New Energy Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicles for Security Service
(Guardforce Limited)

(7 December 2023)

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Trial of Electric Light Goods Vehicles for Security Service
(Guardforce Limited)

Final Report
(Reporting Period: 1 January 2022 – 31 December 2022)

Executive Summary

1. Introduction

1.1 The New Energy 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. Guardforce Limited (Guardforce) was approved under the Fund for the trial of three electric light goods vehicles for security service. Through the tendering procedures stipulated in the Subsidy Agreement, Guardforce procured three Nissan e-NV200, electric light goods vehicles (EVs; EV-1, EV-2 and EV-3) for trial.

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 vehicles.

1.3 This Final Report summarizes the performance of the EVs in the twelve months of the trial as compared with their conventional counterparts, i.e. the CVs.

2. Trial and Conventional Vehicles

2.1 The trial EVs – Nissan e-NV200 electric light goods vehicles – each had a gross vehicle weight (GVW) of 2,250 kg, capable of carrying a driver with four passengers and goods. It had a 40 kWh lithium-ion battery pack. According to its manufacturer, it has a driving range of 317 km with air-conditioning off.

2.2 The EVs were charged using charging facilities installed inside the carpark of Guardforce Centre. There were two 32-ampere chargers serving the three EVs.

2.3 Guardforce assigned two diesel light goods vehicles and a petrol private car providing the same services as the conventional counterparts (CVs; CV-1. CV-2 and CV-3) for comparing with the EVs.

2.4 The EVs, and the corresponding CVs, were used for security services, including one for patrol service, one for courier service and the other one for maintenance support service. Key features of the EVs, the charging facilities and the CVs are in Appendix 1 and their photos are in Appendix 2.

3. Trial Information

3.1 The trial commenced on 1 January 2022 and lasted for 12 months. Guardforce was required to collect and provide trial information including each EV's mileage reading before 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 EVs and the charging facilities. Similar data of the CVs were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Guardforce were collected to reflect any problems of the EVs.

4. Findings of Trial

4.1 The following table summarizes the statistical data of the EVs and the CVs. The fleet average fuel cost of the EVs was HK$1.92/km (i.e., about 85%) lower than that of the CVs. The fleet average total operating cost of the EVs was HK$2.11/km (i.e., about 84%) lower than that of the CVs.

Table 1: Key operation statistics of each vehicle (1 January 2022 – 31 December 2022)

		EVs			**CVs**		
		EV-1	**EV-2**	**EV-3**	**CV-1**	**CV-2**	**CV-3**
Total distance travelled (km)		16,421	11,201	26,479	47,744	38,223	48,467
Average distance travelled per working day (km/day)		51	36	74	132	123	136
Average fuel economy	km/kWh	3.77	4.67	3.65	-	-	-
	km/litre	-	-	-	10.11	12.60	7.22
	km/MJ	1.05	1.30	1.01	0.28 [1]	0.39 [1]	0.20 [1]
Average fuel cost (HK$/km)		0.35 [2]	0.29 [2]	0.36 [2]	2.06 [3]	1.81 [3]	2.88 [3]
Fleet average fuel cost (HK$/km)		0.33			2.25		
Average Total Operating Cost (HK$/km) [4]		0.53	0.29	0.36	2.28	1.86	3.35
Fleet average total operating cost (HK$/km)		0.39			2.50		
Downtime (Day) [4][5]		44.5	2.5	5	4.5	1	9.5

[1] Assuming lower heating value of 36.13 MJ/litre for diesel fuel and 32 MJ/litre for petrol

[2] Electricity cost was based on HK$1.289/kWh for January to October 2022 and HK$1.451/kWh for November to December 2022

[3] The market fuel price was used for calculation

[4] Maintenance and downtime not related to the performance of the vehicle was not included for comparison

[5] Downtime refers to the working days the vehicle is not in operation due to maintenance, which counted from the first day it stops operation till the day it is returned to the operator.

4.2Apart from the fuel cost, maintenance cost and other indirect costs which may include parking fee, towing fee, vehicle replacement fee, etc., were also included in the average total operating cost in Table 1. For the EVs, there were three scheduled and one unscheduled maintenances for EV-1, two scheduled maintenances for EV-2, and two scheduled and two unscheduled maintenances for EV-3. For the CVs, there were four scheduled maintenances for CV-1, three scheduled maintenances for CV-2 and five scheduled and two unscheduled maintenances for CV-3, in the twelve months of the trial.

4.3 There were 365 working days for EV-1 and EV-3 and 312 working days for EV-2, in the twelve months period. The utilization rates were 88% for EV-1, 99% for EV-2 and 99% for EV-3, compared with 99% for CV-1, 99.7% for CV-2 and 97% for CV-3. The low utilization rate of EV-1 is associated with the long waiting time for the repair parts. Based

on the above, the average daily mileages of EV-1, EV-2 and EV-3 were 51 km, 36 km and 74 km respectively, compared with 132 km, 123 km and 136 km for CV-1, CV-2 and CV-3 respectively.

4.4 Drivers of the EVs had no problem in operating the EVs and were satisfied with the performance of the EVs. However, the driver of EV-2 considered that the power of the EV was not good enough on uphill driving comparing with the CV and the daily operation was affected by the charging process. Overall, Guardforce considered that using the EVs is good because they can provide a greener and quieter environment as well as EVs have a lower fuel cost. However, Guardforce did not agree that the EVs are meeting their operational requirements because of the lower travel range of EVs compared with CVs.

