Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicle for Civil Engineering Industry
(Cinpek Engineering Limited)

(15 February 2021)

PREPARED BY:
Dr. C.S. Cheung

List of Monitoring and Evaluation Team Members

Dr. C.S. Cheung (Team Leader)
Department of Mechanical Engineering
The Hong Kong Polytechnic University

Dr. W.C. Lo (Deputy Team Leader)
Department of Electrical Engineering
The Hong Kong Polytechnic University

Ir Dr. C. NG
Department of Mechanical 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 Civil Engineering Industry
(Cinpek Engineering Limited)

Final Report
(Reporting Period: 1 September 2019 – 31 August 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. Cinpek Engineering Limited (Cinpek) was approved under the Fund for trial of one electric light goods vehicle for civil engineering industry. Cinpek, through the tendering procedures stipulated in the Agreement entered into with the Government, procured a Nissan e-NV200 electric light goods vehicle (EV) for trial. According to the manufacturer, the EV has a travel range of 317 km with its battery fully charged and air-conditioning off.

1.2 PolyU Technology and Consultancy Company Limited 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. Cinpek originally assigned a Toyota diesel light goods vehicle with a gross vehicle weight (GVW) of 2,800 kg and 2,494 c.c. engine and provided similar service as the conventional counterpart for comparison. However, it was scrapped in October 2019. A Mercedes Benz diesel light goods vehicle (DV) with a GVW of 3,050 kg and 2,142 c.c. engine, providing the same service, was assigned to replace the Toyota one since November 2019.

1.3 This Final Report summarizes the performance of the EV in the 24 months of the trial as compared with its conventional counterpart i.e. the DV.

2. Trial and Conventional Vehicles

2.1 Key features of the EV, the charging facility and the DV are in Appendix 1 and photos of the vehicles and the charging facility are in Appendix 2. The EV was used for the delivery of tools and parts for civil engineering industry to various construction sites on the Hong Kong Island and in Kowloon and the New Territories.

2.2 Cinpek installed a 7kW AC charging facility for the EV. The charging facility was installed inside a car-park in Clear Water Bay, Sai Kung for charging and recording the amount of electricity charged. The EV was not charged every day due to the low travel distance involved each day. In the first few months of the trial, the EV was also charged at a construction site in Wan Chai. The amount of electricity charged while charging at the construction site was based on the meter readings on the dashboard of the EV.

3. Trial Information

3.1 The trial commenced on 1 September 2019 and lasted for 24 months. Cinpek was required to collect and provide trial information including the EV's mileage reading at charging, amount of electricity consumed and time used in each charging, and operation downtime due to charging, cost and downtime associated with scheduled and unscheduled maintenances of the EV and the charging facility. Similar set of data of the DV was also required. In addition to the cost information, reports on maintenance work and operational difficulties and opinions of the driver and Cinpek were collected to reflect any problem of the EV.

4. Findings of Trial

4.1 The following table summarizes the statistical data of the EV and the DV. The average fuel cost of the EV was HK$0.70/km (74%) lower than that of the DV. The average total operating cost of the EV was HK$0.66/km (60%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle, 1 September 2019 – 31 August 2021

		EV	**DV**
Total distance travelled (km)		33,060	39,355
Average daily mileage (km/working day)		56	67
Average fuel economy	(km/kWh)	4.84	-
	(km/litre)	-	15.72
	(km/MJ)	1.35	0.44 [1]
Average fuel cost (HK$/km)		0.25 [2]	0.95 [3]
Average total operating cost (HK$/km)		0.44	1.10
Downtime (working day) [4]		3	4

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

[2] Electricity cost was 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 working days the vehicle is not in operation, which counted from the first day it stops operation till the day it is returned to the operator.

