Pilot Green Transport Fund

Final Report
On
Trial of Hybrid Light Goods Vehicle for Logistics Service
(P & J Logistics Limited)

(5 August 2021)

PREPARED BY:
Dr. D.W. Yuen

List of Monitoring and Evaluation Team Members

Dr. C.S. Cheung (Team Leader)
Professor
Department of Mechanical Engineering
The Hong Kong Polytechnic University

Dr. Edward W.C. Lo (Deputy Team Leader)
Associate Professor
Department of Electrical Engineering
The Hong Kong Polytechnic University

Ir. Dr. C. Ng
Senior Technical Officer
Department of Mechanical Engineering
The Hong Kong Polytechnic University

Dr. W.T. Hung
PolyU Technology and Consultancy Company Limited
The Hong Kong Polytechnic University

Dr. David Yuen
PolyU Technology and Consultancy Company Limited
The Hong Kong Polytechnic University

Pilot Green Transport Fund
Trial of Hybrid Light Goods Vehicle for Logistics Service
(P & J Logistics Limited)

Final Report
(Trial Period: 1 March 2019 – 28 February 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 and innovative transport technologies, contributing to better air quality and public health for Hong Kong. The Fund has subsidized P&J Logistics Limited (P & J) to try out one diesel-electric hybrid light goods vehicle (HV) for logistics service.

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 operational performance of the trial vehicle. The Assessor regularly visited P & J to collect information for evaluating the performance of the HV and compared it with the performance of a diesel light goods vehicle (DV) which provided the same service in the same areas. The information collected includes the said vehicles' operation data, fuel bills, maintenance records, reports on operation difficulties, and opinions of the HV driver and P & J from survey questionnaires.

1.3 This Final Report summarizes the performance of the HV for logistics service in the 24-month of the trial as compared with the DV.

2. Trial and Conventional Vehicles

2.1 P & J procured one Mitsubishi Fuso diesel-electric hybrid light goods vehicle (i.e. HV) with gross vehicle weight (GVW) of 5,500 kg and cylinder capacity of 2,998 cc for trial. One Isuzu diesel light goods vehicle (i.e. DV) of GVW of 5,500 kg and cylinder capacity of 5,193 cc operating in the same service areas was assigned for comparison with the HV.

2.2 Both HV and DV are stationed at a Kwai Chung car park near Tsuen Tsing Interchange and they are providing logistic service between Tsuen Wan and Chai Wan. The HV ran on Mondays, Wednesdays and Fridays from 08:00 to 18:30 between Tsuen Wan and Chai Wan. The DV ran on Tuesdays and Thursdays from 08:00 to 18:30 between Tsuen Wan and Chai Wan and only ran in Tsuen Wan on Saturdays. Both vehicles did not provide service on Sundays.

2.3 Key features and photos of the HV and DV are in Appendix 1 and Appendix 2, respectively.

3. Trial Information

3.1 The trial commenced on 1 March 2019 and would last for 24 months. P & J was required to collect and provide trial information including the HV's mileage reading before refueling, amount and cost of fuel in each refueling, and the cost and operation downtime associated with scheduled and unscheduled maintenances of the HV. 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 P & J were collected to reflect any problems of the HV.

4. Findings of Trial

4.1 Table 1 shows a summary of all the key operation statistics for each vehicle. The average fuel cost of HV was lower than that of the DV by HK$0.19/km (i.e., about 7%) and the average fuel economy of HV was higher than that of the DV by 0.40 km/litre (i.e., about 7%). Taking the maintenance cost in account, the average total operating cost of the HV was HK$0.30/km (i.e. about 10%) lower than that of the DV.

Table 1: Key operation statistics of each vehicle (1 March 2019 – 28 February 2021)

	HV	**DV**
Total distance traveled (km)	63,407	94,520
Average daily mileage (km/working day)	204	307
Average fuel economy (km/litre)	5.76	5.36
Average fuel cost (HK$/km) [1]	2.504	2.697
Average total operating cost (HK$/km) [2]	2.73	3.03
Downtime (working days) [2] [3]	2 [4]	5

[1] The market fuel price was used for calculation

[2] Maintenance due to incident not related to the performance of the vehicle was not included for comparing the performance

[3] Downtime refers to the equivalent number of working days in which the vehicle was not in operation due to maintenance, counting from the first day it stopped operation till the day it was returned to the operator.

