

Pilot Green Transport Fund

Final Report On
Trial of Electric Light Goods Vehicle
for Environmental Service
(Waste & Environmental Technologies Limited)

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The Monitoring and Evaluation Team's views expressed in this report do not necessarily reflect the views of the Environmental Protection Department, HKSAR.

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Trial of Electric Light Goods Vehicle for Environmental Service
(Waste & Environmental Technologies Limited)

Final Report
(Trial Period: 1 March 2016 – 28 February 2018)

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. Waste & Environmental Technologies Limited (WET) was approved under the Fund for trial of one electric light goods vehicle with the associated charging facility for environmental service. Through the tendering procedures stipulated in the Subsidy Agreement, WET procured one Nissan e-NV200 light goods vehicle (EV) for trial.

1.2 PolyU Technology and Consultancy Company Limited (PolyU) 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 vehicle as compared with its conventional counterpart. WET assigned an Isuzu diesel light goods vehicle (DV) which has a 2,499 c.c. engine and provided same type of service as the conventional counterpart for comparison.

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

2. Trial Vehicles

2.1 The EV is designed to carry 620 kg payload. According to its manufacturer, the EV has a travel range of 165 km with its battery fully charged and air-conditioning off. Key features and photos of the EV and its charging facility as well as the DV are shown in Appendix 1 and Appendix 2 respectively. The vehicles were mainly used for providing service between the Science Park office and the Yuen Long workshop of WET. Day-to-day travel for providing such service was generally less than 100 km for the EV.

2.2 In the beginning of the trial (from March to November 2016), WET used the public charging facilities at the Science Park car park, Shui Pin Wai Estate, Yuen Long and Choi Yuen Plaza, Sheung Shui to charge the EV. The EV was charged when its service was required. A 30-ampere charger has been installed at WET's Yuen Long workshop to support its charging since November 2016.

3. Trial Information

3.1 The trial started on 1 March 2016 and lasted for 24 months. WET was required to collect and provide trial information including the EV 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 EV and the charging facilities. Similar data from the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver were collected to reflect any problem of the EV.

4. Findings of Trial

4.1 Operating Costs

4.1.1 The average fuel economy and cost statistics of the EV and the DV are summarized in Table 1. The fuel cost of the EV was HK\$0.603/km (72%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle

		EV	DV
Total distance travelled (km)		40,095	67,630
Average fuel economy	(km/kWh)	4.80	-
	(km/litre)	-	13.81
	(km/MJ)	1.33	0.382 ^[1]
Average fuel cost (HK\$/km)		0.236	0.839

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

4.1.2 Table 2 below summarizes the operating cost data of the EV and the DV. During the trial period, the EV and the DV each had three scheduled maintenances, resulting in 3 days of downtime. However, no unscheduled maintenance was recorded for both. The utilization rates of the DV and the EV are close to 100%.

Table 2: Summary of all the costs and downtime of the EV and the DV.

	EV	DV
Fuel cost (HK\$)	9,452	56,715
Maintenance cost (HK\$)	0 ^[1]	0 ^[1]
Other cost (HK\$)	0	0
Total operating cost (HK\$)	9,452	56,715
Average total operating cost (HK\$/km)	0.236	0.839
Downtime ^[2] (working days)	3	3

^[1] No maintenance cost incurred by the EV and the DV as both were under warranty.

^[2] Downtime refers to working days that the vehicle is not in operation, which counted from the first day it stops operation till the day it is returned to the operator.

4.1.3 The scheduled maintenances of the EV and the DV involved scheduled inspections and annual examinations.

4.1.4 Scheduled maintenance of the EV was simpler than that of the DV since the DV required replacement of filters and engine oil and passing the smoke test, all of which were not required for the EV.

4.1.5 Apart from the fuel costs, Table 2 also shows the average total operating costs which included maintenance costs and other indirect costs such as towing fee and vehicle replacement fee. The EV and the DV incurred only fuel costs in this trial because both of them were under warranty during the trial period. The total operating cost is therefore equal to the fuel cost. Compared with the DV, the total operating cost of the EV was also 72% lower.

4.2 Performance and Reliability

4.2.1 In the twenty-four months of the trial, the total mileage and the average daily mileage of the EV were 40,095 km and 55.2 km/day respectively while those of the DV were 67,630 km and 93 km/day respectively. The EV driver had no problem in operating the EV. However, he did not agree that the air was cleaner inside the vehicle. He also felt that the performance of the vehicle and the travel mileage after full charging had deteriorated over time, which affected his daily operation. However, the analyzed results did not show deterioration in the performance of the EV and the batteries.

4.2.2 Overall, WET 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 trial might still not be able to reflect the operational cost components because the EV was still new and not much maintenance cost was involved in the 24-month trial period. WET tends to replace all existing conventional vehicles with the electric vehicles.

4.2.3 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. For the EV, the 12-month moving average varied narrowly between 4.7 km/kWh and 4.94 km/kWh, indicating that there was no deterioration in the fuel economy during the trial period.

4.2.4 The rated capacity of the battery is 24 kWh. Throughout the trial period, the charged amount could reach 24 kWh, indicating that there was no deterioration in the charge capacity of the batteries during the trial period.

4.2.5 The CO₂ equivalent (CO_{2e}) emissions from the EV and the DV were 4,374 kg and 8,049 kg, respectively. Compared with the DV, there was a total reduction of 3,675 kg CO_{2e} emission (i.e., around 46%) by using EV during the trial period.

5. Summary

5.1 The trial results showed that the EV had lower fuel cost as compared with its conventional diesel counterpart, with a saving of HK\$0.603/km or 72%. The total operating cost for the EV was also 72% lower than that of the DV.

5.2 The EV driver found no problem in operating the EV. The operation of the EV was smooth. In the trial period, the EV involved only three scheduled maintenances, with a utilization rate close to 100%.

5.3 The 12-month moving average fuel economy of the EV varied narrowly between 4.7 km/kWh and 4.94 km/kWh. There was no indication of fuel economy deterioration during the trial period. 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 light goods vehicle could meet WET'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 EV

Registration mark	TY7702
Make:	Nissan
Model:	e-NV200
Class:	Light goods vehicle
Gross vehicle weight:	2,250 kg
Seating capacity:	5 passengers (including driver)
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:	620 kg
Year of manufacture:	2014

2. DV Used for Comparison

Registration mark	TR3949
Make:	Isuzu
Model:	TFS86JD-V-AT
Class:	Light Goods Vehicle
Gross vehicle weight:	3,000 kg
Seating Capacity:	5 passengers (including driver)
Cylinder capacity:	2,499 cc
Year of manufacture:	2014

3. Charging system

Model:	EVSE-RSW30B25CXXW-0002
Output:	20VAC/ 30A
Charging standard:	SAE J1772

Appendix 2: Photos of Vehicles and Charger

1. Trial EV and Charging Facility

	
EV – front view	EV – end view
	
EV – side view 1	EV – side view 2
	
Battery Charger	

2. Diesel Vehicle for Comparison



DV