information including the EV mileage reading before charging, amount of electricity consumed in each charging, charging time and operation downtime due to charging, cost and downtime associated with scheduled and unscheduled maintenance of the EVs and the charging facilities. Historical data of the DVs were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver were collected to reflect operational problems of the EVs.

3.2 The following table summarizes the statistical data of the EVs and the DVs. The average fuel cost of the EVs was lower than that of the DVs by HK$2.42/km (75%) but the average total operating cost was higher by 136%.

Table 1: Key operation statistics of each vehicle (January to December 2017)

		Electric light buses		**Diesel buses[1] (historical data)**	
		EV-1	**EV-2**	**DV-1**	**DV-2**
Total mileage/km		25,501	27,264	86,629	76,847
Average fuel economy	km/kWh	1.43	1.40		
	km/litre			3.72	3.65
	km/MJ	0.398	0.39	0.103[2]	0.101[2]
Fleet average fuel economy		1.42 km/kWh		3.69 km/litre	
Average fuel cost (HK$/km)		0.788	0.805	3.19	3.26
Fleet average fuel cost (HK$/km)		0.796		3.22	
Average total operating cost (HK$/km)		8.31	6.94	3.19	3.26
Fleet average total operating cost (HK$/km)		7.59		3.22	
Downtime/days[3]		123	111	31.5	25

[1] Historical data from June 2014 to May 2016; fuel cost based on average market fuel price of January to December 2017

[2] Assuming lower heating value of 36.13 MJ/litre for diesel fuel

[3] Downtime refers to the working days the vehicle is not in operation, which counted from the first day it stops operation till the day it is discharged from the vehicle supplier to the operator. Downtime of DVs converted to 12-month period

3.3 Apart from the maintenance cost, other indirect costs may include towing fee, vehicle replacement fee and cost of operation downtime due to charging and maintenance of the EVs. There was one scheduled maintenance for each EV. However EV-1 and EV-2 had 18 and 15 unscheduled maintenances, respectively, in the first twelve months of the trial period. From June 2014 to May 2016, DV-1 had 11 scheduled and 17 unscheduled maintenance while DV-2 had 9 scheduled and 13 unscheduled maintenance; leading to downtime of 63 days for DV-1 and 50 days for DV-2, or on average 31.5 days and 25 days for DV-1 and DV-2 respectively for the twelve-month period.

3.4 In the reporting period, there were no maintenance costs involved for both EVs and DVs because the EVs were still under warranty while the rentals of the DVs included the maintenance costs. However, the EVs incurred vehicle replacement costs during their downtime. The vehicle replacement costs involved were HK$191,750 for EV-1 and HK$167,200 for EV-2. Thus, the total operating costs of the EVs were higher than those of the DVs.

3.5 EV-1 and EV-2 each had 123 days and 111 days of downtime respectively, with utilization rates of 66.3% and 69.6% respectively. DV-1 and DV-2 each had 31.5 days and 25 days of downtime respectively, with utilization rates of 91.4% and 93.2% respectively. The lower utilization rates of the EVs were due to the frequent and long unscheduled maintenances.

4. Summary

4.1 The average fuel cost of the EVs was 75% lower than that of the DVs. The average saving for the EVs over the DVs was HK$2.42/km. The economic advantage of the EVs is obvious as far as fuel cost is concerned. However, the average total operating cost of the EVs was 136% higher than that of the DVs because vehicle replacement costs were incurred by the EVs during the downtime periods.

4.2 In the first twelve months of the trial, the average daily mileage of EV-1 was 105 km, while that of EV-2 was 107 km. For the DVs, the average daily mileage of DV-1 was 130 km, while that of DV-2 was 113 km.

4.3 EV-1 and EV-2 had utilization rates of 66.3% and 69.6% respectively. DV-1 and DV-2 had utilization rates of 91.4% and 93.2% respectively. The lower utilization rates of the EVs were due to the frequent and long unscheduled maintenances.

