Pilot Green Transport Fund

Final Report
On
Trial of Electric Light Goods Vehicle for Wastewater Treatment Service (Hong Kong Wastewater Treatment Plant Management Company Limited)

(20 September 2021)

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(Reporting Period: 1 July 2019 – 30 June 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. Hong Kong Wastewater Treatment Plant Management Company Limited (HK Wastewater) was approved under the Fund for trial of one electric light goods vehicle for wastewater treatment service. HK Wastewater, through the tendering procedures stipulated in the Agreement entered into with the Government, procured a Nissan e-NV200 electric light goods vehicle (EV) for trial.

1.2 PolyU Technology and Consultancy Company Limited has been engaged by the Environmental Protection Department as an independent third party assessor (the Assessor) to monitor the trial and evaluate the performance of the trial vehicle. HK Wastewater assigned a Toyota diesel light goods vehicle (DV) with a GVW of 2,800 kg and 2,982 c.c. engine and provided similar service as the conventional counterpart for comparison.

1.3 This Final Report summarizes the performance of the EV in the 24 months of the trial as compared with its conventional counterpart i.e. the DV.

2. Trial and Conventional Vehicles

2.1 Key features of the EV, the charging facility and the DV are in Appendix 1 and photos of the vehicles and the charging facility are in Appendix 2. The EV was used for the delivery of tools and parts for maintenance work in Fanling and Yuen Long regions. According to the manufacturer, the EV has a travel range of 317 km with its battery fully charged and air-conditioning off.

2.2 HK Wastewater installed a 7 kW AC charging facility for the EV. The charger was installed inside the carpark of its office in Fanling for charging and recording the amount of electricity charged. The EV was charged on a daily basis. However, due to operational requirement, the driver returned the EV to the company's carpark for charging only occasionally. Normally the EV was charged using public charging facilities.

3. Trial Information

3.1 The trial commenced on 1 July 2019 and lasted for 24 months. HK Wastewater was required to collect and provide trial information including the 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 EV and the charging facility. Similar data of the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver and HK Wastewater were collected to reflect any problems of the EV.

4. Findings of Trial

4.1 Table 1 summarizes the statistical data of the EV and the DV.

Table 1: Key operation statistics of each vehicle (1 July 2019 – 30 June 2021)

		EV	**DV**
Total mileage (km)		24,557	55,367
Average daily mileage (km/working day)		42	94
Average fuel economy	(km/kWh)	4.95	-
	(km/litre)	-	9.91
	(km/MJ)	1.38	0.27[1]
Average fuel cost (HK$/km)		0.24[2]	1.49[3]
Average total operating cost (HK$/km) [4]		0.37	1.72
Downtime (working day)[4][5]		2	2

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

[2] Electricity bills not provided, electricity cost was based on HK$1.177/kWh for 2019 and HK$1.218 for January 2020 to June 2021

[3] The market fuel price was used for calculation

[4] Maintenance cost unrelated to the vehicle performance was excluded from comparison.

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

4.2 In the 24 months of the trial, the total mileage and the average daily mileage were 24,557 km and 42 km/day respectively for the EV and 55,367 km and 94 km/day respectively for the DV. The average fuel cost of the EV was HK$1.25/km (about 84%) lower than that of the DV. The average total operating cost of the EV was HK$1.35/km (about 78%) lower than that of the DV, taking the maintenance cost into account.

4.3 There were four scheduled maintenances for the EV and two scheduled and two unscheduled maintenances for the DV in the 24 months of the trial. The EV and the DV each had 2 days of downtime for maintenance. The utilization rates were therefore 99.7% for both of them.

4.4 To remove the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the EV's fuel economy in this report. The 12-month moving average fuel economy of the EV decreased from 5.05 km/kWh to 4.84 km/kWh, which is less than 4%. The results showed that the fuel economy of the EV decreased slightly in the 24-month trial period. However, there was no indication of obvious deterioration in the battery capacity of the EV.

