

Pilot Green Transport Fund

Final Report On

Trial of Electric Light Goods Vehicles (Van Type)

for Pest Management Service

(BioCycle (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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(BioCycle (Hong Kong) Limited)

Final Report
(Trial Period: 1 October, 2013 – 30 September, 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 (the green innovative technology), contributing to better air quality and public health for Hong Kong. BioCycle (Hong Kong) Limited (BioCycle) was approved under the Fund for trial of two electric light goods vehicles (van-type) with the associated charging facilities for pest management service. Through the tendering procedures stipulated in the Subsidy Agreement that BioCycle entered into with the Government, BioCycle procured two Renault Kangoo Van Z.E. vehicles (EVs) for trial.

1.2 PolyU Technology and Consultancy Company Limited (PolyU) has been engaged by the Environmental Protection Department as an independent third party assessor to monitor the trials and evaluate the operational performance of trial vehicles. PolyU regularly visited BioCycle to collect information for evaluating the performance of the EVs as compared with their counterparts which provided the same service in the same areas. The information collected on a monthly basis included mileage reading before charging, amount of electricity consumed, time used in each charging and operation downtime due to charging. Maintenance records included cost and downtime associated with scheduled and unscheduled maintenance of the EVs and the charging facilities. Similar monthly data from the diesel light goods vehicles (van type) (DVs) were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers were collected to reflect any problems of the EVs.

1.3 This report summarizes the performance of the EVs in the 24-month trial as compared with their conventional counterparts.

2. Trial Vehicles

2.1 BioCycle procured two Renault Kangoo Van Z.E. vehicles (EV-1 and EV-2) and each has a gross vehicle weight (GVW) of 2,126 kg and 22 kWh battery capacity with 44 kW rated power for trial. BioCycle has set up at its Kwun Tong workshop two designated wall-mounted chargers, each equipped with a watt-hour meter, to charge the EVs with a maximum of 16A. It took about 8 hours

to fully charge the EV batteries. The EVs were only charged at the workshop. The EVs were used for providing pest management service in Hong Kong.

2.2 Two Toyota HiACE diesel light goods vehicles (van-type) (DV-1 and DV-2) of 2,982 cc cylinder capacity and 2,800 kg GVW were assigned for comparison with the two EVs.

2.3 Key features and photos of the EVs and DVs are in Appendices 1 and 2 respectively.

3. Trial Information

3.1 The trial started on 1 October 2013 and lasted for 24 months. All the EVs and DVs were stationed at BioCycle's Kwun Tong workshop. According to the routes of the EVs, day to day usage is generally less than 80 km for EV-1 and 70 km for EV-2. The pest management service only operates from 09:00 to 18:00 from Monday to Saturday, except public holidays.

4. Findings of Trial

4.1 Operating Costs

4.1.1 Table 1 below summarizes the total operating costs of the EVs and the DVs. The total operating costs of EV-1 and EV-2 were both about 67% lower than those of DV-1 and DV-2. The overall average total operating cost of the two EVs was about 67% lower than that of the DVs.

Table 1: Total operating costs (October 2013 to September 2015)

	Electric Vehicles		Diesel Vehicles	
	EV-1	EV-2	DV-1	DV-2
Fuel cost (HK\$)	5,028	6,130	63,677	68,579
Maintenance cost (HK\$) ^[1]	8,016	8,016	31,050 ^[2]	22,020
Other cost (HK\$)	0	0	0	0
Total operating cost (HK\$)	13,044	14,146	94,727	90,599
Average total operating cost (HK\$/km)	0.77	0.74	2.33	2.24
Downtime (working days) ^[3]	31	20	9	9
Average total operating cost by vehicle type (HK\$/km)	0.75		2.29	

^[1] Annual examination fee included.

^[2] Cost of maintenance due to incident not related to the performance of the vehicle were excluded in comparison.

^[3] Downtime refers to the working days that 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.

4.1.2 During the trial period, EV-1 had undergone three scheduled maintenances and seven unscheduled maintenances. Of the seven unscheduled maintenances, four were due to abnormal noise when the air conditioning system was on, one was due to car motor failure, one was due to air conditioning system failure and one was due to a charging system fault. The total cost for scheduled and unscheduled maintenances was HK\$8,016. EV-2 had undergone three scheduled maintenances and four unscheduled maintenances. One of the unscheduled maintenances was due to air conditioning system failure, one was due to a charging system fault, and the remaining two were due to abnormal noise when the air conditioning system was on. The total cost for scheduled and unscheduled maintenances was HK\$8,016. As the EVs were under warranty, the labour and parts costs were waived in unscheduled maintenances. During the 24-month trial period, the utilization rates of EV-1 and EV-2 were 95% and 97% respectively.

4.2 Performance and Reliability

4.2.1 The EV drivers found no problem in operating the EVs but opined that the EVs consumed significantly more electricity during hill-climbing and the battery capacity was limited so the daily job orders should be well planned. Furthermore, the EVs could not accelerate as quickly as the DVs. The EVs' handling was not good on winding roads either. Nonetheless, the charging frequency and average fuel economy of both EVs did not indicate any deterioration in their performance or their batteries. Overall, the drivers agreed that the EVs were greener and quieter compared with the DVs.

