Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicles for Aviation Maintenance Products Delivery (Pan Asia Pacific Aviation Services Limited)

(31 March 2022)

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(Reporting Period: 1 August 2019 – 31 July 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. Pan Asia Pacific Aviation Services Limited (PAPAS) was approved under the Fund for trial of three electric light goods vehicles for aviation maintenance products delivery. PAPAS, through the tendering procedures stipulated in the Agreement entered into with the Government, procured three Nissan e-NV200 electric light goods vehicles (EVs) 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 vehicles. PAPAS assigned three diesel light goods vehicles (DVs) providing similar service as the conventional counterparts for comparison.

1.3 This Final Report summarizes the performance of the EVs in the 24 months of the trial as compared with their conventional counterparts i.e. the DVs.

2. Trial and Conventional Vehicles

2.1 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 stationed inside the airport usually. They were mainly used for the delivery of aviation maintenance products within the airport and would also travel outside the airport.

2.2 The EVs were charged using charging facilities installed within the airport provided by the Airport Authority Hong Kong. The EVs used whichever charger was available for charging rather than had a specific charger for each. The amount of electricity charged could be reflected by the meter on each EV which indicated the percentage of electricity available at the commencement of charging and at the end of charging.

3. Trial Information

3.1 The trial commenced on 1 August 2019 and lasted for 24 months. PAPAS was required to collect and provide trial information including the EV 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. Similar sets of data of the DVs were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and PAPAS 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 DVs. The fleet average fuel cost of the three EVs was HK$1.94/km (85%) lower than that of the three DVs. The fleet average total operating cost of the three EVs was HK$2.62/km (83%) lower than that of the three DVs.

Table 1: Key operation statistics of each vehicle (1 August 2019 – 31 July 2021)

		EVs			**DVs**		
		EV-1	**EV-2**	**EV-3**	**DV-1**	**DV-2**	**DV-3**
Total distance travelled (km)		28268	29965	30383	17973	6212	56392
Average distance travelled per working day (km/day)		42	41	43	25	9	77
Average fuel economy	km/kWh	3.49	4.05	3.56	-	-	-
	km/litre	-	-	-	5.96	6.42	7.19
	km/MJ	0.97	1.13	0.99	0.16 [1]	0.18 [1]	0.20 [1]
Fleet average fuel economy		3.70 km/kWh			6.52 km/litre		
Average fuel cost (HK$/km)		0.35 [2]	0.30 [2]	0.34 [2]	2.48 [3]	2.27 [3]	2.07 [3]
Average Total Operating Cost (HK$/km) [5]		0.56	0.61	0.45	2.48	4.94	2.07
Fleet average fuel cost (HK$/km)		0.33 [2]			2.27 [3]		
Fleet average total operating cost (HK$/km) [5]		0.54			3.16		
Downtime (Day) [4][5]		6	10	4	0	7	1

[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 due to maintenance, which 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 technology was not included for comparing the performance of the vehicles.

4.2 In the 24 months of the trial, the average daily mileages of the vehicles were 42 km for EV-1, 41 km for EV-2, 43 km for EV-3; and 25 km for DV-1, 9 km for DV-2, 77 km for DV-3.

4.3 EV-1 had 6 days and 61 days of downtime respectively for scheduled and unscheduled maintenances. EV-2 had 10 days downtime for scheduled maintenances. EV-3 had 4 days and 28 days of downtime respectively for scheduled and unscheduled maintenances. DV-1 did not incur any downtime for maintenance. DV-2 had 7 days and 39 days of downtime respectively for scheduled and unscheduled maintenances. DV-3 had one day of downtime for scheduled maintenance. However, the unscheduled maintenances of EV-1, EV-3 and DV-2 were not related to the performance of the vehicles and hence the downtime involved in each case was not counted in the utilization rate. The utilization rates were 99% or higher for each of the EVs and DVs.

4.4 In general, the drivers of the EVs had no problem in operating the EVs and were satisfied with the performance of the EVs. However, some of them opined that the power of the EVs was not as good as the DVs on uphill driving. PAPAS agreed that using the EVs is good because they can provide a greener and quieter environment as well as EV has a lower fuel cost.

4.5 To remove the seasonal fluctuations, 12-month moving averages were used in this report to evaluate the trend of the EVs' fuel economy. There was no indication that the fuel economy of EV-1 had deteriorated. However there were 8% deterioration in fuel economy of EV-2 and 4% deterioration for EV-3. For each EV, there was no indication that the battery charge capacity had deteriorated in the trial period.

