Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicle for Vegetable Delivery II (Vegetable Marketing Organization)

(18 November 2022)

PREPARED BY:
Dr. C.S. Cheung

List of Monitoring and Evaluation Team Members

Dr. C.S. Cheung (Team Leader)
Department of Mechanical Engineering
The Hong Kong Polytechnic University

Ir. Dr. C. Ng
Department of Mechanical Engineering
The Hong Kong Polytechnic University

Mr. K.S. Tsang
Department of Mechanical Engineering
The Hong Kong Polytechnic University

Dr. Edward W.C. Lo
Department of Electrical Engineering
The Hong Kong Polytechnic University

Dr. W.T. Hung
PolyU Technology and Consultancy Company Limited
The Hong Kong Polytechnic University

Pilot Green Transport Fund
Trial of Electric Light Goods Vehicle for Vegetable Delivery II
(Vegetable Marketing Organization)

Final Report
(Reporting Period: 1 June 2020 – 31 May 2022)

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 for Hong Kong. Vegetable Marketing Organization (VMO) was approved under the Fund for trial of one electric light goods vehicle for vegetable delivery. VMO, through the tendering procedures stipulated in the Agreement entered into with the Government, procured a JOYLONG EW5 electric light goods vehicle (EV) for trial. According to the manufacturer, the EV has a travel range 330 km with its battery fully charged and air-conditioning off.

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 trial and evaluate the performance of the trial vehicle. VMO assigned a TOYOTA HIACE diesel light goods vehicle (DV) providing the same service as the conventional counterpart for comparing with the EV. Since the operation of the EV, the DV was replaced by the EV. Hence, historical data of the DV were used for comparison.

1.3 This Final Report summarizes the performance of the EV in the 24 months of the trial as compared with its conventional counterpart, i.e. the DV.

2. Trial and Conventional Vehicles

2.1 Key features of the EV, the charging facility and the DV are in Appendix 1 and photos of the vehicles and the charging facility are in Appendix 2. The EV was used for the delivery of vegetables to various districts on Hong Kong Island, in Kowloon and the New Territories.

2.2 VMO installed a designated 30 kW DC charging facility inside the car park of Cheung Sha Wan Vegetable Marketing Organization office for charging and recording the amount of electricity charged. The EV was charged almost every day.

3. Trial Information

3.1 The trial commenced on 1 June 2020 and lasted for 24 months. VMO was required to collect and provide trial information including the EV's mileage reading before charging, amount of electricity consumed and time used in each charging, and operation downtime due to charging, cost and downtime associated with scheduled and unscheduled maintenances of the EV and the charging facility. Similar data of the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver and VMO were collected to reflect any problems of the EV.

4. Findings of Trial

4.1 The following table summarizes the statistical data of the EV and the DV. The average fuel cost of the EV was HK$2.13/km (84%) lower than that of the DV. The average total operating cost of the EV was HK$2.25/km (71%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle (1 June 2020 – 31 May 2022)

		EV	**DV (Historical)**
Total distance travelled (km)		54,547	59,344
Average daily mileage (km/working day)		91	95
Average fuel economy	(km/kWh)	3.06	-
	(km/litre)	-	6.54
	(km/MJ)	0.85	0.18 [1]
Average fuel cost (HK$/km)		0.403 [2]	2.53 [3]
Average total operating cost (HK$/km) [4][6]		0.912	3.16
Downtime (working day) [4] [5][6]		11	4

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

[2] Electricity cost is based on HK$1.218/kWh for 2020/2021 and HK$1.289/kWh for 2022

[3] Based on twice the total distance travelled and fuel consumption of corresponding period in 1 April 2019 to 31 March 2020 and the market fuel prices of 1 June 2020 to 31 May 2022 for calculation of fuel cost.

[4] Maintenance due to incident not related to the performance of the vehicle was not included for comparing the performance.

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

[6] Based on the historical DV maintenance records of 1 April 2019 to 31 March 2020. The maintenance cost and downtime for the 24-month trial are assumed to be twice of that based on the 1-year historical record.

4.2 Apart from the fuel cost, maintenance cost and other indirect costs which may include parking fee, towing fee, vehicle replacement fee and cost of operation downtime due to charging and maintenance of the EV are also included in Table 1. There were two scheduled and six unscheduled maintenances for the EV in the 24 months of the trial. For the DV, there were one scheduled and five unscheduled maintenances, based on the 12-month historical records. The scheduled maintenances of the EV and the DV were for conducting annual examinations. The unscheduled maintenances of the EV were for the replacement of damaged windscreen and tail light, and for repair associated with damages caused by water leakage of the cargo, which were not related to the performance of the EV. Other unscheduled maintenances included: replaced rubber mounts of the driving motor, adjusted steering wheel, replaced battery management unit parts and removed and reinstalled the battery pack. The unscheduled maintenances of the DV were for the replacement of air and oil filters, lubricating oil, battery, clutch disc and bearings, checking of air conditioning system, checking of engine exhaust gas recirculation valve and cleaning of inlet pipe etc.

