Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicle for Gas Engineering Industry
(Kam Po Engineering Company Limited)

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Trial of Electric Light Goods Vehicle for Gas Engineering Industry
(Kam Po Engineering Company Limited)

Final Report
(Trial Period: 1 June 2019 – 31 May 2021)

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. Kam Po Engineering Company Limited (Kam Po) was approved under the Fund for trial of one electric light goods vehicle. Through the tendering procedures stipulated in the Subsidy Agreement entered into with the Government, Kam Po procured one Joylong EW4 electric light goods vehicle (EV) for trial.

1.2 The PolyU Technology and Consultancy Company Limited has been engaged by the Environmental Protection Department as an independent third party assessor to monitor the trial and evaluate the performance of the trial vehicle.

1.3 Kam Po assigned a Toyota HIACE diesel light goods vehicle (DV), which provided the same service, as the conventional counterpart for comparison purpose. The EV replaced the DV thereafter, and the DV was sold at the end of May 2019. Kam Po has provided 1-year DV fuel bills and maintenance receipts (Apr-2018 ~ Mar-2019) to compare the fuel economy and operation cost with the EV. For calculation purpose, the 1-year mileage and maintenance data of the DV had been repeated twice in 2-year trial period but the market fuel prices in the trial period had been used for calculation.

1.4 This Final Report summarizes the performance of the EV in the 24 months of the trial and compares it with the historical data of its conventional counterpart, i.e. DV.

2. Trial and Conventional Vehicles

2.1 The trial EV, Joylong EW4 electric light goods vehicle, has a gross vehicle weight of 3,700 kg capable of carrying a driver with five passengers and goods. It has a 73.4 kWh Li-ion battery pack and the driving range is 300 km with air-conditioning off. Kam Po assigned a designated driver for the EV. Kam Po provided 1-year historical data of the sold DV, Toyota HIACE series 2,982c.c. diesel light goods vehicle, as the conventional counterpart for comparison in this trial. The vehicles were used mainly for providing Towngas installation parts delivery service in Yuen Long. The delivery service is from Monday to Sunday (from 6:00 to 19:00, 6 working hours per day). In the 24-month trial period, the average daily mileage of the EV was around 63 km, while that of the DV was around 98 km.

2.2 Kam Po has installed a 30 kW, 3-phase DC charging facility to charge the batteries of the EV as well as to record the electricity consumed for EV charging. The EV was charged around 2 hours with the charging facility when it was not in use. Key features of the EV, the charging facility and the DV were presented in Appendix 1 and their photos were shown in Appendix 2.

3. Trial Information

3.1 The trial commenced on 1 June 2019 and lasted for 24 months. Kam Po was required to collect and provide trial information including the EV mileage reading before charging, amount of electricity consumed in each charging, time taken for charging, operation downtime due to charging, cost and downtime associated with scheduled and unscheduled maintenances of the EV and charging facility. A similar set of historical 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 Kam Po were collected to reflect any operational problems of the EV.

4. Findings of Trial

4.1 Table 1 summarizes the statistical data of the EV and the DV.

Table 1: Key operation statistics of each vehicle (1 June 2019 – 31 May 2021)

		EV	**DV**
Total mileage (km)		45,607	71,020
Average daily mileage (km/working day)		63 [1]	98 [2]
Average fuel economy	(km/kWh)	3.11	-
	(km/litre)	-	9.67
	(km/MJ)	0.86	0.27 [3]
Average fuel cost (HK$/km)		0.39 [4]	1.52 [5]
Average total operating cost per km (HK$/km) [6]		0.51	1.63
Downtime (working day) [6][7]		6 [1]	4 [2]

[1] The EV had undergone two 3-day scheduled maintenances in March 2020 and 2021, respectively. There was an unscheduled maintenance due to a traffic accident on 10 May 2020. The EV was sent back to the vehicle agent for maintenance until 26 June 2020. The downtime of the EV was 48 working days, which was non-performance related and was not included in estimating the number of working days. Therefore, there were 731 working days in the period of 1 June 2019 to 31 May 2021 and the EV only worked on 725 days.

[2] The DV had 2 scheduled maintenances in a year which was repeated twice for 2-year trial period, so the DV had 4 scheduled maintenances with 4 days downtime. Hence, it only worked on 727 days.

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

[4] Electricity cost is based on HK$1.177/kWh for 2019 and HK$1.218/kWh for 2020 and 2021.

[5] The market fuel prices from 1 June 2019 to 31 May 2021 were used for calculation.