4.6 In the 24-month trial period, the CO_2e from EV-1, EV-2, and EV-3 were 3,257 kg, 2,922 kg and 3,427 kg respectively, while those from DV-1, DV-2 and DV-3, based on the average fuel economy of the three DVs, were 12,001 kg, 12,722 kg and 12,899 kg, respectively. Hence, there was a total reduction of 28,016 kg CO_2e, which is about 74% reduction, with the replacement of DVs by EVs in the trial.

5. Summary

5.1 In the 24 months of the trial, the average daily mileages of the vehicles were 42 km for EV-1, 41 km for EV-2, 43 km for EV-3; and 25 km for DV-1, 9 km for DV-2, 77 km for DV-3. The fleet average fuel cost of the EVs was HK$1.94/km (85%) lower than that of the DVs. The fleet average total operating cost of the EVs was HK$2.62/km (83%) lower than that of the DVs. The utilization rates were 99% or higher for all the EVs and the DVs.

5.2 Based on the 12-month moving average fuel economy, there was no indication of deterioration in the performance of EV-1. However there were 8% deterioration in fuel economy of EV-2 and 4% deterioration for EV-3.

5.3 There was a 28,016 kg (74%) reduction of CO_2e, with the replacement of DVs by EVs in the trial.

5.4 The drivers had no problem in operating the EVs and were satisfied with their performance. However, some of them opined that the power of the EVs was not as good as the DVs on uphill driving. PAPAS agreed that using the EVs is good because they can provide a greener and quieter environment as well as EV has a lower fuel cost.

5.5 The trial results showed that under local operating conditions where air-conditioning is essential, the Nissan e-NV200 electric light goods vehicles could meet PAPAS's daily mileage requirements. 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 EVs

Registration mark	**WC7729 (EV-1), WC8007 (EV-2), WC8087 (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:	2018

2. Charging Facilities (installed within airport by Airport Authority Hong Kong)

Maker:	Schneider Electric
Model:	EVLink
Output:	380-415V 3-phase / 32A (22 kW) AC
Charging Standard:	IEC62196 Type 2A

3. DVs Used for Comparison

Registration mark	**SR869 (DV-1) (scrapped in March 2020)**	**VR5013 (DV-1) (starting from April 2020)**
Make:	Toyota	Isuzu
Model:	KDH201RSSPDY	TFR86JS-V
Class:	Light Goods Vehicle	Light Goods Vehicle
Seating capacity:	Driver+5 passengers	Driver+1 passenger
Gross vehicle weight:	2,800 kg	2,900 kg
Cylinder capacity:	2,982 cc	2,499 cc
Year of manufacture:	2009	2014

Registration mark	**TX5412 (DV-2)**	**VJ2698 (DV-3) (scrapped in October 2019)**	**SF6857 (DV-3) (starting from October 2019)**
Make:	IVECO	Toyota	Toyota
Model:	New Daily	KDH200RSSMD	HIACE Diesel LWB
Class:	Light Goods Vehicle	Light Goods Vehicle	Light Goods Vehicle
Seating capacity:	Driver +2 passengers	Driver +5 passengers	Driver +5 passengers
Gross vehicle weight:	5,200 kg	2,800 kg	2,800 kg
Cylinder capacity:	2,998 cc	2,494 cc	2,982 cc
Year of manufacture:	2015	2005	2013

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial EVs and Charging Facilities

	
EV-1 (WC7729) – front view	EV-1 – rear view
	
EV-1 – right side view	EV-1 – left side view
	
EV-2 (WC8007) – front view	EV-2 – rear view
	
EV-2 – right side view	EV-2 – left side view

	
EV-3 (WC8087) – front view	EV-3– rear view
	
EV-3 – right side view	EV-3 – left side view
	
Charging facilities (installed within airport by Airport Authority Hong Kong)	

2. Diesel Vehicles (DVs) for Comparison

	
DV-1 (SR869) Front View (scrapped in March 2020)	DV-1 (VR5013) Front View (starting from April 2020)
	
DV-2 (TX5412) Front View	

	
DV-3 (VJ2698) Front View (scrapped in October 2019)	DV-3 (SF6857) Front View (starting from October 2019)