4.3 The EV had 25 days of downtime for maintenance but only 11 of which were related to the performance of the EV. Based on the 12-month historical data, the DV had two days of downtime for maintenance in the 12-month trial period and hence it is assumed to be four days in the 24-month trial period. The utilization rates were 98% for the EV and 99% for the DV. Based on the above, the average daily mileages of the EV and the DV were 91 km/day and 95 km/day respectively.

4.4 The driver of the EV had no problem in operating the EV and was satisfied with its performance. Overall, VMO agreed that using the EV is good because it can provide a greener and quiet environment, as well as having a lower fuel cost. VMO would encourage other transport operators to try EVs and would replace all existing conventional vehicles with EVs. In fact, VMO is looking for 5,500 kg electric light goods vehicle for trial.

4.5 The 12-month moving average fuel economy of the EV had slight variations in the 24-month trial period. There was no indication of deterioration in battery capacity within the 24-month trial period.

4.6 In the 24-month of the trial, the total carbon dioxide equivalent (CO_2e) emission from the EV was 6,846 kg. For comparison purpose, based on the mileage of the EV and the fuel economy of the DV, the total CO_2e emission from the DV was 23,122 kg. Hence, there was a 16,276 kg (70%) reduction of CO_2e, with the replacement of DV by EV in the trial.

5. Summary

5.1 The average fuel cost of the EV was 84% (HK$2.13/km) lower than that of the DV. The average total operating cost of the EV was 71% (HK$2.25/km) lower than that of the DV. The utilization rates were 98% for the EV and 99% for the DV. Compared with the DV, there was a 16,276 kg (70%) reduction of CO_2e by the EV during the trial period.

5.2 Based on the 12-month moving average fuel economy, there was only slight variation in the fuel economy of the EV in the 24-month trial. There was no indication of deterioration in battery capacity within the 24-month trial period.

5.3 The driver of the EV had no problem in operating the EV and was satisfied with its performance. VMO agreed that using the EV is good because it can provide a greener and quieter environment and EV has a lower fuel cost.

5.4 The findings showed electric light goods vehicles are becoming more affordable and feasible to the transport trade for saving operating cost and reducing CO_2 emissions, provided that the vehicles can get easy access to charging facilities.

Appendix 1: Key Features of the Vehicles and Charging Facility

1. Trial EV and Charging Facility

EV

Registration mark	**WN7973**
Make:	JOYLONG
Model:	HKL5041XXYBEVI (EW5)
Class:	Light goods vehicle
Gross vehicle weight:	4,300 kg
Seating capacity:	Driver + 4 passengers
Payload:	1,300 kg
Rated power:	100 kW
Travel range:	330 km (air conditioning off)
Battery material:	lithium-ion
Battery capacity:	73.4 kWh
Year of manufacture:	2019

Charging Facility

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

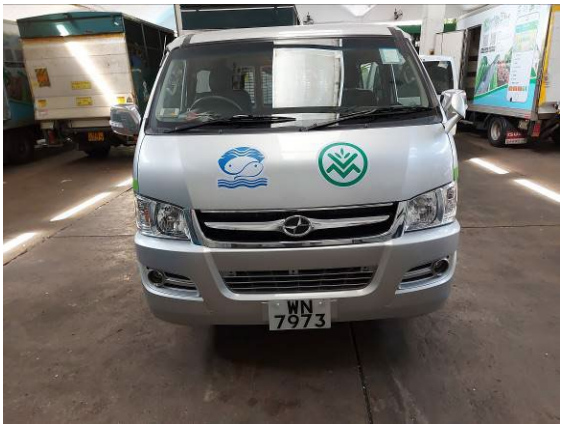
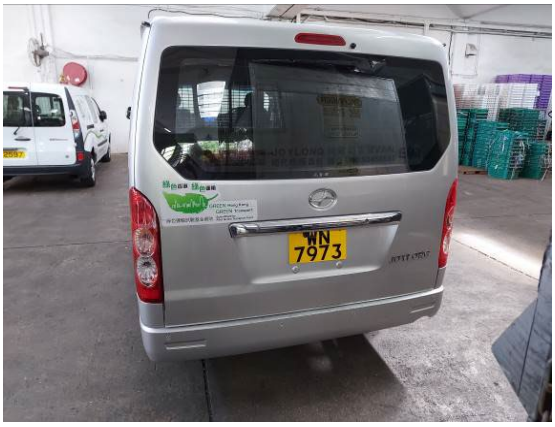
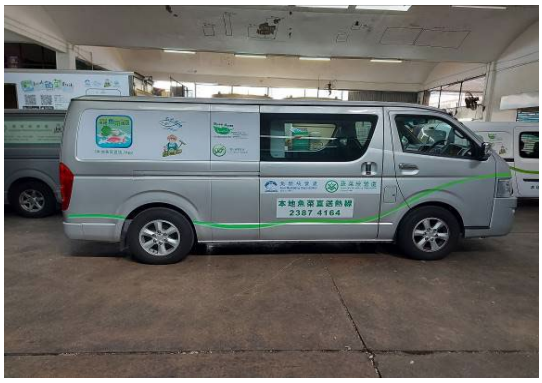
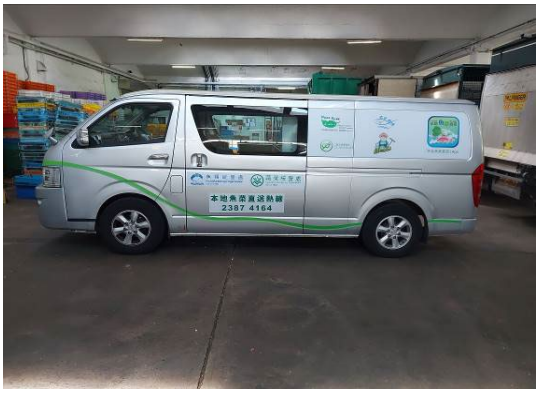
2. DV for Comparison