4.2 There were three scheduled maintenances for the EV, two unscheduled maintenances for the EV charging facility and one scheduled maintenance for the DV in the 24 months of the trial. The scheduled maintenances of the EV included one for the inspection of new vehicle as required by the EV supplier and another two for annual examinations, which incurred three days of downtime. The two unscheduled maintenances of the EV charging facility were due to the replacement of power board and inspection of charger, but no downtime nor maintenance cost was involved. The scheduled maintenance of the DV incurred four days of downtime. The utilization rates were 99.5% for the EV and 99.3% for the DV. Based on the above, the average daily mileages of the EV and the DV were 56 km/day and 67 km/day respectively.

4.3 The driver of the EV had no problem in operating the EV and was satisfied with the performance of the EV, except that the power of the EV was considered not as good as the DV on uphill driving. Cinpek agreed that using the EV is good because it can provide a greener

and quieter environment as well as EV has a lower fuel cost. Cinpek would encourage other transport operators to try out and replace the existing conventional vehicles with the electric light goods vehicles.

4.4 The fuel economy of the EV decreased slightly in the 24-month trial period. However, there was no indication of obvious deterioration in the battery capacity of the EV.

4.5 In the 24-month of the trial, the total carbon dioxide equivalent (CO_2e) emission from the EV was 2,589 kg. For comparison purpose, based on the mileage of the EV and the fuel economy of the DV, the total CO_2e emission from the DV was 5,830 kg. Hence, there was a 3,241 kg (56%) reduction of CO_2e, with the replacement of DV by EV in the trial.

5. Summary

5.1 The average fuel cost of the EV was HK$0.70/km (74%) lower than that of the DV. The average total operating cost of the EV was HK$0.66/km (60%) lower than that of the DV. The utilization rates were 99.5% for the EV and 99.3% for the DV. There was a 3,241 kg (56%) reduction of CO_2e, with the replacement of DV by EV in the trial.

5.2 Based on the 12-month moving average fuel economy, there was 13% reduction in the fuel economy of the EV in the 24 months trial. However, there was no indication that the battery charge capacity had deteriorated in the trial period.

5.3 The driver of the EV had no problem in operating the EV and was satisfied with the performance of the EV, except that the power of the EV was considered not as good as the DV on uphill driving. Cinpek agreed that using the EV is good because it can provide a greener and quieter environment as well as EV has a lower fuel cost. Cinpek would encourage other transport operators to try out and replace the existing conventional vehicles with the electric light goods vehicles.

5.4 The findings showed electric light goods vehicles are becoming more affordable and feasible to the transport trade for saving operating cost and reducing CO_2e emissions, provided that the vehicles can get easy access to charging facilities.

Appendix 1: Key Features of the Vehicles and Charging Facility

1. Trial EV and Charging Facility

(a) EV

Registration mark	**RL9700**
Make:	Nissan
Model:	e-NV200
Class:	Light goods vehicle
Gross vehicle weight:	2,250 kg
Seating capacity:	Driver + 4 passengers
Rated power:	80 kW
Travel range:	317 km (air conditioning off)
Battery material:	lithium-ion
Battery capacity:	40 kWh
Year of manufacture:	2019

(b) Charging Facility

Make:	EV Power
Model:	EVC-32NK
Output:	7kW, 220V AC / max 32A
Charging Standard:	IEC62196-2 Type 2

2. DV Used for Comparison

Registration mark	**WG7876** (September and October 2019)	**TB127** (Starting from November 2019
Make:	Toyota	Mercedes Benz
Model:	KDH200RSSPNY	116BTK
Class:	Light Goods Vehicle	Light Goods Vehicle
Seating capacity:	Driver + 5 passengers	Driver + 4 passengers
Gross vehicle weight:	2,800 kg	3,050 kg
Cylinder capacity:	2,494 c.c.	2,142 c.c.
Year of manufacture:	2005	2015

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV and Charging Facility

(a) EV

	
EV – front view	EV – end view
	
EV – right side view	EV – left side view

(b) Charging Facility

	
7kW battery charger	Watt-hour meter

2. DV for Comparison

	
DV – front view (for September and October 2019)	DV – front view (starting from November 2019)