Pilot Green Transport Fund

Final Report On
Trial of Electric Light Goods Vehicles
for Logistics Service II
(LF Logistics (Hong Kong) Limited)

(17 December 2019)

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Final Report
(Trial Period: 1 May 2017 – 30 April 2019)

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. LF Logistics (Hong Kong) Limited (LF Logistics) was approved under the Fund for trial of two electric light goods vehicles, with the associated charging facilities, for logistics service. LF Logistics, through the tendering procedures stipulated in the Subsidy Agreement entered into with the Government, procured two Nissan e-NV200 electric light goods vehicles (EVs) for trial.

1.2 PolyU Technology and Consultancy Company Limited (PTeC) 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 vehicles as compared with their counterparts. LF Logistics assigned two Ford diesel light goods vehicles (DVs) as the conventional counterparts for comparison. Each DV had a 2,198 c.c. engine and provided similar service as the EVs.

1.3 This Final Report summarizes the results of comparison between the performance of the EVs and the DVs in the 24 months of the trial.

2. Trial Vehicles

2.1 According to the manufacturer, the EV has a travel range of 165 km with its battery fully charged and air-conditioning off. It is designed to carry 620 kg payload. Key features of the EVs, the charging facilities and the DVs are in Appendix 1 and photos of the vehicles and the charging facilities are in Appendix 2. The EVs were used mainly for logistics service from the Yuen Long depot to Tsuen Wan, Kwai Chung, Shatin and Yuen Long.

2.2 LF Logistics has installed a 32-ampere charger for charging and recording the amount of electricity charged for each EV. The EVs were normally charged overnight. Due to the low utilization of the EVs, they were charged only when required.

3. Trial Information

3.1 The trial commenced on 1 May 2017 and lasted for 24 months. LF Logistics was required to collect and provide trial information including the EVs' mileage reading before charging, amount of electricity consumed in each charging, charging time and operation downtime due to charging,

cost and downtime associated with scheduled and unscheduled maintenance of the EVs and the charging facilities. Similar data of the 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.

4. Findings of Trial

4.1 Operating Costs

4.1.1 The fuel economies and cost statistics of the EVs and the DVs are summarized in Table 1. The fleet average fuel cost of the EVs was HK$1.10/km (84%) lower than that of the DVs.

Table 1: Key operation statistics of each vehicle, 1 May 2017 – 30 April 2019

		EV-1	**EV-2**	**DV-1**	**DV-2**
Total distance travelled (km)		22,275	26,972	126,771	97,441
Average daily distance travelled (km/day)		40.5	47.2	218.9	183.5
Average fuel economy	(km/kWh)	5.40	5.55	-	-
	(km/litre)	-	-	10.54	9.54
	(km/MJ)	1.50	1.54	0.29[1]	0.26[1]
Average fuel cost (HK$/km)		0.21[2]	0.21[2]	1.26[3]	1.37[3]
Average total operating cost (HK$/km)		0.58	0.51	1.59	2.77
Downtime[4][5] (working days)		42	21	13	61
Fleet average fuel cost (HK$/km)		0.21		1.31	
Fleet average total operating cost/ (HK$/km)		0.55		2.18	

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

[2] Electricity bills not provided, electricity cost is based on HK$1.13/kWh for 2017, HK$1.154/kWh for Jan - Sept 2018 and HK$1.177/kWh for Oct 2018 – Apr 2019

[3] Market fuel price was used for calculation

[4] Downtime refers to the working days that the vehicle is not in operation, It is counted from the first day it stops operation till the day it is returned to the operator.

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

4.1.2 Apart from the fuel cost, maintenance cost and other indirect costs, which may include parking fee, towing fee, vehicle replacement fee and cost of operation downtime due to charging and maintenance of the EVs, are also included in Table 1. The fleet average total operating cost of the EVs was HK$1.63/km (75%) lower than that of the DVs.

