

Pilot Green Transport Fund

Final Report On Trial of Electric Light Goods Vehicle for Vehicle Repairing and Maintenance Products Delivery (Ever Success Enterprise 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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**Pilot Green Transport Fund
Trial of Electric Light Goods Vehicle for
Vehicle Repairing and Maintenance Products Delivery
(Ever Success Enterprise Limited)**

**Final Report
(Trial Period: 1 January 2017 – 31 December 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. Ever Success Enterprise Limited (Ever Success) was approved under the Fund for trial of one electric light goods vehicle for vehicle repairing and maintenance products delivery. Through the tendering procedures stipulated in the Subsidy Agreement, Ever Success 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. Ever Success assigned an Isuzu diesel light goods vehicle (DV) which has a 2,999 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 According to the EV's manufacturer, the model's maximum payload is not less than 620 kg and it 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 facilities as well as the DV are in Appendix 1 and Appendix 2. The EV was used mainly for delivery of urea solution for diesel vehicles from the Yuen Long office to different parts of Kowloon and the New Territories. Day-to-day travel for providing such service is about 100 km.

2.2 Ever Success used a standard 13-ampere charger for charging the EV. The amount of electricity charged was estimated based on the state of charge of the battery appearing on the dashboard. The EV was normally charged overnight, with top-up charging in the afternoon or evening when it was not in use.

3. Trial Information

3.1 The trial started on 1 January 2017 and lasted for 24 months. Ever Success 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\$1.43/km (85%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle

		EV	DV^[2]
Total distance travelled (km)		58,874	39,185
Average fuel economy	(km/kWh)	4.96	-
	(km/litre)	-	7.20
	(km/MJ)	1.39	0.199 ^[3]
Average fuel cost ^[1] (HK\$/km)		0.249	1.68

^[1] The market fuel price was used for calculation

^[2] For the period January 2017 to June 2018; data from July 2018 and beyond are incomplete due to missing data and hence removed from analysis

^[3] 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 24-month trial period, the EV had five scheduled maintenances resulting in two days of downtime while the DV had one scheduled and one unscheduled maintenance, with a total of 67 days of downtime, from January 2017 to June 2018. The utilization rates of the EV and the DV were 99.7% and 88% respectively.

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

	EV	DV^[3]
Distance travelled (km)	58,874	39,185
Fuel cost (HK\$)	14,648.8	65,903
Average fuel cost (HK\$/km)	0.249	1.68
Average fuel economy (km / MJ)	1.39	0.199
Maintenance cost (HK\$)	1,480.6 ^[2]	17,895
Other cost (HK\$)	0	0
Total operating cost (HK\$)	16,129.4	83,798
Average total operating cost (HK\$/km)	0.274	2.14
Downtime ^[1] (working days)	2	67

^[1] Downtime refers to the working days in which the vehicle was not in operation, which counted from the first day it stopped operation till the day it was returned to the operator.

^[2] No maintenance cost incurred by the EV as it was still under warranty. The cost incurred was for materials and annual inspection fees only.

^[3] For the period January 2017 to June 2018; data from July 2018 and beyond are incomplete due to missing data and hence removed from analysis

4.1.3 The scheduled maintenances of the EV involved scheduled inspections and annual examinations. The unscheduled maintenance of the DV involved replacement of the fuel pump.

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. Compared with the DV, the average total operating cost of the EV was 87% lower.

4.2 Performance and Reliability

4.2.1 In the 24 months of the trial, the total mileage and the average daily mileage of the EV were 58,874 km and 81 km/day respectively while those of the DV were 39,185 km and 72 km/day respectively from January 2017 to June 2018. The EV driver had no problem in operating the EV.

4.2.2 Overall, Ever Success agreed that using electric vehicle is good because it can provide a greener and quiet environment as well as its much lower fuel cost. Ever Success would consider replacing 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 dropped from 5.27 km/kWh to 4.68 km/kWh, indicating that there was a 11% deterioration in the fuel economy during the trial period.

4.2.4 For the EV, the amount of electricity charged was estimated based on the state of charge of the battery showing on the dashboard. The state of charge could reach 100% while the peak charge amount in each month exceeded 90% in each month throughout the trial period, indicating that there was no deterioration in the charge capacity of the batteries during the trial period.

4.2.5 The carbon dioxide equivalent (CO_{2e}) emissions from the EV and the DV were 6,051 kg and 22,733 kg respectively. Compared with the DV, there was a total reduction of 16,682 kg CO_{2e} emission (i.e., around 73%) 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 the DV, with a saving of HK\$1.43/km or 85%. The average total operating cost for the EV was also 87% lower than that of the DV.

5.2 The EV driver had no problem in operating the EV. The operation of the EV was smooth. In the trial period, the EV involved only five scheduled maintenances, with a utilization rate of 99.7%.

