

# **Pilot Green Transport Fund**

## **Final Report On Trial of Electric Light Goods Vehicle for Engineering Industry (CM Geotechnics Limited)**

(6 August 2020)

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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.

## **List of Monitoring and Evaluation Team Members**

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# **Pilot Green Transport Fund**

## **Trial of Electric Light Goods Vehicle for Civil Engineering Industry (CM Geotechnics Limited)**

### **Final Report (Trial Period: 1 April 2014 – 31 March 2016)**

#### **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. CM Geotechnics Limited (CMG) was approved under the Fund for trial of one electric light goods vehicle for transporting document, tools and staff for construction projects around the New Territories. Through the tendering procedures stipulated in the Subsidy Agreement, CMG procured one Renault Kangoo Z.E. light goods vehicle (EV) for trial.

1.2 The 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. CMG assigned one diesel light good vehicle providing the same type of service as the conventional vehicle for comparing with the EV.

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 CMG procured one Renault Kangoo Z.E. light goods vehicle (namely the EV) which has a gross vehicle weight (GVW) of 2,300 kg and a maximum payload of 650 kg. It has a travel range of 170 km with its batteries fully charged and air-conditioning off. The EV was used to transport document, staff and tools for construction projects around the New Territories.

2.2 CMG assigned a Hyundai H1 diesel light goods vehicle (namely the DV) with a GVW of 3,200 kg for comparison with the EV in the trial.

2.3 Key features of the EV, the DV and the charging facility are shown in Appendix 1 and their photos are shown in Appendix 2.

##### **3. Trial Information**

3.1 The trial started on 1 April 2014 and lasted for 24 months. CMG 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 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 driver and CMG were collected to reflect any problems of the EV.

## 4. Findings of Trial

4.1 Table 1 summarises the key operation statistics of the EV and the DV. The average fuel cost of the EV was HK\$1.34/km (about 84%) lower than that of the DV. The average total operating cost of the EV was HK\$1.24/km (about 78%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle (April 2014 – March 2016)

		EV	DV
Total distance travelled (km)		27,257	42,521
Average fuel economy	(km/kWh)	4.44	-
	(km/litre)	-	7.57
	(km/MJ)	1.23	0.21 <sup>[1]</sup>
Average fuel cost (HK\$/km) <sup>[2]</sup>		0.25	1.59
Average total operating cost (HK\$/km)		0.35	1.59
Downtime (working day) <sup>[3] [4]</sup>		11	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.

4.2 During the trial, the EV had 11 days of operation downtime and the DV had no operation downtime, thus the utilization rates of the EV and the DV were 98.1% and 100% respectively.

4.3 The driver expressed the view that the driving habit would be one of the factors which needed to be overcome when operating the EV. He felt that the EV was lacking driving power while going uphill with full load. He feared that it might be a serious problem if the vehicle stalled. The driver also thought that the slow response time of gear shifting for the EV could also increase the risk of a traffic accident occurring if the vehicle could not switch lanes at a sufficient speed.

4.4 CMG agreed that, in general, using the electric vehicle was good because it provided a greener and quieter environment compared with the diesel vehicle. The performance of the EV could meet their expectation on fuel cost saving and the operational requirements. However, CMG expressed that a sufficient number of public charging stations should be provided in proper locations to support opportunity charging. In addition, the price of the EV should be decreased and the travel range of the EV should be increased.

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 12-month moving average fuel economy of the EV varied from 4.21 to 4.56 km/kWh (i.e. about 8% variation). The variation in results over this duration are not significant. The monthly figures follow a reasonable pattern between summer and winter. The variation observed is also related to changing utilisation patterns as CMG's experience in operating the vehicle increases. Furthermore, in this case, CMG chose to utilise the vehicle less in the second half of the trial. In doing so, the type of driving it was regularly used for changed, which in turn impacts the observed fuel economy. Monthly distance travelled was up to 2/3 lower for 10 of the last 12 months, i.e. shorter distance travelled and more stop/start driving will impact/increase fuel consumption. Thus, it was considered that there was no significant deterioration of the battery charge capacity of the EV during the trial period.

4.6 Based on the total distance travelled by the EV in the trial, the carbon dioxide equivalent (CO<sub>2</sub>e) emissions from the EV and the DV were 3,627 kg and 9,984 kg, respectively. Hence the total CO<sub>2</sub>e emission reduction was 6,356 kg (about 64%) by using the EV in this trial.

## 5. Summary

5.1 The EV driver was able to adapt to operating the EV. With planning, the EV was able to cope with its assigned duties for supporting the daily work. However, he was not satisfied with the performance of the EV. From the view of CMG, the performance of the EV could meet their expectation on fuel cost saving and the operational requirements.

5.2 During the 24 months of the trial, the average fuel cost of the EV was about 84% (i.e. HK\$1.34/km) lower than that of the DV, while the average operating cost of the EV was about 78% (i.e. HK\$1.24/km) lower than that of the DV taking the maintenance costs into account. The usage of the EV was on the lower side as reflected by the difference in the total mileage travelled between the EV (27,257 km) and the DV (42,521 km) in the 24 months of trial.

5.3 During the trial, the EV had 11 days of operation downtime and the DV had no operation downtime, thus the utilization rates of the EV and the DV were 98.1% and 100% respectively. There is a reduction of about 6,356 kg CO<sub>2</sub>e emission (which is about 64% reduction) by using the EV in the trial.

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

### 1. Trial EV and Charging Facility

#### (a) Trial EV

<b>Registration Mark</b>	<b>SL 1382 (registered as SP 1709 before October 2015 – same vehicle)</b>
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, no load)
Maximum speed:	130 km/h
Battery material:	Lithium ion
Batteries capacity:	22 kWh
Charging time:	8 hours
Payload:	650 kg
Year of manufacture:	2013

#### (b) Charging Facility







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

### 2. DV used for comparison

<b>Registration Mark</b>	<b>MN 7306</b>
Make:	HYUNDAI
Model:	H1 VAN Standard
Class:	Light goods vehicle
Seating capacity:	driver + 1 passenger
Gross vehicle weight:	3,200 kg
Engine capacity:	2,497 c.c.
Year of manufacture:	2013

## Appendix 2: Photos of Vehicles and Charging Facility

### 1. Trial EV and Charging Facility

	
EV - front view	EV - rear view
	
EV – right side view	EV – left side view
	
Charger at the EV owner's office	Watt-hour meter for the charger

**2. DV for Comparison**



DV front view



DV rear view



DV right side view



DV left side view