Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Good Vehicle
for Construction Engineering Industry
(Darwin Engineering Limited)

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Trial of Electric Light Goods Vehicle for Construction Industry
(Darwin Engineering Limited)

Final Report
(Trial Period: 1 June 2020 – 31 May 2022)

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. Darwin Engineering Limited (Darwin) was approved under the Fund for trial of two electric light goods vehicles (EVs: EV1 and EV2) to provide general transportation services of workers, construction materials and light equipment/machine among its site office, its warehouse, and a number of construction sites in various locations throughout HK (main coverage area is in the N.T. region). Through the tendering procedure stipulated in the Agreement, Darwin procured 2 EVs of model NISSAN e-NV200 for the trial.

1.2 PolyU Technology and Consultancy Company Limited has been engaged by the Environmental Protection Department (EPD) as an independent third-party assessor (the Assessor) to monitor the trial and evaluate the performance of the trial vehicle. Darwin assigned two diesel light goods vehicles (DVs: DV1 and DV2), Hyundai H-1 & Mercedes Benz Vito light goods vehicles for comparing with the EVs.

1.3 This Final Report summarizes the performance of the two EVs in the 24 months of the trial and compared it with the data of its conventional counterpart, i.e. the two DVs.

2. Trial and Conventional Vehicles

2.1 The NISSAN e-NV200 electric LGV has a gross vehicle weight (GVW) of 2.25 tonnes and a 40-kWh lithium-ion battery pack. According to the manufacturer, its driving range is 317 km with air conditioning off. A Hyundai H-1 diesel light goods vehicle and a Mercedes Benz Vito diesel light goods vehicle were assigned for comparison with the EVs in this trial.

2.2 Darwin installed two 7 kW charging facilities in the carpark of its site office at Kwai Yue Lane of Kwai Chung. Key features and photos of the EVs, the charging facilities and the DVs are provided in Appendix 1 and Appendix 2, respectively. As the nature of the general moving services of workers, construction materials and light equipment/machine was on need-basis, there were no fixed daily routes for the four vehicles. In the 24 months of the trial, the average daily (working day) mileage by the EV1 and EV2 were 66 km and 61 km respectively, while those of the DV1 and DV2 were 48 and 61 km, respectively.

3. Trial Information

3.1 The trial commenced on 1 June 2020 and lasted for 24 months. Darwin was required to collect and provide trial information including the vehicle mileage reading before recharging, amount of energy in each recharging, cost and downtime associated with scheduled and unscheduled maintenances of the EVs and the charging facilities. Similar operational data of the DVs were also provided. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver and Darwin were collected and used to reflect any problems of the EVs.

4. Findings of Trial

4.1 The following table summarizes the statistical data of the EVs and DVs.

Table 1: Key operation statistics of the vehicles (1 June 2020 – 31 May 2022)

	EVs		**DVs**	
	EV1	**EV2**	**DV1**	**DV2**
Total mileage (km)	39,721	36,738	28,818	36,421
Average daily distance (km/working day) [5]	66	61	48	61
Average fuel economy (km/kWh)	5.49	5.13	-	-
Average fuel economy (km/litre)	-	-	7.35	9.68
Average fuel economy (km/MJ) [1]	1.53	1.43	0.20	0.27
Fleet average fuel economy (km/MJ)	1.48		0.24	
Average fuel cost (HK$/km) [2]	0.22	0.24	2.36	1.68
Fleet average fuel cost (HK$/km) [2]	0.23		2.02	
Average total operating cost (HK$/km) [3]	0.22	0.24	2.36	1.69
Fleet average total operating cost (HK$/km) [3]	0.23		2.03	
Downtime (working day) [4]	0	0	0	0

[1] Assuming lower heating value of 36.13 MJ/litre for diesel fuel.
[2] The market fuel price was used for calculation.
[3] Maintenance due to incidents unrelated to the performance of the vehicle was not included for comparison.
[4] Downtime refers to the equivalent number of working days in which the vehicle was not in operation due to charging and maintenance, counting from the first day it stopped operation till the day it was returned to the operator.
[5] Net working days within the 24-months trial or operation period was used in the calculations, i.e., loss of working days due to maintenance was taken out.

4.2 In the 24-month trial period, the average fuel cost of the EV1 was lower than that of the DV1 by HK$2.14/km (i.e., about 91%), that between EV2 and DV2 was HK$1.44/km (86%). That for the fleet average between EV1&2 and DV1&2 was HK$1.79/km (89%).

4.3 After taking into account the maintenance & other cost in the periods (which were almost none in the period), the average total operating cost of the EV1 was lower than that of the DV1 by HK$2.14/km (i.e., about 91%), that between EV2 and DV2 was HK$1.45/km (86%). That for the fleet average between EV1&2 and DV1&2 was HK$1.80/km (89%).

4.4 There were 602 working days in the 24 months of the trial. All the four vehicles had no maintenance. In addition, each vehicle had two government vehicle examinations, which resulted in loss of 0 working day. Hence, the utilization rate was 100% for the EVs and DVs.