4.4 The drivers reported various operating difficulties in each month, involving problems with air-conditioning, doors, battery charging, braking, gear shifting, etc. Because of these operating difficulties, the drivers felt they had problem in operating the EVs and the performance of the EVs was deteriorating. In general, they agreed that the EVs emitted less pollutants and they were cleaner inside the vehicle, disregarding its comparatively less power for climbing uphill. In addition, the mileage for each charge was not sufficient for daily operation, and the EVs were not quieter than

the DVs. Therefore, they did not like driving the EVs and would not recommend the EVs to other drivers.

4.5 The feedbacks from the passengers were in general on the positive side, despite some passengers had reservation on supporting replacing all existing vehicles to EVs and did not feel that the EVs were quieter.

4.6 Overall, ICON agreed that using electric vehicle is good because it can provide a greener environment. However, ICON felt that the performance of the EVs did not meet the specifications provided by the vehicle supplier and did not meet their operational requirements. Moreover, the EVs did not help save their operational cost, and they were not easier and cheaper to maintain and that the performance of the EVs were deteriorating. Therefore, ICON has reservation in encouraging other transport operators to try the EVs and has reservation in replacing all existing conventional vehicles with the EVs.

4.7 For the EVs, data related to fuel economy, expressed in km/kWh, showed fluctuation during the first twelve months of the trial. It has to be further observed if the fluctuation in fuel economy is due to seasonal effect or due to deterioration in the performance of the EVs.

Appendix 1: Key Features of Vehicles and Charging Facilities Involved in the Trials

1. Trial EV

Registration Mark	**UD2682, ICON 5 (formerly UD4401)**
Make:	Wuzhoulong
Model:	FDG6700EVG
Class:	Private light bus
Gross vehicle weight:	7,000 kg
Capacity:	17 passengers (including driver)
Rated power:	45 kW
Travel range:	over 180 km
Maximum speed:	over 80 km/h
Battery material:	Lithium-ion battery
Batteries capacity:	101 kWh
Charging time:	~ 4-5 hours
Year of manufacture:	2015

2. DV used for comparison

Registration Mark	**GF7792**	**MA9168**
Make:	Toyota	Toyota
Model:	XZB59RZEMQY5	BB59RZEMQZ5
Class:	Public bus	Public bus
Gross vehicle weight:	5,600 kg	5,300 kg
Seating capacity:	24 passengers (including driver)	24 passengers (including driver)
Cylinder Capacity:	4009 c.c.	4104 c.c.
Year of manufacture:	2007	2005

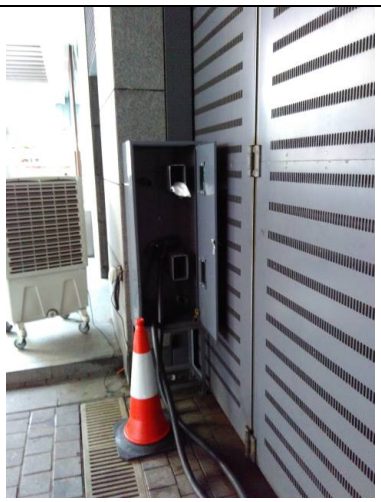
3. Charging system

Make:	XU JI Power Co., Ltd
Model:	EVQC 31 Quick charging system
Output:	400VDC/ 120A
Charging standard:	GB/T 20234

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial EVs (EV1-UD2682, EV2-UD4401) and Charging Facilities

	
EV-1 front view	EV-1 end view
	
EV-1 side view 1	EV-1 side view 2
	
EV-2 front view	EV-2 end view

	
EV-2 side view 1	EV-2 side view 2
	
AC/DC converter installed in baggage room on ground floor (serve charger at ground floor)	Battery charger (with charging cable) installed at ground floor
	
Complete set battery charger installed in basement floor for charging the EVs	