4.5 In the trial period, the CO_2 equivalent (CO_2e) emission from the EV was 2,017 kg while that from the DV was 6,868 kg based on the total mileage of the EV and the fuel economy of the DV for comparison purpose. Hence, there was a reduction of 4,851 kg CO_2e, which is about 71% reduction, with the replacement of DV by EV in the trial.

4.6 The driver of the EV had no problem in operating the EV and was satisfied with its performance. However, he did not like driving the EV because under the current charging arrangement (see paragraph 2.2 for details), the driving range of the EV after each charging was short in comparison with a fully refueled diesel vehicle. Hence, he had to charge the EV frequently in order to ensure that there was sufficient battery power in case long distance operation was required. Overall, HK Wastewater agreed that using the EV is good because it can provide a greener and quieter environment as well as EV has a lower fuel cost.

5. Summary

5.1 In the 24 months of the trial, the average daily mileages of the EV and the DV were 42 km/day and 94 km/day, respectively. The EV had lower fuel cost and total operating cost than the DV. The average fuel cost of the EV was HK$1.25/km (84%) less than that of the DV. The average total operating cost of the EV was HK$1.35/km (78%) lower than that of the DV. The utilization rates were 99.7% for both the EV and the DV.

5.2 The fuel economy of the EV decreased slightly in the 24-month trial period. However, there was no indication of obvious deterioration in the battery capacity of the EV.

5.3 There was a reduction of 4,851 kg CO_2e, which is about 71% reduction, with the replacement of DV by EV in the trial.

5.4 Overall, HK Wastewater agreed that using the EV is good because it can provide a greener and quieter environment as well as EV has a lower fuel cost. The driver of the EV had no problem in operating the EV and was satisfied with its performance. However, he did not like driving the EV because its driving range after each charging with public charger was short in comparison with a fully refueled diesel vehicle and hence frequent charging arrangement for the EV was required. The anxiety of the driver might probably be due to the reliance on public charging. Since it would take only one to two hours for charging the EV each time and hence the EV could not be fully charged up (Note: It takes about 8 hours for full charging with a 7kW public charger), the driver had to arrange

charging frequently. Taking into account the driving range of the EV (317 kilometers) and the average daily mileage of the DV (94 kilometers), if he can change the charging arrangement, wherever possible, to charge the EV overnight with the dedicated charging facility at HK Wastewater's carpark, the situation will be improved.

5.5 The trial results showed that under local operating conditions where air-conditioning is essential, the Nissan e-NV200 electric light goods vehicle could meet HK Wastewater'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.

5.6 As electric vehicle market is expanding and technology is improving, the capital cost of electric light goods vehicle has dropped in recent years. The price difference between electric light goods vehicle and diesel light goods vehicle will narrow down.

Appendix 1: Key Features of the Vehicles and Charging Facility

1. Trial EV and Charging Facility

(a) EV

Registration mark	**VZ6317**
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

(b) Charging Facility

Make:	EN-plus Technologies Co. Ltd
Model:	AC7000-AG-05
Power:	7 kW, single-phase AC (220V / 32 A)
Charging Standard:	Type 2 (GB/T 18487.1-2015)