4.5 During the trial period, it was observed that there was about a 6.0% degradation in the 12-month moving average fuel economy of EV1, from about 5.67 km/kWh to 5.33 km/kWh. The degradation in the moving average fuel economy of EV2 was only 1.3%; from 5.16 km/kWh to 5.09 km/kWh. However, with only data collected from two EVs of this model in this report, it is unable to conclude whether this trend of dropping in fuel economy is generally valid for the model of this EV or it is a single incident due to problematic battery pack of this particular EV1.

4.6 Compared with the carbon dioxide equivalent (CO_2e) emissions of the DV1 (estimated based on the total mileages of the EV1), there was a reduction of 12,203 kg (i.e., about 82%) CO_2e emissions by using the EV1. That between EV2 and DV2 was a reduction of 7,779 kg (i.e., about 74%) CO_2e emissions.

4.7 There was no designated driver for the EV. The drivers had no difficulty, in general, in operating the EVs and felt that the EVs performed satisfactorily. They have overcome the problem of driving range anxiety in the beginning of the trial and eventually have more confidence in using the EVs for longer distance trips. Darwin was also satisfied with the performance of the EVs, especially on the saving of the fuel cost.

4.8 Since the electric light goods vehicle market is expanding and its battery technology is improving to extend the driving range, the price difference between EV and its conventional counterpart is narrowing down, and there is not much difference in the utilization rate between the two. 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. However, degradation of battery packs of EVs over time may still be a concern, but that requires more performance data of this EV model for verification.

5. Summary

5.1 During the 24 months of the trial, the average fuel cost of the EV1 was lower than that of the DV1 by HK$2.14/km (i.e., about 91%), that between EV2 and DV2 was HK$1.44/km (86%). That for the fleet average between EV1&2 and DV1&2 was HK$1.79/km (89%).

5.2 After taking into account the maintenance and other costs in the period (which were almost none in the period), the average total operating cost of the EV1 was lower than that of the DV1 by HK$2.14/km (i.e., about 91%), that between EV2 and DV2 was HK$1.45/km (86%). That for the fleet average between EV1&2 and DV1&2 was HK$1.80/km (89%)

5.3 There were 602 working days in the 24 months of the trial. The utilization rates of the EVs and DV2 were 100%.

5.4 There was a reduction of 12,203 kg (i.e., about 82%) CO_2e emissions by using the EV1. That for EV2 was a reduction of 7,779 kg (i.e., about 74%) CO_2e emissions.

5.5 The drivers had no problem in operating the EVs and they were satisfied with the performance of the EVs. Darwin was also satisfied with the performance of the EVs.

5.6 From the data of the 2-year trial of the two EVs, it is observed that there was a 6% degradation in fuel economy for EV1 and 1.3% for EV2.

5.7 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. However, possible degradation of battery packs of EVs may still a concern, which may need more data for verification.

Appendix 1: Key Features of the Vehicles and Charging Facility

1. Trial EV and Charging Facilities

(a) EVs

Registration mark	**HD730 (EV1) & EE7068 (EV2)**
Make:	Nissan
Model:	e-NV200
Class:	Light Goods Vehicle
Gross vehicle weight:	2,250 kg
Seating capacity:	Driver + 4 passengers
Expected travel range	317 km (air-conditioning off)
Battery material	Lithium ion
Battery Capacity	40 kWh
Maximum motor power	80 kW
Year of manufacture	2019

(b) Charging Facilities (two identical sets)

Make:	Hong Kong EV Power Limited
Model:	EVC-32NK
Input Voltage:	single -phase, 220V
Type:	IEC 62196-2 Type-2
Output:	kW

2. DVs Used for Comparison

(a) DV1

Registration mark	**SE539**
Make:	Hyundai
Model:	H1 Van Standard Euro 5
Class:	Light Goods Vehicle
Gross vehicle weight:	3,230 kg
Seating capacity:	Driver + 5 passengers
Cylinder capacity:	2,497 cc
Year of manufacture:	2014

(b) DV2

Registration mark	**TV836**
Make:	Mercedes Benz
Model:	Vito Model 116BT
Class:	Light Goods Vehicle
Gross vehicle weight:	3,050 kg
Seating capacity:	Driver + 4 passengers
Cylinder capacity:	2,143 cc
Year of manufacture:	2015

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EVs and Charging Facilities

(a) EV1

	
EV1: HD730 – front view	EV1: HD730 – rear view
	
EV1: HD730 – side view 1	EV1: HD730 – side view 2

(b) EV2

	
EV2: EE7068 – front view	EV2: EE7068 – rear view
	
EV2: EE7068 – side view 1	EV2: EE7068 – side view 2

(c) Charging Facilities

	
Charging facility 1 (mainly for charging EV1)	Charging facility 2 (mainly for charging EV2)

2. DVs for Comparison

(a) DV1

	
DV1: SE539 – front view	DV1: SE539 – rear view
	
DV1: SE539 – side view 1	DV1: SE539 – side view 2

(b) DV2

	
DV2: TV836 – front view	DV2: TV836 – rear view
	
DV2: TV836 – side view 1	DV2: TV836 – side view 2