Pilot Green Transport Fund

Final Report On
Trial of Electric Light Goods Vehicle (Van Type) for Industry Support Organization (Hong Kong Productivity Council)

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Final Report
(Trial Period: 1 April 2016 – 31 March 2018)

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. Hong Kong Productivity Council (HKPC) was approved under the Fund for trial of one electric light goods vehicle (van type) for industry support services. Through the tendering procedure stipulated in the Subsidy Agreement, HKPC procured one Nissan e-NV200 light goods vehicle (van type) (hereafter called 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 as compared with its conventional counterpart. HKPC assigned a Toyota petrol vehicle (hereafter called PV) providing the same type of services as the conventional counterpart for comparison.

1.3 This report summarises the performance of the EV in the 24-month trial as compared with its conventional counterpart, i.e. the PV.

2. Trial Vehicles

2.1 The EV is designed to carry 620 kg payload. According to its manufacturer, the EV has a designed travel range of 165 km per charge without air-conditioning. Key features and photos of the EV and the PV are shown in Appendix 1 and Appendix 2 respectively. The vehicles were used mainly for providing industry support service trips from HKPC to different parts of Kowloon and the New Territories. Day-to-day travel for providing such service was less than 100 km for the EV. Both vehicles were normally parked inside the car park of HKPC.

2.2 HKPC installed a 13-ampere standard charger and a 32-ampere charger in the HKPC car park. The EV was normally charged in the evening with the standard charger but occasionally charged with the 32-ampere charger for topping-up charging during office hours. HKPC installed a watt-hour meter for recording the electricity consumed for EV charging since 24/6/2016. Due to the low usage rate, the EV was not charged every day.

3. Trial Information

3.1 The trial started on 1 April 2016 and lasted for 24 months. HKPC was required to collect and provide trial information including the EV daily operation data and maintenance records. EV daily operation data include mileage reading before charging, amount of electricity consumed and time taken in each charging, and operation downtime due to charging. Maintenance records include cost and downtime associated with scheduled and unscheduled maintenance of the EV and the charging facilities. Similar data were also required from the PV. In addition to the cost information, reports on maintenance work and operational difficulties, and opinions of the driver 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 summarised in Table 1. The fuel cost of the EV was HK$2.43/km (91%) lower than that of the PV.

Table 1: Key operation statistics of each vehicle

		EV	**PV**
Total distance travelled (km)		11,538	35,226
Average fuel economy	(km/kWh)	4.91	-
	(km/litre)	-	5.95
	(km/MJ)	1.36	0.186 [1]
Average fuel cost (HK$/km)		0.227	2.66 [2]

[1] Assuming lower heating value of 32 MJ/litre for petrol fuel
[2] The market fuel price was used for calculation.

4.1.2 Table 2 below summarises the operating cost data of the EV and the PV. During the trial period, the EV had four scheduled maintenances and one unscheduled maintenance while the PV had five scheduled maintenances and two unscheduled maintenances. The utilization rates of both vehicle are 98%.

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

	EV	**PV**
Fuel cost (HK$)	2,615.8	93,580
Maintenance cost [1] (HK$)	8,190.6	28,830.4
Other cost	0	0
Total operating cost (HK$)	10,806.4	122,410.4
Average total operating cost (HK$/km)	0.937	3.48
Downtime [1] [2] (working days)	9	10

[1] Maintenance not related to the performance of the vehicle was not included for comparing the performance of the vehicles.

[2] Downtime refers to the working days that the vehicle was not in operation, which counted from the first day it stopped operation till the day it was returned to the operator.

4.1.3 The scheduled maintenances of the EV and PV involved scheduled inspections and annual examinations.

4.1.4 Scheduled maintenance of EV was simpler than that of PV since the PV required replacement of filters and engine oil and inspection of the engine, all of which were not required for the EV.

4.1.5 Apart from the fuel costs, the table also shows the total operating costs which included maintenance costs. The EV and the PV incurred only fuel and maintenance costs in this trial period. Compared with the PV, the average total operating cost of the EV was 73% lower.

4.2 Performance and Reliability

4.2.1 The drivers of the EV had no problem in operating the EV. They agreed that the EV emitted less pollutants but felt that the recharge could affect the operation so they only used the EV for short trips and preferred using the PV when the PV was available.

