

Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicle for
Moving Services
(Elephant Motors Company Limited)

(13 May 2021)

PREPARED BY:
Dr. C. Ng

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

List of Monitoring and Evaluation Team Members

Prof. C.S. CHEUNG (Team Leader)

Department of Mechanical Engineering
The Hong Kong Polytechnic University

Dr. C. NG

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

Dr. David Yuen

PolyU Technology and Consultancy Company Limited
The Hong Kong Polytechnic University

**Pilot Green Transport Fund
Trial of Electric Light Goods Vehicle for Moving Services
(Elephant Motors Company Limited)**

**Final Report
(Trial Period: 1 February 2019 – 31 January 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. Elephant Motors Company Limited (Elephant) was approved under the Fund for trial of one electric light goods vehicle. Through the tendering procedures stipulated in the Subsidy Agreement signed with the Government, Elephant procured one Joylong EW4 electric light goods vehicle (EV) for trial.

1.2 PolyU Technology and Consultancy Company Limited 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 vehicle. Elephant assigned a diesel light goods vehicle providing the same services as the conventional counterpart 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.

2. Trial and Conventional Vehicles

2.1 The trial EV, a 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. From the starting date of the trial to 10 Jul 2019, the EV contains a 73.4 kWh lithium-ion battery pack. Due to potential battery safety concerns, the EV supplier recalled the EV and the original battery pack was replaced with a new 64 kWh lithium-ion battery pack on 10 Jul 2019. A low capacity of battery pack decreased the EV travel range. According to its manufacturer, the driving range decreased from 350 km to 300 km with air-conditioning off. No designated driver was assigned for the EV. In this trial, a Mercedes Benz 116CDI diesel light goods vehicle with a cylinder capacity of 2,143 c.c. (DV) was used as the conventional counterpart for comparison with the EV. Both the EV and the DV were used mainly for providing moving services in the New Territories and Kowloon.

2.2 Elephant has installed a 30 kW, 3-phase DC charger at their own carpark in San Tin. Key features of the EV, DC charger and DV are presented in Appendix 1 and their photos are shown in Appendix 2.

3. Trial Information

3.1 The trial commenced on 1 February 2019 and lasted for 24 months. Elephant 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. Similar set of data of the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Elephant 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.

Table 1: Key operation statistics of each vehicle (1 February 2019 – 31 January 2021)

	EV	DV	
Total distance traveled (km)	18,197	18,183	
Average daily distance travelled (km/day)	31	31	
Average fuel economy	(km/kWh)	3.75	-
	(km/litre)	-	9.69
	(km/MJ)	1.04	0.27 ^[1]
Average fuel cost (HK\$/km)	0.32 ^[2]	1.49 ^[3]	
Average total operating cost per km (HK\$/km)	0.47	1.60	
Downtime (working day) ^[4]	3	3	

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

^[2] Electricity cost is based on HK\$1.177/kWh for 2019 and HK\$1.218/kWh for 2020 and 2021

^[3] The market fuel price was used for calculation.

^[4] 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 distance traveled and the average daily distance traveled of the EV were 18,197 km and 31 km/day, respectively while those of the DV were 18,183 km and 31 km/day, respectively. The average fuel cost of the EV was HK\$1.17/km (i.e. about 79%) lower than that of the DV. The average total operating cost of the EV was HK\$1.13/km (i.e. about 71%) lower than that of the DV taking into account the maintenance required.

4.3 There were 587 working days in the 24 months of the trial. Both the EV and DV had 3-day downtime, the utilization rates of both the EV and DV were 99.5%.

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 narrowly from 3.59 to 3.96 km/kWh. There is a slightly drop in fuel economy of the EV over the trial period, but the variation is narrow that deterioration in fuel economy is insignificant.

4.5 The equivalent carbon dioxide (CO₂e) emissions from the EV and DV were 2,148 kg and 5,205 kg, respectively and hence the EV emitted 3,057 kg CO₂e (about 59%) less than the DV in the trial.

5. Summary

5.1 During the 24 months of the trial, the average daily mileages of the EV and the DV were same, around 31 km. The average fuel cost of the EV was HK\$1.17/km (i.e. about 79%) lower than that of the DV while the average total operating cost of the EV was HK\$1.13/km (i.e. about 71%) lower than that of the DV. The utilization rates of both the EV and DV were 99.5%.

5.2 The fuel cost of the EV was significantly lower than that of the DV. The 12-month moving average fuel economy of the EV varied narrowly from 3.59 to 3.96 km/kWh. There is no indication that the fuel economy of the EV has deteriorated according to the trial results.

5.3 The CO₂e emission from the EV was 2,148 kg while that from the DV was 5,205 kg. There was about 59% decrease in CO₂e emission by using the EV.

5.4 The operation of the EV was smooth. The drivers of the EV had no problem in operating the vehicle and was satisfied with its performance. The subsidy recipient, Elephant, was also satisfied with the performance of the EV.

Appendix 1: Key Features of Vehicles and Charging Facility Involved in the Trial

1. Trial EV and Charging Facility

(a) EV

	1-Feb to 10-Jul-2019	On or After 11-Jul-2019
Registration mark:	JE778	JE778
Make:	Joylong	Joylong
Model:	EW4	EW4
Class:	Light goods vehicle	Light goods vehicle
Gross vehicle weight:	3,700 kg	3,700 kg
Seating capacity:	driver + 5 passengers	driver + 5 passengers
Rated power:	50 kW	50 kW
Travel range ^[1] :	350 km (air conditioning off)	300 km (air conditioning off)
Maximum speed:	100 km/h	100 km/h
Battery material:	lithium-ion	lithium-ion
Battery capacity ^[1] :	73.4 kWh	64 kWh
Year of manufacture:	2018	2018

^[1] On 10th July 2019, the EV has been recalled by the supplier for battery replacement due to the potential battery safety concerns. The original 73.4 kWh Li-ion battery pack was replaced by a 64 kWh Li-ion battery pack.

(b) Charging Facility

Make:	Inovance
Model:	IDCH-T030AM
Power:	30 kW, 3-phase DC
Charging standard:	GB mode
Weight:	99 kg
Year of manufacture:	2018

2. DV Used for Comparison

Registration mark:	JP109
Make:	Mercedes Benz
Model:	116CDI
Class:	Light goods vehicle
Gross vehicle weight:	3,050 kg
Seating capacity:	driver + 4 passengers
Cylinder capacity:	2,143 cc
Year of manufacture:	2013

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV (JE778) and Charging Facility



Front view of EV



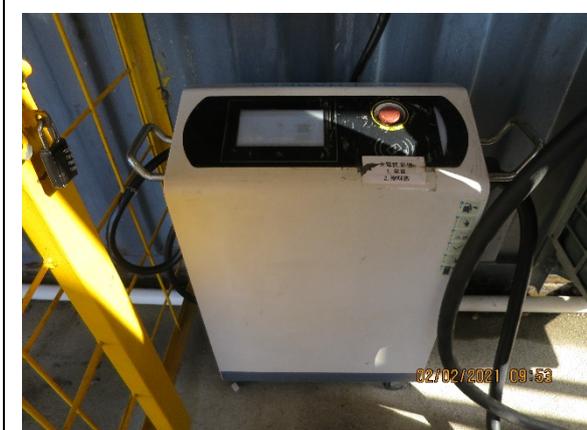
Rear view of EV



Left side view of EV



Right side view of EV



30 kW, 3-phase DC charger

2. DV (JP109) for Comparison



Front view of DV



Rear view of DV



Left side view of DV



Right side view of DV