4.1.3 During the trial period, EV-1 had two scheduled and four unscheduled maintenances which incurred 42 days downtime. EV-2 had two scheduled and two unscheduled maintenances which incurred 21 days downtime. DV-1 had four scheduled and one unscheduled maintenances, with 13 days downtime. DV-2 had four scheduled and two unscheduled maintenances, with 61 days downtime. The scheduled maintenance of each EV was for annual inspection and general maintenance service. The unscheduled maintenances of EV-1 included checking for poor battery conditions and repair of air conditioning system. The unscheduled maintenance of EV-2 included replacing the gear shift console which was not working properly. In addition, both EVs increased their seating capacity from two to five in October 2017. The scheduled maintenance of each DV was for annual inspection and general maintenance service, including the change of engine oil and oil filters. The unscheduled maintenance of DV-1 was for the renewal of crankshaft pulley system while the unscheduled maintenance of DV-2 was for repair of the air conditioning system and replacement of the damaged engine and related parts.

4.1.4 The scheduled maintenance of the EVs was simpler than that of the DVs since the DVs required replacement of filters and engine oil and passing the smoke test, all of which were not required for the EVs.

4.1.5 During the trial period, the downtimes were 42, 21, 13 and 61 days for EV-1, EV-2, DV-1 and DV-2 respectively. There were 592 working days in the trial period, thus, the utilization rates were about 93% for EV-1, 97% for EV-2, 98% for DV-1 and 90% for DV-2.

4.2 Performance and Reliability

4.2.1 In the 24 months of the trial, the total mileage and the average daily mileage were 22,275 km and 40.5 km/day respectively for EV-1; 26,972 km and 47.2 km/day respectively for EV-2; 126,771 km and 218.9 km/day respectively for DV-1 and 97,441 km and 183.5 km/day respectively for DV-2.

4.2.2 The EV drivers had no problem in operating the EVs and were satisfied with their performance except that the power of the EVs was not good on uphill operation. Moreover, there was concern on the low travel range of the EVs.

4.2.3 Overall, LF Logistics agreed that using electric vehicle is good because it can provide a greener and quiet environment as well as its much lower fuel cost. However, the travel range of the trial EVs cannot meet their operational requirements. LF Logistics would not replace their existing conventional vehicles with electrical vehicles.

4.2.4 To remove the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the EVs' fuel economy in this report. The 12-month moving average fuel economy dropped from 5.62 to about 5.10 km/kWh for EV-1 but increased from 5.37 to 5.75 kWh for EV-2. There was deterioration in the fuel economy of EV-1 but no deterioration in the fuel economy of EV-2 in the 24-month trial period.

4.2.5 The rated capacity of the battery is 24 kWh. During the last few months of the trial period, the charged amount could still approach 24 kWh, indicating that there was no deterioration in the charge capacity of the batteries during the trial period.

4.2.6 The CO_2 equivalent (CO_2e) emissions from the EVs and the DVs were 4,584 kg and 13,697 kg, respectively. Compared with the DV, there was a total reduction of 9,113 kg CO_2e emission (i.e., around 67%) by using EV during the trial period.

5. Summary

5.1 The trial results showed that the EVs had lower fuel cost as compared with their conventional diesel counterparts, with a saving of HK$1.10/km or 84%. The average total operating cost for the EVs was also HK$1.63/km (75%) lower than that of the DVs.

5.2 The EV drivers found no problem in operating the EVs. The operation of the EVs was smooth for short trips. In the trial period, utilization rates were about 93% for EV-1 and 97% for EV-2.

5.3 The 12-month moving average fuel economy dropped from 5.62 to about 5.10 km/kWh for EV-1 but increased from 5.37 to 5.75 kWh for EV-2, indicating deterioration in the fuel economy of EV-1 but no deterioration in the fuel economy of EV-2. Also, there was no indication of deterioration in the charge capacity of the batteries.

5.4 The trial results showed that under local operating conditions where air-conditioning is essential, the Nissan e-NV200 e-LGVs could meet LF Logistics' daily mileage requirements for short trips. Moreover, the EVs did not cause any problem to the driver during the trial period and was able to perform as required for short trips.

