

Pilot Green Transport Fund

Final Report On
Trial of Electric Light Goods Vehicle
for Retail and Wholesale Industry
(Kau Kee Hong Kong Limited)

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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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Trial of Electric Light Goods Vehicle for Retail and Wholesale Industry
(Kau Kee Hong Kong Limited)**

**Final Report
(Trial Period: 1 November 2015 – 31 October 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. Kau Kee Hong Kong Limited (Kau Kee) was approved under the Fund for trial of one electric light goods vehicle (EV) for retail and wholesale industry.

1.2 Hong Kong Institute of Vocational Education (Tsing Yi) 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. Kau Kee assigned one 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 EV in the 24 months of the trial as compared with its conventional diesel counterpart.

2. Trial Vehicles

2.1 Through the tendering procedures stipulated in the Subsidy Agreement that Kau Kee signed with the Government, Kau Kee procured one Renault Kangoo Z.E. light goods vehicle for trial.

2.2 Key features of the EV and DV are in Appendix 1 and photos of the vehicles are in Appendix 2. According to the EV's manufacturer, its maximum payload is limited to 650 kg and it has a travel range of 170 km under no load condition with its battery fully charged and air-conditioning off.

3 Trial Information

3.1 The trial started on 1 November 2015 and lasted for 24 months. Kau 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 cost and operation downtime associated with scheduled and unscheduled maintenance of the EV and the charging facility. Similar monthly data from the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Kau Kee were collected to reflect any problems of the EV.

4 Findings of Trial

4.1 Table 1 below summarizes the total operating costs of EV and DV. Average total operating cost of the EV was about HK\$0.57/km (26%) lower than the DV. The average fuel cost of the EV is HK\$1.96/km (90%) lower than the DV.

Table 1: Key operation statistics of each vehicle (November 2015 – October 2017)

		EV	DV
Total Mileage (km)		19,439	19,374
Average fuel economy	(km/kWh)	5.19	-
	(km/litre)	-	5.10
	(km/MJ)	1.44	0.14 ^[1]
Average fuel cost (HK\$/km) ^[2]		0.22	2.18
Average total operating cost (HK\$/km)		1.61 ^[5]	2.18
Downtime (working day) ^{[3][4]}		9	0

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

[2] The market fuel price was used 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.

[5] Since Kau Kee experienced problem with the property management on the installation of charging facility, the designated charging station was not installed during the reporting period. The EV was therefore required to recharge at various commercial parking spaces with charging facilities, mostly during non-working hours. The total additional cost from parking fee was HK\$16,324 (HK\$0.85/km).

4.2 In the reporting period, there were scheduled maintenance and unscheduled maintenances for the EV, leading to 7 days of operational downtime. There was no scheduled maintenance and unscheduled maintenance for DV. There were 498 working days in this reporting period, the utilization rates of EV and the DV were 98% and 100% respectively.

4.3 The driver had no problem in operating the EV and felt the EV was quiet and environmentally friendly. However, the EV driver expressed that the EV did not have sufficient power for climbing uphill. He also discovered that the energy consumption increased heavily during extremely hot or cold weather conditions, which might be due to an increase in cooling load of air-conditioning unit in summer and heating load in winter.

4.4 Kau Kee agreed that the EV provided a greener and quieter environment compared with the DV. However, the battery capacity of the EV was not sufficient for the daily travel needs. Kau Kee expected that the battery capacity of electric light goods vehicle and related technology could be improved in future. Furthermore, Kau Kee has a concern that the burden on electricity consumption of the EV would increase in case the vehicle carries too many heavy objects, which may bring about the risk of insufficient battery power for completing the journey.

4.5 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the EV's fuel economy. The fuel economy varied from 4.94 to 5.43 km/kWh for EV. It can be observed that the fuel economy of EV had a steady fall during the trial period. During the 24-month trial period, the variation in fuel economy of the EV is significant and hence there was an indication that the fuel economy and the batteries charge capacity had deteriorated during the trial period.

4.6 The carbon dioxide equivalent (CO_{2e}) emissions from the EV and the DV were 1,979 kg, and 10,567 kg respectively, and hence there is an emission reduction of 8,588 kg CO_{2e}, which is about 81% reduction, in the trial.

4.7 Since Kau Kee experienced problem with the property management on the installation of charging facility, the designated charging station was not installed during the reporting period. Kau Kee installed its designated charging facility after the completion of the trial on the EV, trial of the charging facility commenced from January 2018 to December 2019. No major maintenance was required during its 24-month trial period. Key features and photos of the charging facility are shown in Appendixes 1 and 2 respectively.

5 Summary

5.1 The driver had no problem in operating the EV. However, the driver expressed that the EV did not have sufficient power for climbing uphill. He also discovered that the energy consumption increased heavily during extremely hot or cold weather conditions, which might be due to an increase in cooling load of air-conditioning unit in summer and heating load in winter.

5.2 The trial showed that the EV had lower average fuel cost as compared with its conventional diesel counterpart, with a saving of HK\$1.96/km (90%). The average total operating cost of the EV was about HK\$0.57/km (26%) lower than that of the DV. Also, the EV had about 81% CO_{2e} emission less than the DV. The utilization rates of EV and the DV were 98% and 100% respectively.

5.3 At present, the price of EV is higher than that of its conventional counterpart, the accumulated fuel saving may not be able to offset the higher EV cost within a few years of operation. Since electric vehicle market is expanding and electric vehicle technology is improving, the price difference between electric vehicle and conventional vehicle is narrowing down and more affordable to the transport trade.

Appendix 1: Key Features of Vehicles and Charging Facility

1. Trial EV

Registration Mark	RA2668
Make:	Renault
Model:	Kangoo Z.E.
Class:	Light goods vehicle
Gross vehicle weight:	2,300 kg
Seating capacity:	Driver + 4 passengers
Rated power:	44 kW
Travel range:	170 km (air-conditioning off)
Maximum speed:	130 km/h
Battery Type:	Lithium ion
Batteries capacity:	22 kWh
Charging time:	8 hours (Max. input current 16A)
Year of manufacture:	2015

EV Charging Facility

Charging standard:	IEC62196 Type 2
Charging mode:	220V / 20A, A/C

2. DV for comparison

Registration Mark	EU1192
Make:	HINO
Model:	XZU425RHKFQD3
Class:	Light goods vehicle
Seating capacity:	Driver + 2 passengers
Gross vehicle weight:	5,500 kg
Engine capacity:	4,009 c.c.
Year of manufacture:	2007

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV and Charging Facility



EV – front view



EV – rear view



EV – left side view



EV – right side view



EV charging station

2. DV for Comparison



DV – front view



DV – rear view



DV – left side view



DV – right side view