Pilot Green Transport Fund

Final Report
On
Trial of Hybrid Light Goods Vehicles for Logistics Services (Po Tak Transport Limited)

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Trial of Hybrid Light Goods Vehicles for Logistics Services
(Po Tak Transport Limited)

Final Report
(Trial Period: 1 November 2018 – 31 October 2020)

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. Po Tak Transport Limited (Po Tak) was approved under the Fund for trial of three diesel-electric hybrid light goods vehicles (HVs) for logistic 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 this trial and evaluate the operational performance of the trial vehicles. The Assessor regularly visited Po Tak to collect information for evaluating the performance of the three HVs as compared with the three conventional diesel light goods vehicles (DVs) which provided the same service in the same area and road conditions. The information collected included the said vehicles' operation data, fuel bills, maintenance records, reports on operation difficulties, and opinions of the HVs drivers and Po Tak from survey questionnaires.

1.3 This Final Report summarizes the performance of the HVs for logistics services in the 24-month trial as compared with their respective conventional counterparts, i.e. the DVs.

2. Trial and Conventional Vehicles

2.1 Po Tak procured three Hino 300 series diesel-electric hybrid light goods vehicles (HV-1, HV-2 and HV-3) each of 5,500 kg gross vehicle weight (GVW) and 4,009 cc cylinder capacity for trial.

2.2 Po Tak assigned three 5,500 kg GVW diesel light goods vehicles (DVs) (i.e., one ISUZU LGV (DV-1) with cylinder capacity of 4,751 cc; one ISUZU LGV (DV-2) with cylinder capacity of 5,193 cc and one Mitsubishi FUSO LGV (DV-3) with cylinder capacity of 2,998 cc) for comparison with the HVs. All vehicles were equipped with air-conditioning units. The diesel vehicle for DV-1 was replaced twice in this 24-month trial period due to the retirement and the resale of the respective DVs.

2.3 Key features and photos of the HVs and DVs are in Appendix 1 and Appendix 2, respectively

3. Trial Information

3.1 The 24-month trial started on 1 November 2018. One pair of vehicles (HV-1 and DV-1) operated from the Airport Freight Forwarding Centre (AFFC) on the Airport Island in North Lantau to deliver freight to areas in Kowloon and Hong Kong Island and two pairs of vehicles (HV-2 and DV-2 as well as HV-3 and DV-3) operated from Kwai Chung Container Terminal 3 (T3) to deliver freight to all districts in Hong Kong. There was no fixed route. The vehicles provided service on Monday to Saturday from 08:00 to 19:30 except Sundays and public holidays.

4. Findings of Trial

4.1 Table 1 shows a summary of all the key operation statistics for each vehicle. The average fuel costs of HV-1 and HV-3 were lower than those of DV-1 and DV-3 by about 8% and about 36%, respectively but the average fuel costs of HV-2 was higher than that of DV-2 by about 5%. The driver of HV-2 was probably an aggressive driver (had two careless crashes) leading to poor fuel economy. The fleet average fuel cost of the three HVs was about 17% (i.e., HK$0.5/km) lower than that of the DVs. The average fuel economies of HV-1 and HV-3 were higher than those of DV-1 and DV-3 by about 8% and about 58%, respectively while the average fuel economy of HV-2 was lower than that of DV-2 by about 5%. The fuel economies of the HVs fluctuated in a narrower margin than the DVs probably because the DVs varied in age and engine size. Since there were 3 HVs and 3 DVs used in the trial for comparison purpose, the results of the fleet HVs was compared with the results of the fleet DVs. The fleet average fuel economy of the HVs was about 16% (i.e., 0.77 km/litre) higher than that of the DVs.

4.2 The average total operating costs of HV-1 and HV-3 were about 6% and about 38% lower than those of DV-1 and DV-3, respectively. The fuel pump of DV-3 was problematic leading to poor fuel economy; fuel economy returned to a comparative level after replacing the pump in the last few months of the trial. The average total operating costs of HV-2 was about 4% higher than that of DV-2. The fleet average total operating cost of three HVs was about 18% (i.e., HK$0.61/km) lower than that of the DVs.

Table 1: Key operation statistics of each vehicle (November 2018 – October 2020)

	HVs			**DVs**		
	HV-1	**HV-2**	**HV-3**	**DV-1**	**DV-2**	**DV-3**
Total distance traveled (km)	100,335	109,391	26,123	29,067	73,418	43,605
Average daily distance traveled (km/day)	169	184	44	49	124	73
Average fuel economy (km/litre)[1]	5.78	5.47	5.81	5.35	5.74	3.67
Average fuel cost (HK$/km)	2.46	2.60	2.46	2.68	2.47	3.87
Fleet average fuel cost (HK$/km)	2.51			3.01		
Average total operating cost [2] (HK$/km)	2.60	2.75	2.89	2.77	2.64	4.64
Fleet average total operation cost (HK$/km)	2.75			3.35		
Downtime (working day)[3]	8.5	6.5	4	1	3	7

[1] The market fuel price was used for calculation

[2] Maintenance due to incident not related to the performance of the vehicles 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.