[6] Maintenance due to incidents unrelated to the performance of the vehicle was not included for comparison.

[7] Downtime refers to the equivalent number of working days in which 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.

4.2. During the 24 months of the trial, the total mileage and the average daily mileage of the EV were 45,607 km and 63 km/day respectively while those of the DV were 71,020 km and 98 km/day respectively. The average fuel cost of the EV was HK$1.13/km (about 74%) lower than that of the DV. The average total operating cost of the EV was HK$1.12/km (about 69%) lower than that of the DV.

4.3 There were 731 working days in the 24 months of the trial. Regarding the maintenance related to the performance of the vehicle, the EV had undergone two scheduled maintenances resulting in a downtime of 6 working days; while the DV had undergone four scheduled maintenances resulting in a downtime of 4 working days. The utilization rates of the EV and DV were 99.2% and 99.5%, respectively.

4.4 To remove the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the EV's fuel economy. The 12-month moving average fuel economy varied from 2.98 to 3.25 km/kWh. There was a slightly drop in fuel economy of the EV over the trial period, but the variation is narrow that deterioration in fuel economy was insignificant.

4.5 Based on the total mileage of the EV and the fuel economy of the DV, the equivalent carbon dioxide (CO_2e) emission from the DV could be estimated for comparison purpose. The CO_2e emissions from the EV and DV were 6,083 kg and 13,070 kg, respectively and hence the EV emitted 6,987 kg CO_2e (about 53%) less than the DV in the trial period.

4.6 The operation of the EV was smooth. The EV driver had no problem in operating the EV and was satisfied with its performance. Kam Po was also satisfied with the performance of the EV and was of the view that using the EV is good because it can improve roadside air quality as well as its economic advantage.

5. Summary

5.1 During the 24 months of the trial, the average daily mileage of the EV was 63 km, while that of the DV was 98 km. The utilization rates of the EV and the DV were 99.2% and 99.5%, respectively.

5.2 The data showed that the EV had lower fuel cost than the DV, with an average fuel cost saving of 74%. Accounting the maintenance costs incurred for both the EV and the DV, the average total operating cost of the EV was 69% lower than that of the DV.

5.3 In the trial period, the 12-month moving average fuel economy of the EV varied narrowly from 2.98 to 3.25 km/kWh. There was a slightly drop in fuel economy of the EV over the trial period, but the variation is narrow that deterioration in fuel economy was insignificant.

5.4 Compared with the DV, there was a total reduction of 6,987 kg CO_2e (about 53%) in the trial by using the EV.

5.5 The EV driver had no problem in operating the EV. Both the driver and Kam Po were satisfied with the performance of the EV. Kam Po is of the view that that using the EV is good because it can improve roadside air quality as well as its economic advantage.

5.6 As electric vehicle market is expanding and technology is improving, the capital cost of the electric light goods vehicle is anticipated to drop. The price difference between electric light goods vehicle and diesel light goods vehicle may narrow down.

Appendix 1: Key Features of Vehicles and the Charging Facility

1. Trial EV and the Charging Facility

(a) EV

Registration mark	**WC1083**
Make:	Joylong
Model:	HKL5040XXYBEV1 (EW4)
Class:	Light goods vehicle
Gross vehicle weight:	3,700 kg
Seating capacity:	driver + 5 passengers
Rated power:	50 kW
Travel range:	300 km (air conditioning off)
Maximum speed:	100 km/h
Battery material:	lithium-ion
Battery capacity:	73.4 kWh
Year of manufacture:	2018

(b) Charging Facility

Make:	Hangzhou AoNeng Power Supply Equipment Co. Ltd
Model:	ANDC5-500V/60A-1
Type:	3-phase, 380V, movable type
Power:	30 kW, DC (max. 500V/60A)
Charging Standard:	GB

2. DV Used for Comparison

Registration mark	**TP7223**
Make:	Toyota
Model:	HIACE DIESEL LWB
Class:	Light goods vehicle
Gross vehicle weight:	2,800 kg
Seating capacity:	driver + 5 passengers
Cylinder capacity:	2,982 cc
Year of manufacture:	2015

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV (WC1083) and Charging Facility

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Front view of EV</td><td>Rear view of EV</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Left side view of EV</td><td>Right side view of EV</td></tr>
<tr><td>  </td><td></td></tr>
<tr><td>30 kW, 3-phase DC charging facility</td><td></td></tr>
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2. DV (TP7223) for Comparison

	
Front view of DV	Rear view of DV
	
Left side view of DV	Right side view of DV