Registration mark	**SG4115**
Make:	TOYOTA
Model:	HIACE Diesel LWB
Class:	Light goods vehicle
Seating capacity:	Driver + 5 passengers
Payload:	About 900 kg
Gross vehicle weight:	2,800 kg
Cylinder capacity:	2,982 cc
Year of manufacture:	2013

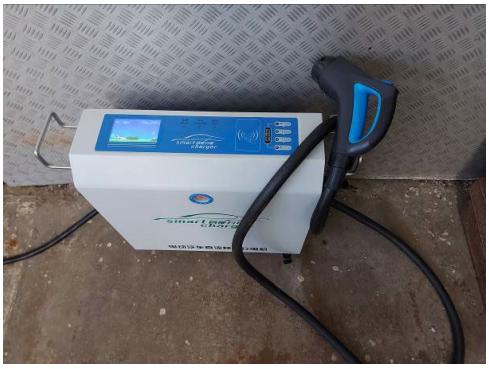
Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV and Charging Facility

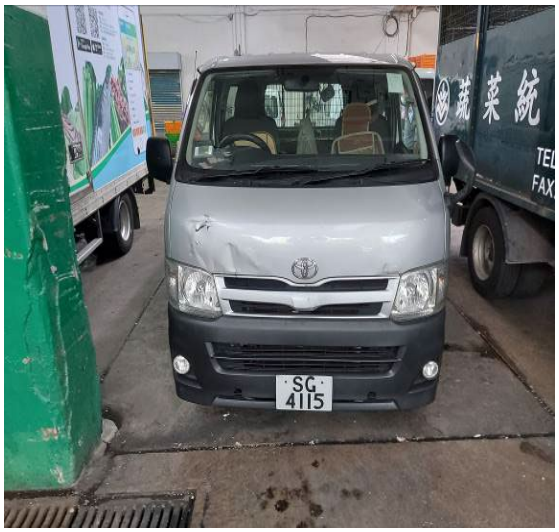
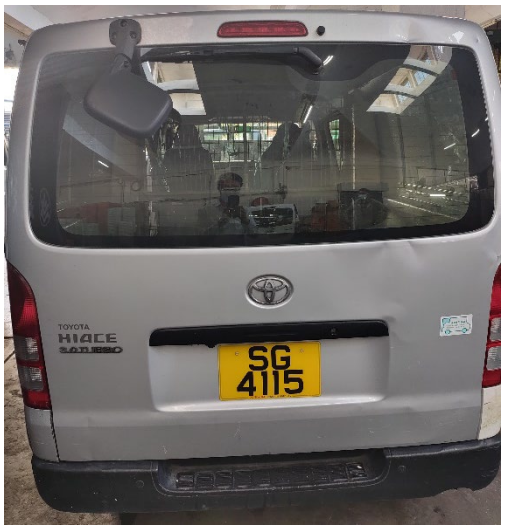
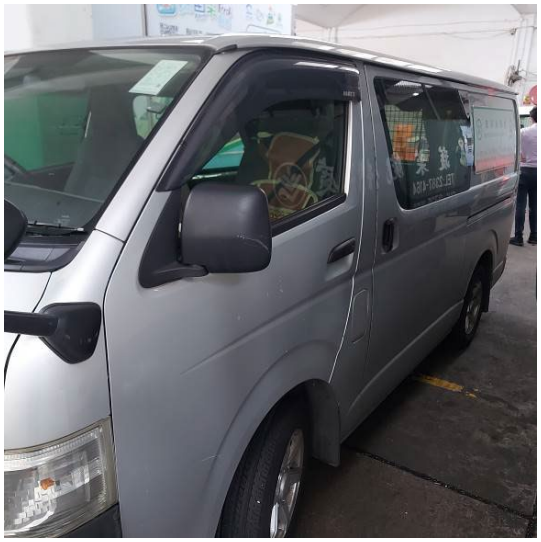
EV (WN7973)

	
EV – front view	EV – rear view
	
EV – right side view	EV – left side view

Charging Facility

	
30 kW DC charging facility	

2. Diesel Vehicle (DV) for Comparison

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