5.3 The 12-month moving average fuel economy of the EV dropped from 5.27 km/kWh to 4.68 km/kWh. There was indication of fuel economy deterioration during the trial period. However, 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 Ever Success'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 Electric Light Goods Vehicle (EV)

Registration mark	UM1062
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:	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:	2015

2. Charging Facilities

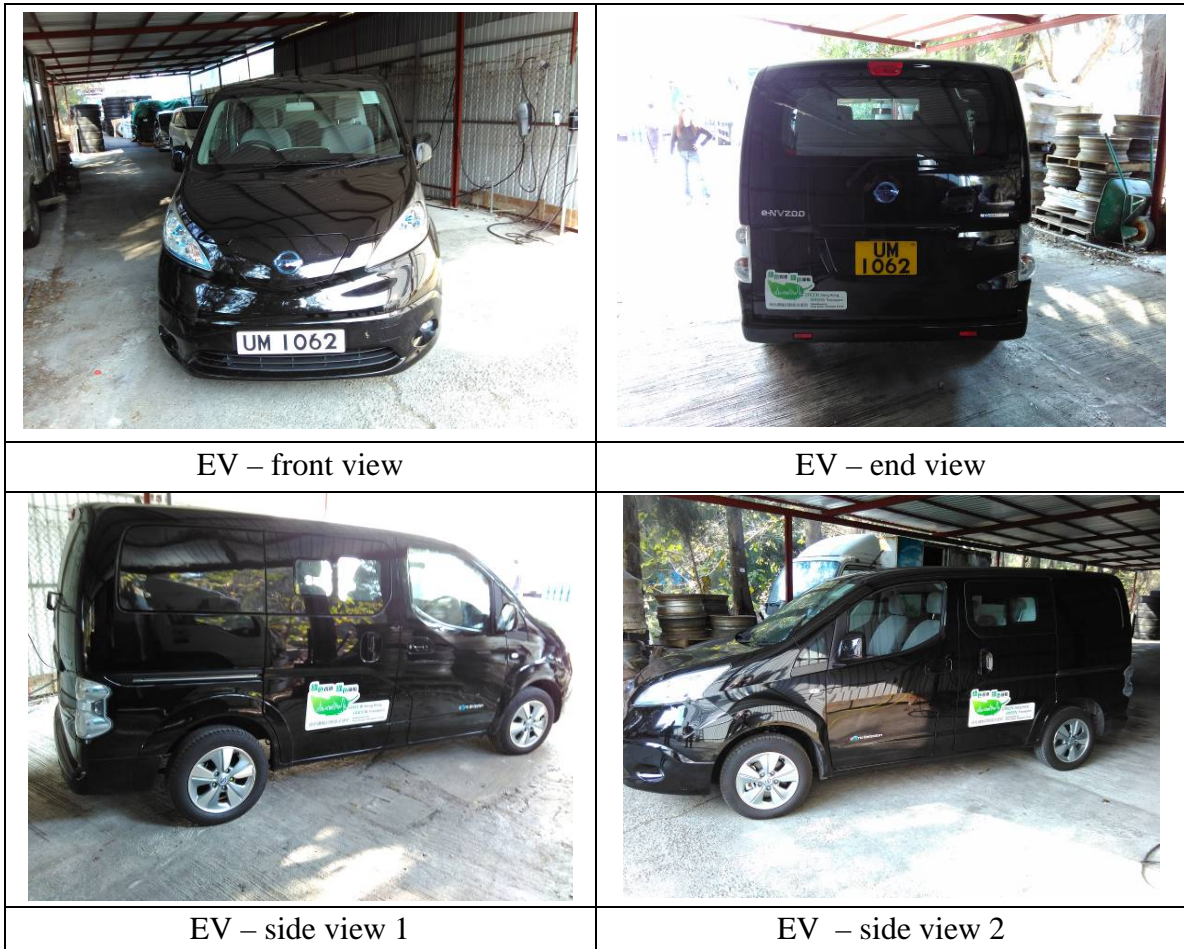
Charging Standard:	IEC 61851
Charging Mode:	220V / 13A, AC (Mode 1)

3. Diesel Light Goods Vehicle Used for Comparison (DV)

Registration mark	ST5145
Make:	Isuzu
Model:	NKR77E-13M
Class:	Light Goods Vehicle
Gross vehicle weight	5,300 kg
Seating capacity:	driver + 2 passengers
Cylinder capacity:	2,999 cc
Payload:	1,800 kg
Year of manufacture:	2004

Appendix 2: Photos of Vehicles

1. Trial Electric Light Goods Vehicle (EV)



2. Diesel Light Goods Vehicle (DV) for Comparison

