Pilot Green Transport Fund

Final Report On
Trial of Electric Light Goods Vehicle for Engineering Industry

(Tong Kee Engineering Limited)

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Tong Kee Engineering Limited
Final Report
(Trial Period: 1 September 2015 – 28 February 2018)

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. Tong Kee Engineering Limited (Tong Kee) was approved under the Fund for trial of one Mitsubishi Minicab MiEV electric light goods vehicle (EV) for engineering industry work.

1.2 The Hong Kong Institute of Vocational Education (Tsing Yi) (IVE) has been engaged by the Environmental Protection Department as an independent third party assessor to monitor the trials and evaluate the performance of the trial vehicle. Tong Kee assigned one Toyota diesel light goods vehicle (DV) providing similar services as the conventional vehicle for comparing with the EV.

1.3 This report summarizes the performance of the EV in the 24-month trial within the period of 1 September 2015 to 28 February 2018. During the period of September to December 2016, April 2017 and September 2017, the data cannot be retrieved. The data from September 2017 to February 2018 are therefore used. This report compares the performance of the EV with its conventional counterpart.

2. Trial Vehicles

2.1 Through the tendering procedures stipulated in the Subsidy Agreement that Tong Kee entered into with the Government, Tong Kee procured one Mitsubishi Minicab MiEV electric light goods vehicle for trial.

2.2 Key features of the EV and DV are in Appendix 1 and photos are in Appendix 2. The vehicles were used for transporting staff, parts and construction materials in the construction sites in Disneyland and other locations. According to the EV's manufacturer, it has a travel range of 150 km under no load condition with its battery fully charged and air-conditioning off.

2.3 Tong Kee has set up one dedicated charger at their office in August 2014 and can use chargers at the Disneyland construction site. The EV was charged at various sites pending its work assignment. The EV was charged once per day.

3. Trial Information

3.1 The trial started on 1 September 2015 and lasted for 30 (24+6) months. Tong Kee 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, downtime due to charging and operation downtime associated with scheduled and unscheduled maintenance of the EV and the charging facilities. Similar monthly data from the DV was also required. In addition to the cost

information, reports on maintenance work, operational difficulties and opinions of the driver and Tong Kee were collected to reflect any problems of the EV.

4. Findings of Trial

4.1 Table 1 below summarises the total operating costs of the EV and DV. Average total operating cost of the EV was about HK$0.89/km (72%) lower than that of the DV. The average fuel cost of the EV is HK$0.82/km (79%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle (September 2015 – February 2018)

		EV	**DV**
Total mileage	(km)	19,668	64,613
Average fuel economy	(km/kWh)	5.21	-
	(km/litre)	-	10.86
	(km/MJ) [1]	1.45	0.30
Average fuel cost (HK$/km) [2]		0.22	1.03
Average total operating cost (HK$/km)		0.34	1.23
Downtime (days) [3][4]		1	4

[1] Assuming lower heating value of 36.13MJ/litre for diesel.
[2] Market rate was adopted for calculation.
[3] Downtime refers to the equivalent number of working days in which the vehicle is not in operation due to charging, and the period the vehicle is not in operation due to maintenance, counting from the first day it stops operation till the day it is returned to the operator.
[4] Maintenance due to incidents unrelated to the performance of the vehicle was not included for comparison.

4.2 There were one and two scheduled maintenances for the EV and DV in this reporting period and lead to 1 day and 4 days of operational downtime respectively. There was no unscheduled maintenance for both the EV and DV. There were 591 working days in the reporting period and the utilisation rates of EV and the DV were 99.8% and 99.3% respectively.

4.3 The EV drivers felt that the EV was quiet and environment friendly as compared with the conventional vehicles. Since the Disneyland construction site was far from the city, the vehicle would not be used for the duties in the urban area as it did not have sufficient battery capacity for the required driving range. The EV would only be assigned for the duties in Disneyland area with relatively short travelling distance for round-trip, in which the vehicle was only allowed to operate at restricted speed of 30 mph inside the Disneyland. The EV did not have sufficient power when driving uphill and when loaded. It's cargo carrying capacity was poor and it could not accommodate any bulky tools they needed to carry.

4.4 Tong Kee reflected that the EV was suitable for their operations within Disneyland only and the EV could easily charge up its battery using charging stations. On the other hand, they did not recommend to use the EV in an urban area unless the charging facilities and the battery range of EV could be improved with better hill climbing and load carrying capabilities.

4.5 To eliminate the effect of seasonal fluctuations, the 12-month moving averages were used to evaluate the trend of the EV's average fuel economy. The average fuel economy varied from 4.83 to 5.35 km/kWh for the EV. During the second half of the trial it was noted that the battery charge capacity was lower during the hotter summer months.

4.6 The carbon dioxide equivalent (CO_2e) emission from the EV and the DV are 1,964 kg and 5,023 kg respectively, and hence there is a reduction of 3,059 kg CO_2e emissions, which is about 61% reduction in the trial.

5. Summary

5.1 The EV drivers found the EV was only suitable for shorter range driving as it did not have sufficient battery capacity for longer driving ranges. They also noted that the EV did not have sufficient power when driving uphill and when loaded, it's cargo capacity was also poor and it could not accommodate any bulky tools they needed to carry. The utilisation rate of the EV and DV were 99.8% was 99.3% respectively. There is a total reduction of 3,059 kg (i.e. 61%) CO_2e emission by using EV in the trial.

5.2 However, the usage of the EV was on the lower side as reflected by the difference in the total mileage travelled between the EV (19,668 km i.e. an average of 33 km between daily recharging) and the DV (64,613 km, i.e. 110 km on average per working day) in the trial.

5.3 The fuel cost of the EV was significantly lower than that of the DV. The 12-month moving average fuel economy figures suggest there is no significant deterioration in the fuel economy of the EV towards the end of the trial period. During the second half of the trial it was noted that the battery charge capacity was lower during the hotter summer months.

5.4 At present, the price of an electric vehicle is higher than that of a conventional vehicle, so the accumulated fuel saving may not be able to offset the higher vehicle cost shortly. However, the electric vehicle market is expanding and electric vehicle technology is improving, the price difference between electric vehicle and conventional vehicle technology is narrowing down and more affordable to the transport trade.

Appendix 1: Key Features of Vehicles Involved in the Trial

1. Trial EV

Registration Mark	**TP1437**
Make:	Mitsubishi
Model:	Minicab MiEV
Class:	Light Goods Vehicle
Gross vehicle weight:	1.66 tonnes
Seating capacity:	Driver + 3 passengers
Rated power:	25 kW
Travel range:	150 km (air-conditioning off)
Maximum speed:	130 km/h
Battery Type:	Lithium ion
Batteries capacity:	16 kWh
Charging time:	8 hours (Max. current 16A)
Year of manufacture:	2013

2. DV used for comparison

Registration Mark	**MZ8048**
Make:	Toyota
Model:	Hiace 3.0 Turbo
Class:	Light Goods Vehicle
Gross vehicle weight:	2.8 tonnes
Seating capacity:	Driver + 5 passengers
Engine capacity:	2,982 c.c.
Year of manufacture:	2007

Appendix 2: Photos of Vehicles

1. Trial Electric Light Goods Vehicle

	
EV - front view	EV - rear view
	
EV – left side view	EV – right side view
	
EV Charging Station	

2. Diesel Light Goods Vehicle for Comparison

	
DV front view	DV rear view
	
DV left side view	DV right side view