

Pilot Green Transport Fund

Final Report On Trial of Electric Light Goods Vehicle for Logistics Service (Airport Freight Forwarding Centre Co. Ltd)

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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 Logistics Service
(Airport Freight Forwarding Centre Co. Ltd)**

**Final Report
(Trial Period: 1 July 2017 – 30 June 2019)**

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. Airport Freight Forwarding Centre Company Limited (AFFC) was approved under the Fund for trial of one electric light goods vehicle, with the associated charging facilities, for logistics service. AFFC, through the tendering procedures stipulated in the Subsidy Agreement (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 (PTeC) has been engaged by the Environmental Protection Department (EPD) as an independent third party assessor (the Assessor) to monitor the trial and evaluate the performance of the trial vehicle. AFFC also assigned a conventional counterpart, an Isuzu diesel light goods vehicle (DV) which had a 2,499 c.c. engine and provided same type of service as the EV, 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.

2. Trial Vehicles

2.1 Key features of the EV, the EV 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 mails from the AFFC Chek Lap Kok office to the AFFC Wan Chai office, for the delivery of materials to Tung Chung, and for patrol within the AFFC. According to the EV's manufacturer, it has a travel range of 165 km, with its battery fully charged and air-conditioning off. AFFC had assigned a conventional counterpart, an Isuzu diesel light goods vehicle (DV) which had a 2,499 c.c. engine and provided same type of service as the EV, for comparison.

2.2 AFFC has installed a 32-ampere charger with a watt-hour meter to charge the batteries of the EV as well as to record the electricity consumed for EV charging. The EV was normally charged during day time when its service was not required.

3. Trial Information

3.1 The trial commenced on 1 July 2017 and lasted for 24 months. AFFC was required to collect and provide trial information including EV mileage reading before charging, amount of electricity consumed and time taken for charging, 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 and submitted to reflect any problems of the EV.

4. Findings of Trial

4.1 Operating Costs

4.1.1 The key operation statistics of the EV and the DV are summarized in Table 1. The average fuel cost of the EV was HK\$1.39/km (82%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle (1 July 2017 – 30 June 2019)

| | | EV | DV |
|---|------------|-----------|---------------------|
| Total distance travelled (km) | | 4,468 | 2,268 |
| Average daily distance travelled (km/day) | | 9.2 | 5.4 |
| Fuel cost (HK\$) | | 1,341 | 3,830 |
| Average fuel economy | (km/kWh) | 3.71 | - |
| | (km/litre) | - | 7.82 |
| | (km/MJ) | 1.03 | 0.22 ^[1] |
| Average fuel cost (HK\$/km) | | 0.30 | 1.69 |
| Average total operating cost (HK\$/km) | | 2.75 | 18.63 |
| Downtime ^[2] (working days) | | 6 | 73 |

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

^[2] Downtime refers to the equivalent number of working days in which 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.

4.1.2 Apart from the fuel cost, maintenance cost and other indirect costs, which may include parking fee, towing fee, vehicle replacement fee and cost of operation downtime due to charging and maintenance of the EV are included in the average total operating cost. The average total operating cost of the EV was HK\$15.88/km (85%) lower than that of the DV.

4.1.3 During the trial period, the EV had two scheduled maintenances which incurred 6 days of downtime; while the DV had two scheduled and one unscheduled maintenances, with 73 days of downtime in total. The scheduled maintenance of the EV involved annual service and annual inspection. The scheduled maintenance of the DV involved annual inspection and general maintenance for passing the annual inspection. The unscheduled maintenance of the DV involved replacement of the clutch and the flywheel.

4.1.4 The 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 During the trial period, the downtimes were 6 days and 73 days for the EV and the DV, respectively. There were 491 working days in the trial period, thus, the utilization rates were 99% for the EV and 85% for the DV.

4.2 Performance and Reliability

4.2.1 In the 24 months of the trial, the total mileage and the average daily mileage were 4,468 km and 9.2 km/day respectively for the EV; and 2,268 km and 5.4 km/day for the DV.

4.2.2 The EV driver had no problem in operating the EV and was satisfied with its performance. Overall, AFFC agreed that using electric vehicle is good because it can provide a greener and quiet environment as well as its much lower fuel cost. AFFC will consider replacing all existing conventional vehicles with electrical 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. The 12-month moving average fuel economy dropped from 3.81 to about 3.6 km/kWh for the EV, indicating that there was a slight deterioration in the fuel economy of the EV in the 24-month trial period.

4.2.4 The rated capacity of the battery is 24 kWh. During the last few months of the trial period, due to the low mileage of the EV, the amount of electricity charged was low. Although there was indication that the fuel economy the EV had slight deteriorated in the trial period, it could not be concluded if the battery charge capacity had deteriorated or not in the trial period due to the low mileage of the EV.

4.2.5 The CO₂ equivalent (CO₂e) emissions from the EV and the DV were 614 kg and 1,584 kg, respectively. Compared with the DV, there was a total reduction of 970 kg CO₂e emission (i.e., around 61%) 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\$1.39/km or 82%. The average total operating cost for the EV was also HK\$15.88/km (85%) 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, utilization rate was 99% for the EV.

5.3 The 12-month moving average fuel economy dropped from 3.81 to 3.6 km/kWh for the EV, indicating a slight deterioration in the fuel economy of the EV; however, it could not be concluded if the battery charge capacity had deteriorated or not in the trial period due to the low mileage of the EV.

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 AFFC' 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 Facility

1. Trial EV

| | |
|-----------------------------------|-------------------------------|
| Registration mark | UW3438 |
| 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 after fully charged: | 165 km (air conditioning off) |
| Maximum speed: | over 120 km/h |
| Battery material: | lithium-ion |
| Battery capacity: | 24 kWh |
| Payload load: | 620 kg |
| Year of manufacture: | 2017 |

2. EV Charging Station

| | |
|--------------------|----------------------------|
| Maker: | Hong Kong EV Power Limited |
| Model: | EVC-32N |
| Charging Standard: | IEC62196 |
| Charging Mode: | 340V / 32A (max.), AC |

3. DV Used for Comparison

| | |
|--------------------------|-----------------------|
| Registration mark | MB6090 |
| Make: | Isuzu |
| Model: | TFR54HDR |
| Class: | Light Goods Vehicle |
| Seating capacity: | driver + 4 passengers |
| Gross vehicle weight: | 2,800 kg |
| Cylinder capacity: | 2,499 cc |
| Year of manufacture: | 2005 |

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV



EV – front view



EV –end view



EV – side view 1



EV – side view 2

2. EV Charging Station



EV – battery charger



EV-watt-hour meter

3. DV used for Comparison



DV – front view