

Pilot Green Transport Fund

Final Report

On

Trial of Electric Light Goods Vehicle for University
(The Hong Kong University of Science and Technology)

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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 Period: 1 May, 2016 – 30 April, 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. The Hong Kong University of Science and Technology (HKUST) was approved under the Fund for trial of one electric light goods. Through the tendering procedures stipulated in the Subsidy Agreement, HKUST procured one Nissan e-NV200 electric light goods vehicle (EV) for trial. According to the manufacturer, it has a driving range of 165 km with battery fully charged and air-conditioning off.

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. HKUST assigned a Hyundai diesel light goods vehicle (DV) providing same services, as the conventional counterpart for comparing with the EV.

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

2. Trial Vehicles

2.1 The trial EV – a Nissan e-NV200 electric light goods vehicle – has a gross vehicle weight of 2,250 kg capable of carrying a driver with four passengers and goods. It has a 24 kWh lithium-ion battery pack and the driving range is 165km with air-conditioning off. No designated driver used the EV. The DV – Hyundai 2,497c.c. diesel light goods vehicle – was used as the conventional counterpart for comparison in this trial. The vehicles were used mainly for providing good delivery service for HKUST facility management. Key features of the EV and DV and photos of the vehicles are provided in Appendix 1 and Appendix 2, respectively.

2.2 HKUST has installed a standard charging facility (limited by 10-ampere) at its own cost at LG 5 indoor car park on-campus to charge the batteries of the EV as well as to record the electricity consumed for EV charging. The EV was charged overnight every day (from 17:00 to 08:00 on the next day).

3. Trial Information

3.1 The trial commenced on 1 May 2016 and lasted for 24 months. HKUST was required to collect and provide trial information including the EV mileage reading before charging, amount electricity consumed in each charging, time taken for charging, operation downtime due to charging, cost and downtime associated with scheduled and unscheduled maintenance of the EV. 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 were collected and provided to reflect any problems of the EV.

4. Findings of Trial

4.1 The following table summarizes the statistical data of the EV and the DV.

Table 1: Key operation statistics of each vehicle (1 May 2016 – 30 April 2018)

| | | EV | DV |
|--|------------|----------|---------------------|
| Fuel cost (HK\$) | | 6,613.8 | 34,918.3 |
| Total mileage (km) | | 20,556 | 16,833 |
| Average fuel economy | (km/kWh) | 3.53 | - |
| | (km/litre) | - | 5.65 |
| | (km/MJ) | 0.98 | 0.16 ^[1] |
| Average fuel cost (HK\$/km) ^[2] | | 0.32 | 2.07 |
| Maintenance cost and other cost (HK\$) | | 3,482.0 | 11,100.0 |
| Total operating cost (HK\$) | | 10,095.8 | 46,018.3 |
| Average total operating cost (HK\$/km) | | 0.49 | 2.73 |
| Downtime (working day) ^[3] | | 6 | 8 |

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

[2] The market fuel price was used for calculation

[3] Downtime refers to the equivalent number of working days in which the vehicle is not in operation due to charging, and the period that the vehicle is not in operation due to maintenance, counting from the first day it stops operation till the day it is returned to the operator.

4.2 During the 24 months of the trial, the total mileage and the average daily mileage of the EV were 20,556 km and 42 km/day respectively while those of the DV were 16,833 km and 34 km/day respectively. The average fuel cost of the EV was HK\$1.75 (i.e. about 85%) lower than that of the DV. The average total operating cost of the EV was HK\$2.24/km (i.e. about 82%) lower than that of the DV taking into account the maintenance required.

4.3 Both EV and DV had undergone 3 scheduled maintenances, but had no unscheduled maintenance. Since there were 6 days downtime for the EV, the utilization rate of the EV was 98.8%. There were 8 days downtime for the DV, so its utilization rate was 98.4%.

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. The 12-month moving average varied narrowly from 3.59 to 3.51 km/kWh. There is a very slight drop in fuel economy of the EV over the trial period, but the variation is very narrow that deterioration in fuel economy is insignificant.

4.5 In this 24-month trial period, the total equivalent carbon dioxide (CO₂-e) emission from the EV was 3,036 kg, while that from the conventional vehicle would be 10,082 kg. Hence, there is a reduction of 7,046 kg (70%) CO₂-e emission in this EV trial.

5. Summary

5.1 During the 24 months of the trial, the average fuel cost of the EV was about 85% (i.e., HK\$1.75/km) lower than that of the DV and the average operating cost of the EV was about 82% (i.e., HK\$2.24/km) lower than that of the DV. The utilization rate of EV was 98.8% due to 6-day downtime for scheduled maintenances. The utilization rate of DV was 98.4% due to 8-day downtime for scheduled maintenances.

5.2 The drivers had no problem in operating the EV and both the representative of HKUST and the EV drivers were satisfied with its performance.

5.3 There is no indication that the fuel economy has significantly deteriorated in the trial period.

5.4 The trial showed that under local operating conditions where air-conditioning is essential, the Nissan e-NV200 electric light goods vehicle could meet HKUST's daily mileage requirements.

Appendix 1: Key Features of the Vehicles Involved in the Trial

1. Trial EV


| | |
|--------------------------|-------------------------------|
| Registration mark | UA5744 |
| 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 |
| Year of manufacture: | 2015 |

2. DV Used for Comparison

| | |
|--------------------------|-----------------------|
| Registration mark | RD5020 |
| Make: | Hyundai |
| Model: | H1 Van Standard |
| Class: | Light goods vehicle |
| Gross vehicle weight: | 3,230 kg |
| Seating capacity: | driver + 5 passengers |
| Cylinder capacity: | 2,497 cc |
| Year of manufacture: | 2011 |

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV and Charging Facility

| | |
|---|---|
|  A silver Nissan van with license plate UA 5744 parked in front of a building with blue doors. A timestamp '08/05/2018 16:01' is visible in the bottom right corner. |  Rear view of the silver van UA5744. The license plate is clearly visible. A timestamp '08/05/2018 16:02' is visible in the bottom right corner. |
| UA5744 – front view | UA5744 – rear view |
|  Side view of the silver van UA5744 parked in a lot. The side of the van has text in Chinese and English. A timestamp '08/05/2018 16:02' is visible in the bottom right corner. |  Another side view of the silver van UA5744 from a slightly different angle. A timestamp '08/05/2018 16:02' is visible in the bottom right corner. |
| UA5744 – side view 1 | UA5744 – side view 2 |
|  A close-up of the charging station for van UA5744. It features a watt-hour meter and a charging port. The label 'UA 5744' is visible. A timestamp '08/05/2018 16:10' is visible in the bottom right corner. | |
| Battery charger with watt-hour meter (HKUST installed at its own cost) | |

2. DV for Comparison

| | |
|--|---|
|  |  |
| RD5020 – front view | RD5020 – rear view |
|  |  |
| RD5020 – side view 1 | RD5020 – side view 2 |