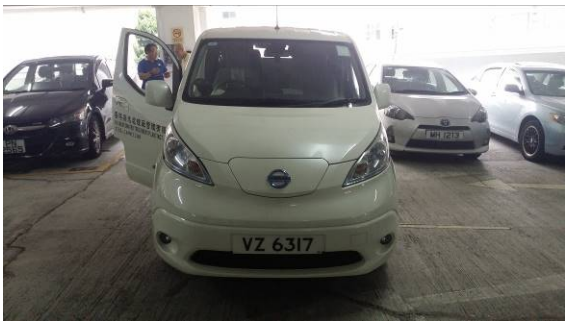
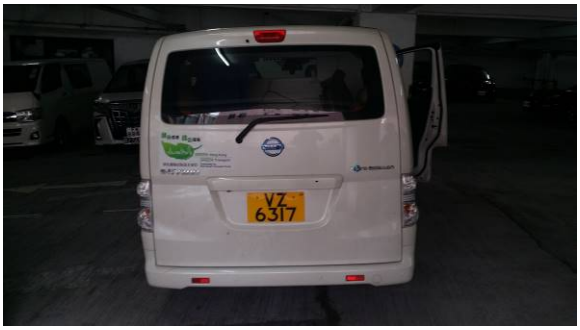
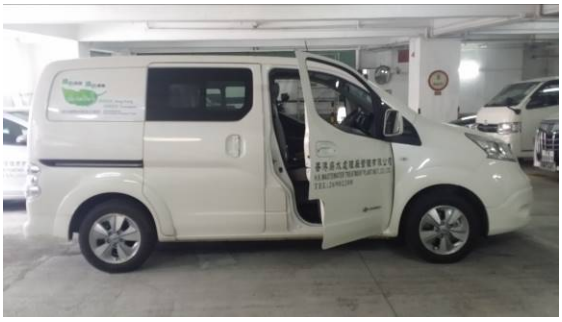
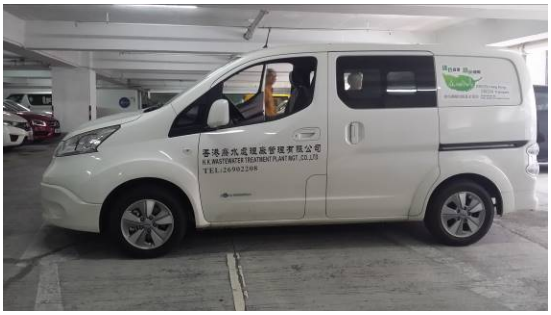
2. DV Used for Comparison

Registration mark	**PL5181**
Make:	Toyota
Model:	KDH201RSSMDY
Class:	Light Goods Vehicle
Seating capacity	Driver + 5 passengers
Gross vehicle weight:	2,800 kg
Cylinder capacity:	2,982 cc
Year of manufacture:	2010

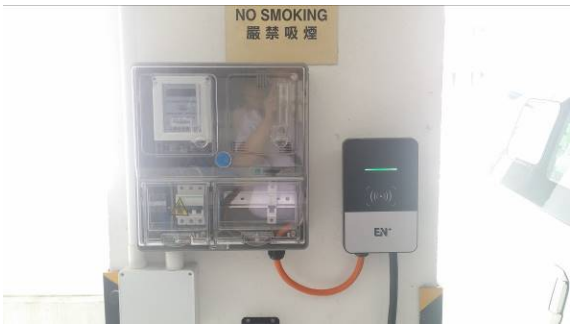
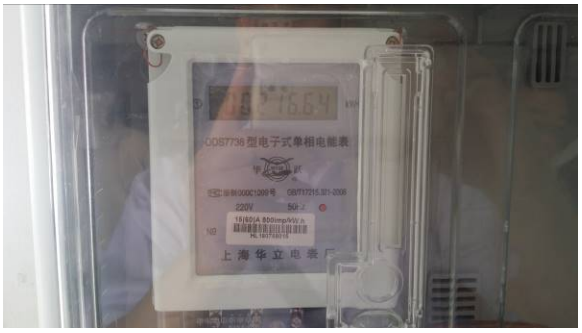
Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV and Charging Facility

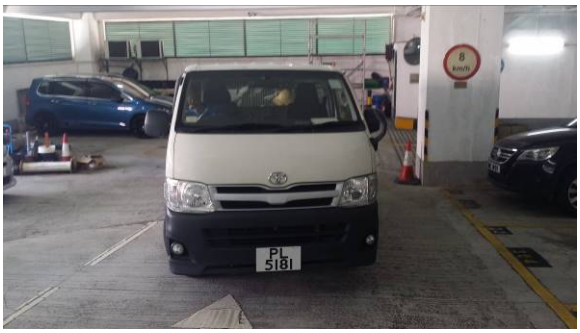
(a) EV

	
EV – front view	EV – end view
	
EV – right side view	EV – left side view

(b) Charging Facility

	
EV – watt-hour meter and charger	EV – watt-hour meter

2. Diesel Vehicle (DV) for Comparison



DV Front View