Appendix 1: Key Features of the Vehicles and Charging Facilities

1. Trial EVs

Registration mark	**UG6662 (EV-1), UG8266 (EV-2)**
Make:	Nissan
Model:	e-NV200
Class:	Light goods vehicle
Gross vehicle weight:	2,250 kg
Seating capacity:	driver + 1 passenger [changed to 1 driver + 4 passengers since Oct 2017]
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. DV Used for Comparison

Registration mark	**SY5470 (DV-1)**	**TC3918 (DV-2)**
Make:	Ford	Ford
Model:	Transit 2.2D LW LR B	Transit 2.2D LW LR B
Class:	Light Goods Vehicle (van Type)	Light Goods Vehicle (van type)
Seating capacity:	driver + 5 passengers	driver + 2 passengers
Gross vehicle weight:	3,330 kg	3,330 kg
Cylinder capacity:	2,198 cc	2,198 cc
Year of manufacture:	2014	2014

3. Charging Facilities

Maker:	evMega
Model:	EVB-200
Output:	380VAC / 32A
Charging Standard:	IEC62196

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial EVs

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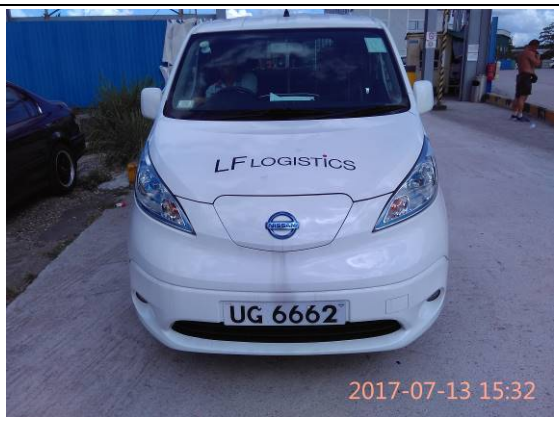
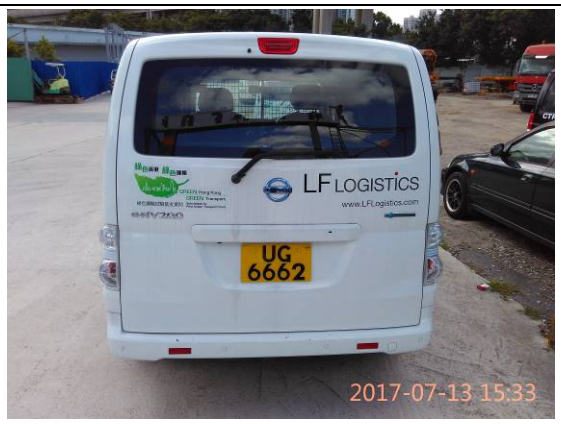
<tr><td> 
</td><td> 
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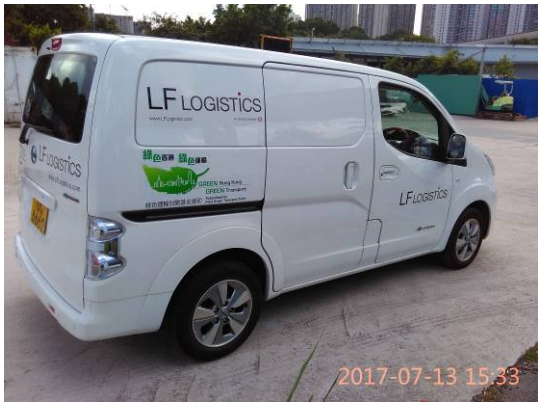
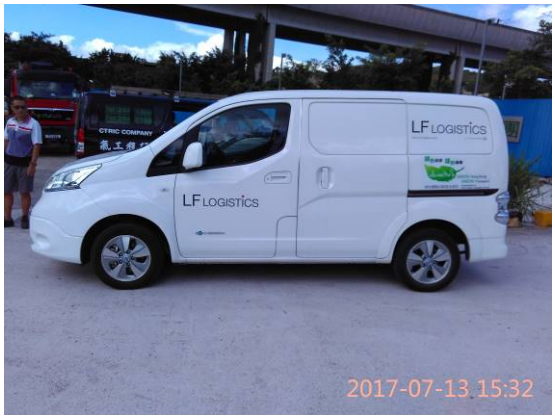
<tr><td>EV-1 (UG6662) – front view</td><td>EV-1 – rear view</td></tr>
<tr><td> 
</td><td> 
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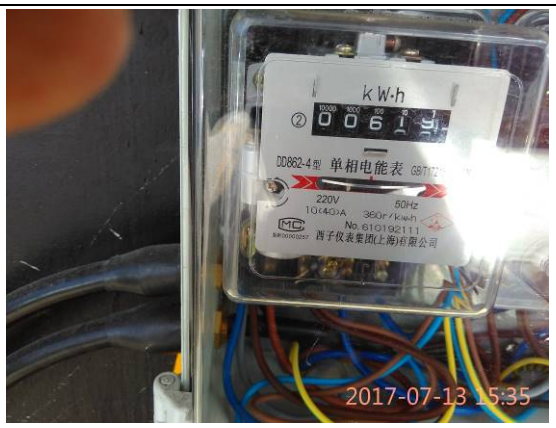
<tr><td> 
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<tr><td>EV-1 – watt-hour meter</td><td></td></tr>
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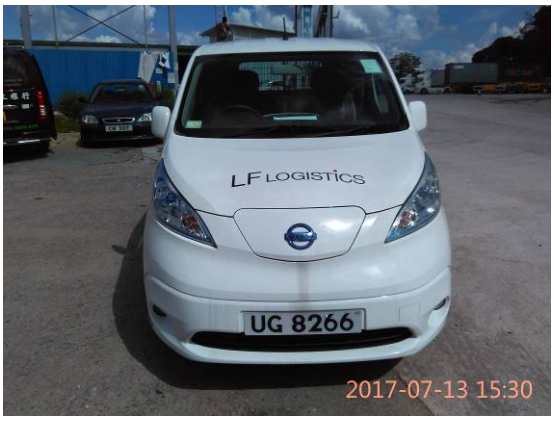
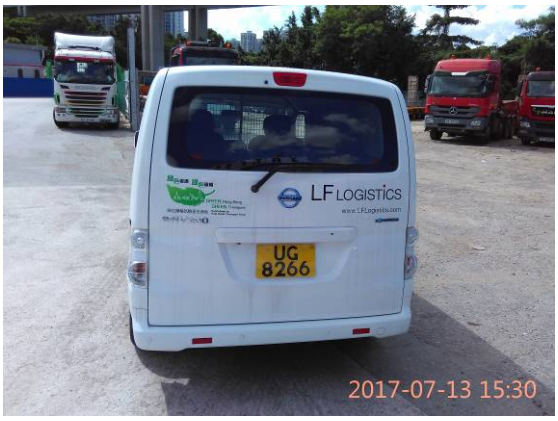
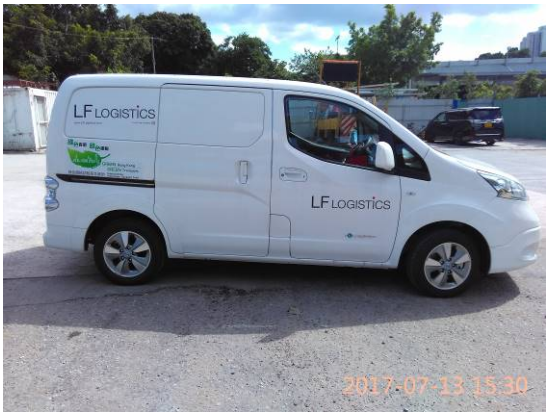
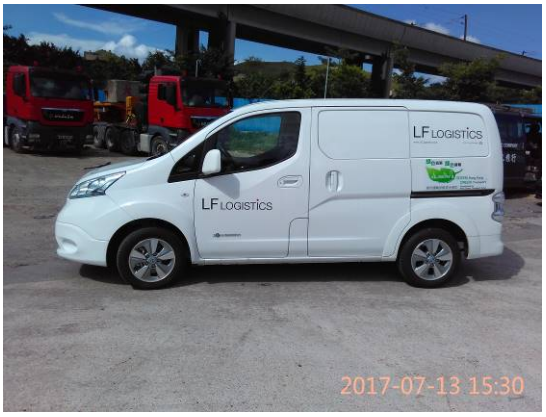
	