4.5 After the 12-month trial period, the amount of electricity stored in the battery of each EV after a full charging operation could be maintained at the level of 40 kWh. Thus, the deterioration in battery capacity within the 12-month trial period was insignificant, if any.

4.6 In the 12-month of the trial, the total carbon dioxide equivalent (CO_2e) emission from the EVs was 5,464 kg. For comparison purpose, based on the mileage of the EVs and the fuel economy of the CVs, the total CO_2e emission from the CVs was 17,070 kg. Hence, there was a 11,606 kg (i.e., 68%) reduction of CO_2e, with the replacement of three CVs by three EVs in the trial.

5. Summary

5.1 The fleet average fuel cost of the EVs was HK$1.92/km (85%) lower than that of the CVs. The fleet average total operating cost of the EVs was HK$2.11/km (84%) lower than that of the CVs. The utilization rates of EV-1, EV-2 and EV-3 were 88%, 99% and 99% respectively while the utilization rates of CV-1, CV-2 and CV-3 were 99%, 99.7% and 97% respectively. There was a 11,606 kg (i.e., 68%) reduction of CO_2e, with the replacement of three CVs by the three EVs in the trial.

5.2 For each EV, after the 12-month trial period, a full charging operation could be maintained at the level of 40 kWh. Thus, the deterioration in battery capacity within the 12-month trial period was insignificant.

5.3 Drivers of the EVs had no problem in operating the EVs and were in general satisfied with the performance of the EVs. Overall, Guardforce considered that using the EVs is good because they can provide a greener and quieter environment as well as EVs have a lower fuel cost.

5.4 The findings show 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 Vehicles and Charging Facilities

1. Trial EVs and charging facilities

Trial vehicles

Registration mark	**XP6586 (EV-1), XP7273 (EV-2), XP7343 (EV-3)**
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:	2020

Charging facilities (2 sets)

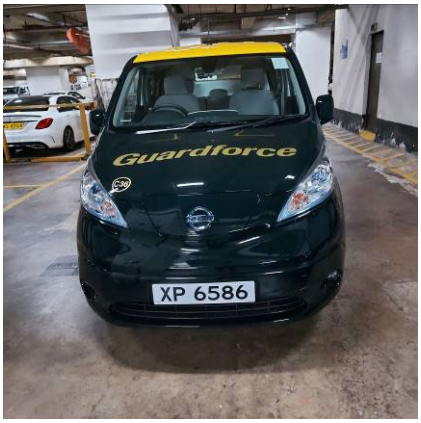
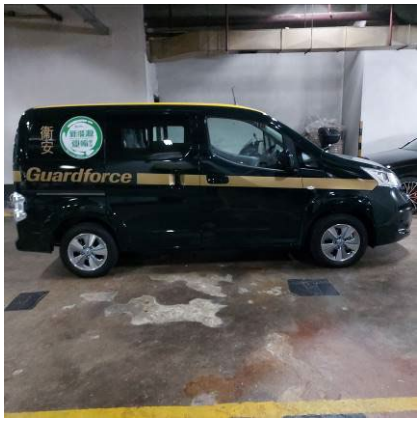
Maker:	EV Power
Model:	EVC 32NK
Output:	220V AC / max 32A
Charging Standard:	IEC62196 Type 2A

2. CVs Used for Comparison

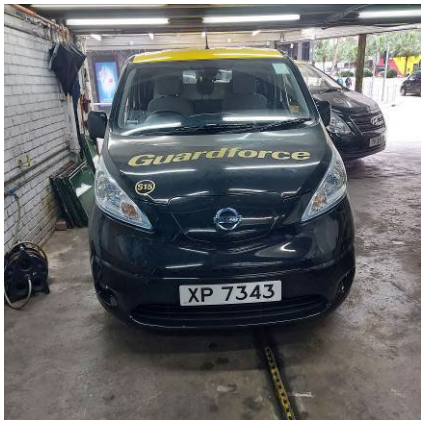
Registration mark	**VX860 (CV-1)**	**GFHK2 (CV-2)**	**TG4193 (CV-3)**
Make:	Hyundai	Toyota	Hyundai
Model:	H-1 M/T Euro 6	SPADE	HI VAN Standard Euro 5
Class:	Light Goods Vehicle	Private car	Light Goods Vehicle
Seating capacity:	Driver+5 passengers	Driver+4 passengers	Driver+5 passengers
Gross vehicle weight:	3,200 kg	NA	3,230 kg
Cylinder capacity:	2,497 cc (diesel)	1,496 cc (petrol)	2,497 cc (diesel)
Year of manufacture:	2018	2017	2014

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial EVs and Charging Facilities

	
EV-1 (XP6586) – Front view	EV-1 – Rear view
	
EV-1 – Right side view	EV-1 – Left side view

	
EV-2 (XP7273) – Front view	EV-2 – Rear view
	
EV-2 – Right side view	EV-2 – Left side view

	
EV-3 (XP7343) – Front view	EV-3– Rear view
	
EV-3 – Right side view	EV-3 – Left side view
	
Charging station 1	Charging station 2

2. Conventional Vehicles (CVs) for Comparison

	
CV-1 (VX860) – Front view	CV-1 – Rear view
	
CV-1 – Right side view	CV-1- Left side view

	
CV-2 (GFHK2) – Front view	CV-2 – Rear view
	
CV–2 - Right side view	CV-2 - Left side view

	
CV-3 (TG4193) – Front view	CV-3 – Rear view
	
CV–3 - Right side view	CV-3 - Left side view