

Pilot Green Transport Fund

Final Report

On

Trial of Electric Van for School

(Hong Kong International School Association)

(20 March 2017)

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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 Period: 1 January 2014 – 31 December 2015)

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. The Hong Kong International School Association (HKIS) was approved under the Fund for trial of one electric van-type light goods vehicle with associated charging facilities for school service. Through the tendering procedures stipulated in the Subsidy Agreement HKIS entered into with the Government, HKIS procured one Renault Kangoo Van Z.E. light goods vehicle (EV) for trial.

1.2 PolyU Technology and Consultancy Company Limited (PolyU) 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. HKIS assigned a petrol vehicle (PV) 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 as compared with its conventional petrol counterpart.

2. Trial Vehicles

2.1 Key features of the EV and the PV are shown in Appendix 1 and photos of the vehicles are shown in Appendix 2. The vehicles were used for transporting goods and mail between the Repulse Bay campus and the Tai Tam campus. Day-to-day travel for providing such service was generally less than 50 km for the EV. The EV is designed to carry 650 kg payload. According to its manufacturer, the EV has a designed travel range of 170 km per charge without air-conditioning.

2.2 HKIS had set up at the Repulse Bay campus a 13A electricity outlet to charge the batteries of the EV as well as a watt-hour meter to record the related electricity consumption. It took about 10 hours to charge the batteries from 0 to 100%. Despite of the short daily journey, the EV was charged almost every day. It was normally carried out from 15:30 to 07:30 next morning. During the trial period, the EV was stationed and charged at the Repulse Bay campus. Photos of the charging facilities are shown in Appendix 2.

3. Trial Information

3.1 The trial started on 1 January 2014 and lasted for 24 months. HKIS 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, operation downtime due to charging, and cost and downtime associated with scheduled and unscheduled maintenances of the EV and the charging facilities. Similar data from the PV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and HKIS were collected to reflect any problems of the EV.

4. Findings of Trial

4.1 Operating Costs

4.1.1 The average fuel economy and cost statistics of the EV and the PV are summarized in Table 1. The fuel cost of the EV was \$1.81/km (84%) lower than the PV.

Table 1: Key operation statistics of each vehicle

		EV	PV
Total distance travelled / km		13,477	12,818
Average fuel economy /	(km/kWh)	4.25	-
	(km/litre)	-	7.31
	(km/MJ)	1.18	0.228 ^[1]
Average fuel cost /(\$/km)		0.351	2.16

^[1] Assuming lower heating value of 32 MJ/litre for petrol

4.1.2 Table 2 below summarizes the operating cost data of the EV and the PV. During the trial period, the EV had four scheduled and one unscheduled maintenances with a total of 12 days of downtime. The PV had two scheduled maintenances with 1 day of downtime. Utilization rates of the EV and the PV were 97.6% and 99.8% respectively.

Table 2: Summary of all the costs and downtime of each vehicle

	EV	PV
Fuel cost/\$	4,725	27,685
Maintenance cost/\$	10,688 ^[1]	15,290
Other cost/\$	0	0
Total operating cost/\$	15,413	42,975
Average total operating cost/(\$/km)	1.14	3.35
Downtime/working days ^[2]	12	1

^[1] No maintenance cost as the EV was still under warranty; cost was for routine inspection and service after each six months and annual examination.

^[2] Downtime refers to the period the vehicle is not in operation, which counted from the first day it stops operation till the day it is returned to the operator.

4.1.3 In the morning of 20 May 2014, the EV failed to operate after charging. The EV was returned to the local agent for repair and a high tension cable was replaced.

4.1.4 Scheduled maintenance of the EV was simpler than the PV since the latter required replacement of filters and engine oil. However, the EV had a general inspection and maintenance service for each 5,000 km or 6 months according to factory recommendation, which caused extra operating cost and downtime to the EV.

4.1.5 Apart from the fuel costs, the table also shows the average total operating costs which included maintenance costs and other indirect costs such as towing fee, vehicle replacement fee. The EV and the PV incurred only fuel and maintenance costs in this trial. The total operating cost of the EV was \$1.14/km. Compared with the PV, the total operating cost of the EV was lower by 66%, given that HKIS did not pay for the repair of the EV which was still covered by warranty.

4.2 Performance and Reliability

4.2.1 The EV driver had no problem in operating the EV and had no adverse comments on the EV.

4.2.2 Overall, HKIS agreed that using electric vehicle was good because it could provide a greener and quieter environment as well as its much lower fuel cost. Thus HKIS would consider replacing all its existing conventional vehicles with the green vehicles.

4.2.3 To remove the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the vehicles' fuel economy. For the EV, the 12-month moving average varied narrowly from 4.19 km/kWh to 4.34 km/kWh. There is no indication of fuel economy deterioration during the trial period.

4.2.4 The EV was charged normally on a daily basis and the daily charged amount was less than 10 kWh throughout the trial period, which is much below the battery capacity of 22 kWh. There is no indication that there is deterioration in the capacity of the batteries.

4.2.5 The equivalent CO₂ emissions from the EV and the PV are 2,492 kg and 5,004 kg, respectively, and hence there is a reduction of 2,512 kg (50.2%) CO₂ emission in the trial.

5. Summary

5.1 The trial showed that the EV had lower fuel cost as compared with its conventional petrol counterpart, with a saving of \$1.81/km or 84%. The total operating cost for the EV was 66% lower than the PV, given that HKIS did not pay for the repair of the EV which was still covered by warranty.

5.2 The EV driver found no problem in operating the EV. The operation of the EV was smooth despite having one unscheduled maintenance. However, the EV had a general maintenance service for each 5,000 km or 6 months according to factory recommendation, which caused extra operating cost and downtime to the EV. As a result, the EV's total downtime was 12 days in the 24-months period and its utilization rate was 97.6%. On the other hand, the PV's utilization rate was 99.8%.

5.3 The average fuel economy of all vehicles involved hardly changed during the trial. For the EV, the stable fuel economy is another indication that its battery has not deteriorated.

5.4 The trial showed that under local operating conditions where air-conditioning is essential, the Renault Kangoo Van Z.E. could meet the user's daily mileage requirements using in-house charging facilities. Moreover, the EV did not cause any problem to the driver during the trial period and was able to perform as required.

Appendix 1: Key Features of the Vehicles Involved in the Trial

1. Trial EV

Registration Mark:	SJ5673
Make:	Renault
Model:	Kangoo Van Z.E.
Class:	Light goods vehicle
Gross vehicle weight:	2.3 tonnes
Seating capacity:	driver + 4 passengers
Rated power:	44 kW max.
Travel range:	170 km [no load, no air-conditioning]
Maximum speed:	130 km/h
Battery material:	lithium-ion
Battery capacity:	22 kWh
Charging time:	10 hours [13A]
Payload:	650 kg
Year of Manufacture:	2013

2. PV used for comparison

Registration Mark:	LN6780
Make:	Ford
Model:	ECONOVAN 2.OP4.7MSRW
Class:	Light Goods Vehicle
Gross vehicle weight:	2.72 tonnes
Payload:	about 1,300 kg
Seating Capacity:	driver + 5 passengers
Cylinder capacity:	1,998 cc
Year of manufacturer:	2004

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial Electric Van (EV) and Charging Facility

	
EV – front view	EV – end view
	
EV – side view	
	
Charging station	Watt-hour meter in store room

2. Petrol Vehicle (PV) for Comparison



PV