EV-2 (UG8266) – front view	EV-2 – rear view
	
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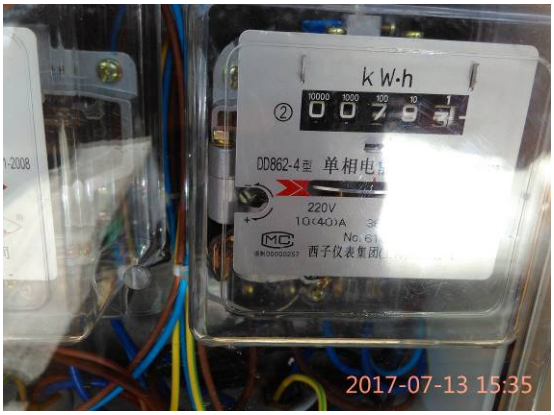
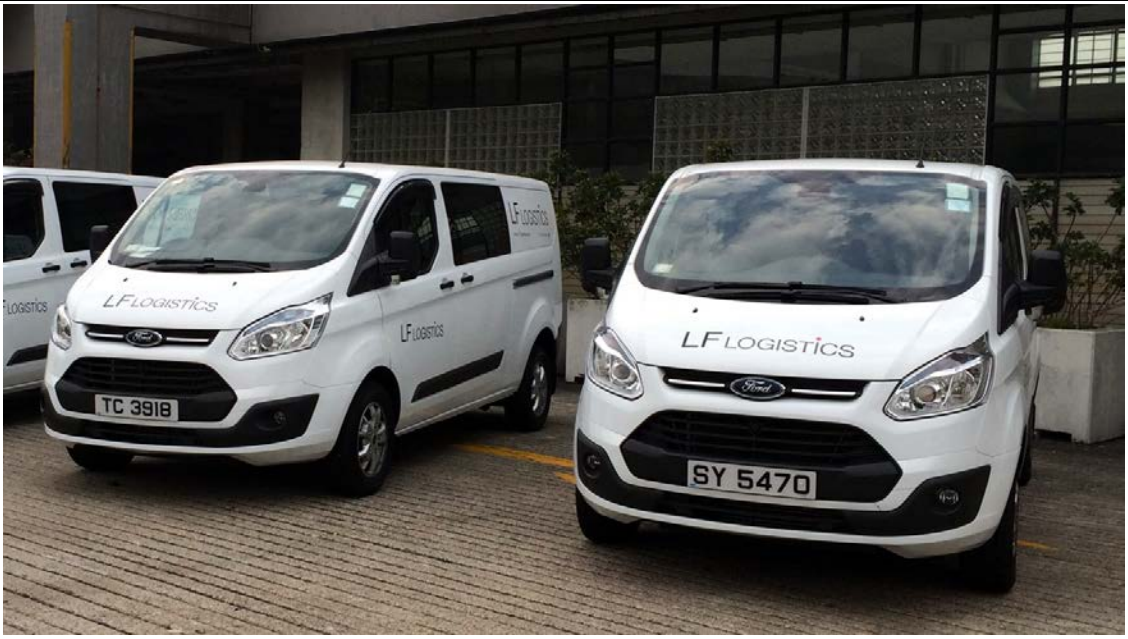
	
EV-2 watt-hour meter	

2. Diesel Vehicles (DV) for Comparison



DV – front view

3. Battery charger