4.3 Excluding the downtime of vehicles un-related to their performance due to the scheduled and unscheduled maintenance, HV-1, HV-2 and HV-3 had 8.5 days, 6.5 days and 4 days downtime, respectively while DV-1, DV-2 and DV-3 had 1 day, 3 days and 7 days downtime, respectively. The utilization rates of HV-1. HV-2 and HV-3 were 98.6%, 98.9% and 99.3%, respectively while those of DV-1, DV-2 and DV-3 were 99.8%, 99.5% and 98.8%, respectively.

4.4 Po Tak had designated drivers for the HVs. The drivers found no problem in operating the HVs and in general felt the HVs were clean and less polluted. However, they reflected that the HVs responded slower and less powerful than the DVs especially when driving upslope. Po Tak was satisfied with the HVs and would consider replacing the entire vehicle fleet with hybrid vehicles because the hybrid vehicles are on average better performed than the conventional diesel vehicles in particular the fuel economy.

4.5 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 economies of the HVs fluctuated slightly over the 24-month trial period. It appears that the engines of the HVs were still in normal working conditions and the fuel economy could be maintained through proper maintenance.

4.6 The carbon dioxide equivalent (CO_2e) emissions from HV-1, HV-2 and HV-3 were 48,159 kg, 55,418 kg and 12,467 kg, respectively while those from DV-1, DV-2 and DV3 on HVs mileages would be 51,969 kg, 52,856 kg and 19,728 kg, respectively. There was thus a total reduction of 8,509 kg CO_2e emission (i.e., around 7%) in the trial by using the three HVs compared with the three DVs.

5. Summary

5.1 With a total of 593 working day in the 24-month trial period, the average daily mileages of HV-1, HV-2 and HV-3 were 169 km, 184 km and 44 km, respectively while those for DV-1, DV-2 and DV-3 were 49, 124 and 74 km, respectively. Excluding the downtime of vehicles un-related to their performance due to the scheduled and unscheduled maintenances, the utilization rates of HV-1, HV-2 and HV-3 were 98.6%, 98.9% and 99.3%, respectively while those of DV-1, DV-2 and DV-3 were 99.8%, 99.5% and 98.8%, respectively.

5.2 The fleet average fuel cost of the three HVs was about 17% lower than that of the DVs. Including the maintenance costs, the fleet average total operating cost of the three HVs was about 18% lower than that of the DVs. There was 7% CO2e reduction by using HVs during the 24-month trial period as compared with DVs.

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

5.4 The drivers had no problem in operating the HVs except that the HVs responded slower and had less power than the DVs especially when driving upslope. Po Tak was satisfied with the HVs and would consider replace the entire light goods vehicle fleet with the HVs because of the overall benefits of the HVs.

Appendix 1: Key Features of Vehicles

1. Trial HVs

Registration Mark:	**HA313 (HV-1) / NY6772 (HV-2)**
Make:	HINO
Model:	300 Series Hybrid XKU720R-HKUQS3
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	driver + 2 passengers
Cylinder capacity:	4,009 cc
Year of manufacture:	2018

Registration Mark:	**SY101 (HV-3)**
Make:	HINO
Model:	300 Series Hybrid XKU710R-HKUQS3
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	driver + 2 passengers
Cylinder capacity:	4,009 cc
Year of manufacture:	2018

2. DVs used for comparison

Registration Mark:	**MA9256 (DV-1)**
Make:	ISUZU
Model:	NPR70PU-5JM-D
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating Capacity:	driver + 2 passengers
Cylinder capacity:	4,751 cc
Year of manufacture:	2005

Registration Mark:	**VP3513 replaced MA9256 from Mar 2019 (DV-1)**
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:	2018

Registration Mark:	**TE8454 replaced VP3513 from Sep 2019 (DV-1)**
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:	2010

Registration Mark:	**VG4525 (DV-2)**
Make:	ISUZU
Model:	NPR75KH-V
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating Capacity:	driver + 2 passengers
Cylinder capacity:	5,193 cc
Year of manufacture:	2014

Registration Mark:	**SJ8926 (DV-3)**
Make:	MITSUBISHI FUSO
Model:	FEC71GR4SDAD
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating Capacity:	driver + 2 passengers
Cylinder capacity:	2,998 cc
Year of manufacture:	2013

Appendix 2: Photos of the Trial Vehicles

1. **Trial HVs**

HV-1

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Front view of HV-1 (HA313)</td><td>Right side view of HV-1</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Left side view of HV-1</td><td>Rear view of HV-1</td></tr>
</table>

HV-2

	
Front view of HV-2 (NY6772)	Right side view of HV-2
	
Left side view of HV-2	Rear view of HV-2

HV-3

	
Front view of HV-3 (SY101)	Right side view of HV-3
	
Left side view of HV-3	Rear view of HV-3

2. DVs used for comparison

DV-1

	
Front view of DV1(MA9256)	Front view of VP3513 replaced MA9256 from Mar 2019 (DV-1)


Front view of TE8454 replaced VP3513 from September 2019 (DV-1)

DV-2

	
Front view of DV-2(VG4525)	Right side view of DV-2
	
Left side view of DV-2	Rear view of DV-2

DV-3

	
Front view of DV-3(SJ8926)	Right side view of DV-3
	
Left side view of DV-3	Rear view of DV-3