4.2.2 Overall, HKPC agreed that using EV is good because it can provide a greener and quiet environment as well as its much lower fuel cost. HKPC would consider replacing 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 EV's fuel economy. For the EV, the 12-month moving average increased initially from 4.79 km/kWh to 5.56 km/kWh and then dropped to 5.01 km/kWh, indicating that there might be deterioration in fuel economy towards the end of the trial period. However, the low

usage of the EV caused larger fluctuations in the performance of the EV. Hence, it cannot be concluded that there was deterioration in the performance of the EV during the trial period.

4.2.4 The rated capacity of the battery is 24 kWh. The EV was not charged on a daily basis and the charged amount was less than 10 kWh most of the time, which is much below the battery capacity of 24 kWh. Moreover, the average monthly mileage of the EV was less than 500 km per month. There was no indication that there was deterioration in the capacity of the batteries.

4.2.5 In the trial period, the CO_2 equivalent emissions from the EV and the PV are 1,223 kg and 5,249 kg respectively, and hence there was a reduction of 4,026 kg CO_2 equivalent emission, which is about 77%, in the trial.

5. Summary

5.1 The trial showed that the EV had lower average fuel cost as compared with its conventional diesel counterpart, with a saving of HK$2.43/km or 91%. The average total operating cost for the EV was 73% lower than that of the PV.

5.2 The EV driver had no problem in operating the EV for short trips, and the operation of the EV was smooth. In the trial period, the EV involved only four scheduled maintenances and one unscheduled maintenance, with utilization rate of 98% which is the same as that of the PV. However, the usage of the EV was on the low side as reflected by the difference in the total mileage travelled between the EV (11,538 km, i.e. 23 km on average per working day) and the PV (35,226 km, i.e. 71 km on average per working day) in the 24 months of trial.

5.3 The 12-month moving average indicates that there might be deterioration in fuel economy towards the end of the trial period. However, the low usage of the EV caused larger fluctuations in the performance of the EV. Hence, it cannot be concluded that there was deterioration in the performance of the EV during the trial period. Also, there was no indicating of deterioration in the charge capacity of the batteries.

5.4 The trial showed that under local operating conditions where air-conditioning is essential, the Nissan e-NV200 light goods vehicle (van type) 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 and Charging Facilities

1. Trial EV

Registration mark:	**TY4645**
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:	165 km (air conditioning off)
Maximum speed:	over 120 km/h
Battery material:	lithium-ion
Battery capacity:	24 kWh
Payload load:	620 kg
Year of manufacture:	2015

2. Charging Facilities

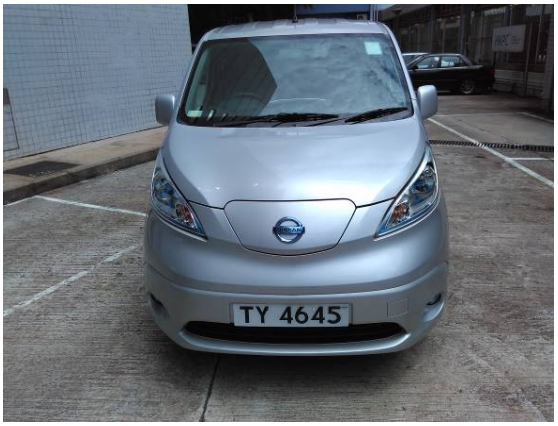
Charging power:	21 kW (max), 3-phase, 32A
Charging outlet standard:	IEC 62196

3. PV Used for Comparison

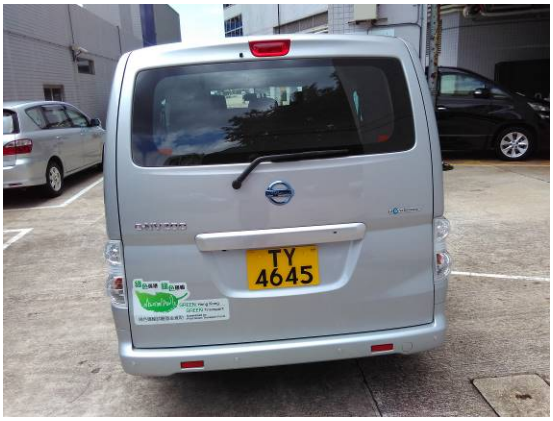
Registration mark:	**SR4452**
Make:	Toyota
Model:	VELLFIRE
Seating Capacity:	driver + 6 passengers
Cylinder capacity:	3,456 cc
Year of manufacture:	2014

