

Pilot Green Transport Fund

Final Report On Trial of Hybrid Medium Goods Vehicles for Logistics Services (Po Tak Transport 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 Hybrid Medium 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 medium goods vehicles (HVs) 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 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 medium 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 medium goods vehicles (HV-1, HV-2 and HV-3) each with a gross vehicle weight (GVW) of 8,500 kg and cylinder capacity of 4,009 cc capable of carrying a driver with two passengers and goods for trial.

2.2 Po Tak assigned three diesel medium goods vehicles (MGVs) (including two HINO MGVs with GVW of 16,000 kg and cylinder capacity of 7,684cc each for DV-1 and DV-3, and one ISUZU MGV with GVW of 15,000 kg and cylinder capacity of 7,790 cc for DV-2) each capable of carrying a driver with two passengers and goods, for comparison with the HVs. All vehicles were equipped with air-conditioning units. Two pairs of vehicles in trial (HV-1 and DV-1 as well as HV-2 and DV-2) operated from Kwai Chung Container Terminal 3 (T3) to deliver freight to all districts in Hong Kong, while one pair of vehicles (HV-3 and DV-3) operated from AFFC to deliver freight to Kowloon and Hong Kong Island areas. There was no fixed route. The vehicles provided logistic services every day from 08:00 to 19:30 from Monday to Saturday, excluding Sundays and public holidays.

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. Po Tak was required to collect and provide trial information including the mileage reading at refuelling, date of refuelling and refuelled amount, costs and operation downtime associated with scheduled and unscheduled maintenances of the HVs. Similar monthly data from the DVs were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Po Tak were collected to reflect any problems of the HVs.

4. Findings of Trial

4.1 Table 1 shows a summary of all key operation statistics for each vehicle. The average fuel costs of HV-1, HV-2 and HV-3 were lower than those of DV-1, DV-2 and DV-3 by 50%, 37% and 22%, respectively. The fleet average fuel cost of the three HVs was 38% (i.e., HK\$1.49/km) lower than that of the DVs. The average fuel economies of HV-1, HV-2 and HV-3 were higher than those of DV-1, DV-2 and DV-3 by 99%, 61% and 30%, respectively. The fuel economy of DV-1 was worst out of the three DVs probably because of its problematic fuel pump which was consistently repaired and eventually replaced. The fleet average fuel economy of the HVs was 60% (i.e., 2.20 km/litre) higher than that of the DVs.

4.2 The average total operating costs of HV-1, HV-2 and HV-3 were 56%, 45% and 22% lower than those of DV-1, DV-2 and DV-3, respectively and the fleet average total operating cost of the three HVs was 43% (HK\$2.03/km) lower than that of the DVs.

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

	HV _s			DV _s		
	HV-1	HV-2	HV-3	DV-1	DV-2	DV-3
Total distance traveled (km)	57,647	56,361	78,107	83,905	48,434	94,831
Average daily distance traveled (km/day)	97	95	132	141	82	160
Average fuel economy (km/litre) ^[1]	6.21	5.93	5.53	3.11	3.69	4.26
Average fuel cost (HK\$/km)	2.29	2.39	2.59	4.56	3.83	3.33
Fleet average fuel cost (HK\$/km)	2.42			3.91		
Fleet average fuel economy (km/litre)	5.89			3.69		
Average total operating cost (HK\$/km) ^[2]	2.51	2.76	2.76	5.65	4.97	3.51
Fleet average total operating cost (HK\$/km)	2.68			4.71		
Downtime (working day) ^[3]	5.5	9.5	5	10	25	6

^[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 Out of the 593 working days in the trial, HV-1, HV-2, HV-3, DV-1, DV-2 and DV-3 had 5.5 days, 9.5 days, 5 days, 10 days, 25 days and 6 days downtime respectively, excluding the downtime resulting from those maintenances un-related to the performance of the vehicles. The utilization rates were 99.1%, 98.4% and 99.2% for HV-1, HV-2 and HV-3; and 98.3%, 95.8% and 99.0% for DV-1, DV-2 and DV-3, 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 when driving uphill. Po Tak was satisfied with the HVs in general and would consider replacing the entire medium goods vehicle fleet with hybrid vehicles because the hybrid vehicles were 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 24,517 kg, 25,080 kg and 37,270 kg, respectively while those from the conventional vehicles DV-1, DV-2 and DV3 on HVs mileages were 48,889 kg, 40,313 kg and 48,357 kg, respectively. There was thus a total emission reduction of 50,693 kg CO_{2e} emission (37%) 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 97 km, 95 km and 132 km, respectively while those of DV-1, DV-2 and DV-3 were 141 km, 82 km and 160 km, respectively. The utilization rates were 99.1%, 98.4% and 99.2% for HV-1, HV-2 and HV-3 respectively; and 98.3%, 95.8% and 99.0% for DV-1, DV-2 and DV-3 respectively.

5.2 The fleet average fuel cost of the three HVs was 38% lower than that of the DVs. Including the maintenance costs, the fleet average total operating cost of the three HVs was 43% lower than that of the DVs. There was 37% CO_{2e} emission 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 but felt that the HVs responded slower than the DVs and had less power than the DVs especially when driving uphill. Po Tak was satisfied with the overall performance of the HVs and would consider replacing the entire medium goods vehicle fleet with hybrid medium goods vehicles.

Appendix 1: Key Features of Vehicles

1. Trial HVs

Registration Mark : GR1031 (HV-1)
Make: HINO
Model: 300 Series Hybrid XKU730R-HKUTS3
Class: Medium goods vehicle
Gross vehicle weight: 8,500 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 4,009 cc
Year of manufacture: 2018

Registration Mark : LS706 (HV-2) / MB45 (HV-3)
Make: HINO
Model: 300 Series Hybrid XKU720R-HKUTS3
Class: Medium goods vehicle
Gross vehicle weight: 8,500 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 4,009 cc
Year of manufacture: 2018

2. DVs used for comparison

Registration Mark : KONGKING (DV-1)
Make: HINO
Model: GH8JPKA
Class: Medium goods vehicle
Gross vehicle weight: 16,000 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 7,684 cc
Year of manufacture: 2009

Registration Mark : DZ3299 (DV-2)
Make: ISUZU
Model: FTR34P-6S
Class: Medium goods vehicle
Gross vehicle weight: 15,000 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 7,790 cc
Year of manufacture: 2006

Registration Mark : UC709 (DV-3)
Make: HINO
Model: 500 SERIES GH8JSMA
Class: Medium goods vehicle
Gross vehicle weight: 16,000 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 7,684 cc
Year of manufacture: 2017

Appendix 2: Photos of Vehicles

1. Trial HVs

HV-1

	
Front view of HV-1(GR1031)	Left side view of HV-1
	
Right side view of HV-1	Rear view of HV-1

HV-2



Front view of HV-2(LS706)



Left side view of HV-2



Right side view of HV-2



Rear view of HV-2

HV-3



Front view of HV-3(MB45)



Left side view of HV-3



Right side view of HV-3



Rear view of HV-3

2. DVs used for comparison

DV-1

	
Front view of DV-1 (KONGKING)	Left side view of DV-1
	
Right side view DV-1	Rear view of DV-1

DV-2



Front view of DV-2 (DZ3299)



Left side view of DV-2



Right side view of DV-2



Rear view of DV-2

DV-3



Front view of DV-3 (UC709)



Left side view of DV-3



Right side view of DV-3



Rear view of DV-3