4.2.2 A representative of BioCycle agreed that using EVs could provide a greener and quiet environment as well as its much lower fuel cost. However, BioCycle opined that the EVs under trial had lower performance on hill-climbing; the air conditioning system is rather noisy; and the battery capacity limited the services that could be provided by the EV.

4.2.3 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the EVs' fuel economy. The fuel economy varied from 4.28 to 4.09 km/kWh (i.e., about 4% drop) for EV-1 and from 4.13 to 3.80 km/kWh (i.e., about 8% drop) for EV-2. During the 24-month trial period, there was a very slight drop in fuel economy of the EVs, but the deterioration was insignificant. Meanwhile, there was no evidence that the charging capacity of the EV batteries had decreased during the trial period.

4.2.4 The equivalent carbon dioxide (CO₂e) emissions from EV-1 and EV-2 were 2,523 kg and 3,045 kg respectively, while that from DV-1 and DV-2 were 6,198 kg and 7,542 kg respectively. Hence there is a reduction of 3,675 kg (about 59%) and 4,497 kg (about 60%) CO₂e emission for EV-1 and EV-2 in the trial. The total reduction of CO₂e emissions by using EVs is 8,172 kg.

5. Summary of Findings

5.1 The EVs were used in providing pest management services and the service areas cover Hong Kong island, Kowloon and New Territories. The daily mileage of EV-1 and EV-2 are generally less than 80 km and 70 km, respectively. The total operating costs of EV-1 and EV-2 are both 67%

lower than those of DV-1 and DV-2. The EVs had regular scheduled maintenance similar to the DVs. The EVs seldom had any failure. Out of 591 working days in the 24-month trial period, EV-1 and EV-2 had lost 31 and 20 days and the utilization rates of EV-1 and EV-2 were 95% and 97% respectively. There is a total reduction of 8,172 kg (59%) CO₂ emission by using EVs in the trial.

5.2 The EV drivers and BioCycle found no problem in operating the EVs but opined that the EVs under trial consumed significantly more electricity during hill-climbing, and the battery capacity was limited so the daily job orders should be well planned. Furthermore, the EVs could not accelerate as quickly as the DVs. The EVs' handling was not good on winding roads either. Nonetheless, the charging frequency as well as average fuel economy of both EVs did not indicate any deterioration in their performance or their batteries. Overall, the drivers agreed that the EVs were greener and quieter compared with the DVs.

5.3 During the 24-month trial period, there was a very slight drop in fuel economy of the EVs, but the deterioration was insignificant. Meanwhile, there was no evidence that the charging capacity of the EV batteries had decreased during the trial period.

Appendix 1: Key Features of Vehicles Involved in the Trials

1. EVs

EV-1

Registration Mark:	SF3108
Make:	Renault
Model:	Kangoo Van Z.E.
Class:	Light goods vehicle (van type)
Gross vehicle weight:	2,126 kg
Payload:	650 kg
Seating Capacity:	driver + 4 passengers
Rated Power:	44 kW
Travel range:	170 km (on flat road and air-conditioning off)
Maximum speed:	130 km/h
Battery material:	Lithium ion
Batteries capacity:	22 kWh
Charging time:	Approx. 8 hours [max. 16 A]
Year of manufacture:	2013

EV-2

Registration Mark:	SF4487
Make:	Renault
Model:	Kangoo Van Z.E.
Class:	Light goods vehicle (van type)
Gross vehicle weight:	2,126 kg
Payload:	650 kg
Seating Capacity:	driver + 4 passengers
Rated Power:	44 kW
Travel range:	170 km (on flat road and air-conditioning off)
Maximum speed:	130 km/h
Battery material:	Lithium ion
Batteries capacity:	22 kWh
Charging time:	Approx. 8 hours [max. 16 A]
Year of manufacture:	2013

EV Charging Facility

Charging standard:	IEC62196 Type 2
Charging mode:	220V / 32A, AC
Charging power:	7.04kW

2. DVs used for comparison

DV-1

Registration Mark:

MX6440

Make:

Toyota

Model:

HiACE KDH201RSSMDY

Class:

Light goods vehicle (van type)

Cylinder capacity:

Diesel 2982 c.c.

Seating Capacity:

driver + 4 passengers

Gross vehicle weight:

2,800 kg

Payload:

1,400 kg

Year of manufacture:

2007

DV-2

Registration Mark:

MV7897

Make:

Toyota

Model:

HiACE KDH201RSSMDY

Class:

Light goods vehicle (van type)

Cylinder capacity:

Diesel 2982 c.c.

Seating Capacity:

driver + 4 passengers

Gross vehicle weight:

2,800 kg

Payload:

1,400 kg

Year of manufacture:

2007

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial EVs and Charging Facilities

	
EV-1 front view	EV-1 rear view
	
EV-1 right side view	EV-1 left side view
	
EV-1 charger	



EV-2 front view



EV-2 rear view



EV-2 left side view



EV-2 right side view



EV-2 charger



Watt-hour meters: A for EV-1; B for EV-2

2. Diesel Vehicles for Comparison

	
DV-1	DV-2