Appendix 2: Photos of Vehicles and Charging Facilities

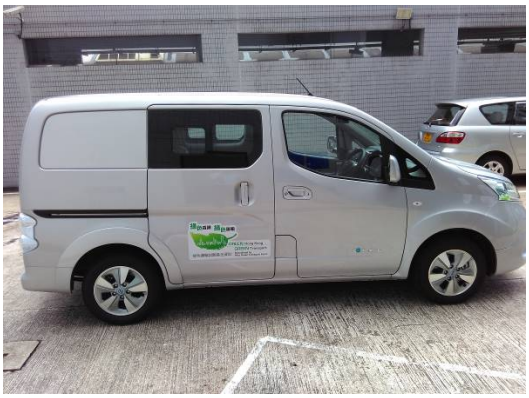
1. Trial EV



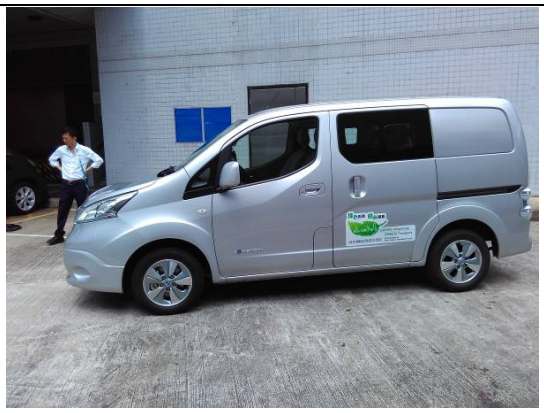
EV – front view



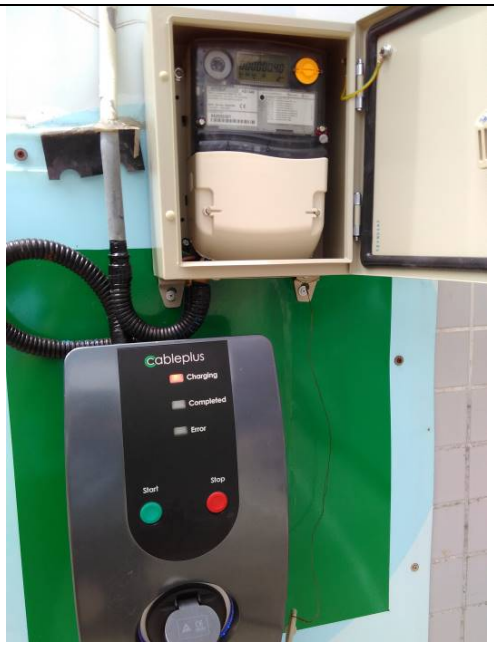
EV – end view



EV – side view 1

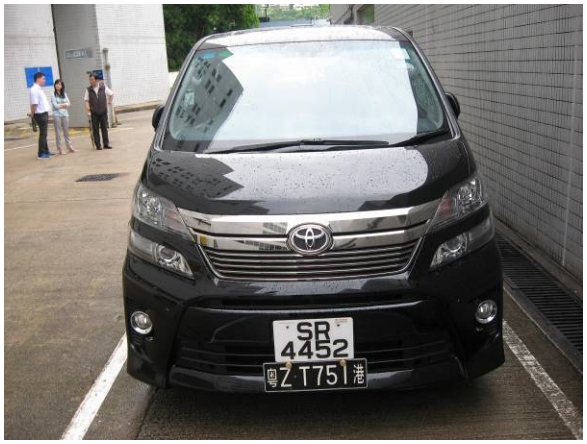


EV – side view 2



EV charger with watt-hour meter

2. Petrol Vehicle (PV) for Comparison



PV – front view