[4] All HV maintenances were arranged on Tuesday and Saturday, which are non-working day of HV. These maintenance days were not counted as downtime.

4.2 During the trial period, the HV had undergone five scheduled maintenances and four unscheduled maintenances while the DV had undergone three scheduled maintenances and two unscheduled maintenances. Since all the HV maintenances were arranged on Tuesday and Saturday, which are non-working days of HV. These maintenance days were not counted as operation downtime. Both the HV and DV were operated 3 days per week. There were 313 working days in the 24 months of the trial period, and the HV and the DV had 2 days and 5 days of operation downtime, respectively. The utilization rates of the HV and DV were therefore 99.4% and 98.4% respectively.

4.3 P & J had a designated driver for the HV. The driver of the HV reflected that he had no problem in its operation. However, the driver reflected that the HV was less powerful than the DV when driving upslope, and responded slower than the DV. P & J was satisfied with the performance of the HV and considered that using hybrid light goods vehicle is good because it can provide a greener environment.

4.4 To remove the effect of seasonal fluctuations, 12-month moving averages are used to evaluate the trend of the HV's fuel economy. The results show that fuel economy of the HV appeared to improve slightly towards the end of the trial. It appears that the engine of the HV was still in normal working condition and the fuel economy could be maintained through proper maintenance.

4.5 The carbon dioxide equivalent (CO_2e) emission from HV was 30,503 kg while that from DV on the respective HV mileage was 32,773 kg. There was a total reduction of 2,270 kg CO_2e emission (i.e., about7%) by using HV in the trial period. Therefore, the adoption of HV in this trial could provide obvious environmental benefit.

5. Summary

5.1 In the 24-month trial period, the average daily mileage of HV was 204 km while that for DV was 307 km. The HV had a better fuel economy than the DV. The average fuel cost of the HV was HK$0.19/km (i.e., about 7%) lower than that of the DV. Including the maintenance costs, the average total operating cost of the HV was HK$0.30/km (i.e., about 10%) lower than that of the DV. There was 2,270 kg CO_2e emission reduction (i.e. about 7%) by using the HV during the 24-month trial period as compared with the DV.

5.2 Excluding the downtime of vehicles unrelated to their performance due to the scheduled and unscheduled maintenances, the HV had 2 days downtime while the DV had 5 days downtime in the 24-month trial period. The utilization rate of the HV was therefore 99.4% while that of the DV was 98.4%.

5.3 No deterioration in the performance of the HV was observed during the trial period.

5.4 In the 24-month trial period, the operation of the HV was smooth. The driver of the HV found no problem in operating the HV. However, the driver reflected that the HV was less powerful than the DV when driving upslope and responded slower than the DV. P & J was satisfied with the performance of the HV and considered that using hybrid light goods vehicle can provide a greener environment.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark:	**VY573 (HV)**
Make:	Mitsubishi Fuso
Model:	FEB74GR3SDAL
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	Driver + 2 passengers
Cylinder capacity:	2,998 cc
Year of manufacture:	2017

2. DV used for comparison

Registration Mark:	**UG7989 (DV)**
Make:	Isuzu
Model:	NPR75HH-V
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	Driver + 2 passengers
Cylinder capacity:	5,193 cc
Year of manufacture:	2011

Appendix 2: Photos of Vehicles

1. Trial HV

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>HV (VY573) (front view)</td><td>HV (VY573) (rear view)</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>HV (VY573) (side view)</td><td>HV (VY573) (side view)</td></tr>
</table>

2. DV used for comparison

	
DV (UG7989) (front view)	DV (UG7989) (rear view)
	
DV (UG7989) (side view)	DV (UG7989) (side view)