

Pilot Green Transport Fund

Final Report

On

Trial of Hybrid Light Goods Vehicles for Courier Service (UPS)

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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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Final Report
(Trial Period: 1 June, 2013 – 31 May, 2015)

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 UPS Parcel Delivery Service Limited (UPS) to try two hybrid light goods vehicles for courier service.

1.2 PolyU Technology and Consultancy Company Limited (PolyU) has been engaged by Environmental Protection Department as an independent third party assessor to monitor the trials and evaluate the operational performance of the trial vehicles. PolyU regularly visited UPS to collect information for evaluating the performance of the hybrid light goods vehicles (HVs) as compared with the diesel light goods vehicles (DVs) which provided the same service. The information collected includes the said vehicles' operation data, fuel bills, maintenance records, reports on operation difficulties, and opinions of the HV drivers from survey questionnaires.

1.3 This Final Report summarizes the performance of the HVs for courier service in the twenty four months of the trial as compared with their conventional counterparts.

2. Trial Vehicles

2.1 UPS procured two 5.5 tonnes GVW HINO 300 Series hybrid light goods vehicles (HV-1 and HV-2) of 4009 cc cylinder capacity for trial.

2.2 Two 5.5 tonnes GVW conventional diesel vehicles - one Isuzu Euro V light goods vehicle with a 5193 cc engine (DV-1) and the other Mitsubishi Canter Euro IV light goods vehicle with 4899 cc engine (DV-2) - were assigned for comparison with the two HVs. Although the DVs might not operate in the same route and same conditions as the HVs owing to the constraints of orders received, they were the best vehicles, in terms of tonnage, age and service areas, that could be identified for comparison.

2.3 Key features and photos of the HVs and DVs are in Appendices 1 and 2 respectively.

3. Trial Information

3.1 The 24-month trial started on 1 June 2013. HV-1 and HV-2 are stationed at Kowloon Bay and Lai Chi Kok respectively. UPS designated two conventional vehicles (i.e. DV-1 and DV-2) that stationed in the same depot but made regular trips to the airport for comparison. Despite operating in different routes and road conditions, DV-1 and DV-2 are still taken as comparison vehicles for HV-1 and HV-2 because UPS had no other non-van type light goods vehicles serving the same urban areas. The vehicles provide service from Monday to Saturday, 11 hours per day according to the daily plan. There is no service on Sundays and public holidays.

4. Findings of Trial

4.1 Operating Costs

4.1.1 During this 24-month report period, HV-1 and HV-2 travelled 6,243 km and 4,307 km respectively whereas DV-1 and DV-2 travelled 55,077 km and 57,916 km respectively. The performance of the HVs and DVs, and their average operating costs in the 24-months trial period are summarized below:

Table 1: Operational cost of each vehicle

	Hybrid Light Goods Vehicles		Diesel Light Goods Vehicles	
	HV-1	HV-2	DV-1	DV-2
Average fuel economy, km/litre	3.44	2.99	5.52	5.37
Average fuel cost, \$/km ^[1]	3.60	4.11	2.23	2.27
Average total operating cost, \$/km ^{[1],[2]}	5.69	7.13	2.55	2.69

[1] The market fuel price was used for calculation

[2] Including costs incurred from maintenance

4.1.2 The DVs were assigned to run between the airport and Kowloon depots and thus travelled on the high speed roads and long distance that led to good fuel economy. The HVs however were assigned to perform pickup and delivery operation with very frequent stops in the urban areas of Kowloon East and Kowloon West respectively; the travel speed was low and the distance travelled was short. Therefore, under these very different operating conditions of the HVs and DVs, comparison on fuel savings between them is considered inappropriate. The average fuel

costs of HV-1 and HV-2 were \$3.60/km and \$4.11/km respectively, while that of DV-1 and DV-2 were \$2.23/km and \$2.27/km respectively.

4.1.3 According to the manufacturer's information, the trial vehicle model could save about 15% fuel as compared with its diesel counterpart according to the calculation method approved by the Ministry of Land, Infrastructure, Transport and Tourism of Japan. Fuel economy depends on road condition. If it travels more in suburban areas or on highways, there would be less fuel saving because the energy recovered by the electric generator at start-stops is much reduced. It should be noted that the HVs are Hino make while the DVs are Isuzu and Mitsubishi make which have a different engine design, therefore the manufacturer's fuel saving information is less applicable to this case.

4.1.4 Besides fuel costs, maintenance cost and other costs associated with breakdowns, such as replacement of components and parts, were also accounted for in calculating the total operating cost. UPS paid \$543 per month for the scheduled maintenance of each HV. It should be noted that the unscheduled maintenance cost of the hybrid vehicles did not include labor cost as the vehicles were still under warranty, the labor cost was waived and only the parts to be replaced were charged. The total operating cost of HV-1 and HV-2 was \$5.69/km and \$7.13/km respectively.

4.1.5 During the 24-month trial period, HV-1 and HV-2 had three scheduled maintenance each involving routine and annual checking. HV-1 had nine unscheduled maintenance; eight involved failure of the engine control resulting in either re-adjusting or replacing the engine computer. HV-2 had seven unscheduled maintenance; three involved failure of starting up the engine, two involved tailgate problems, and the other involved a damaged door lock. As the tailgate and door lock maintenance were not related to the performance of HV-2, the associated costs were excluded in comparison. The total operation downtime for HV-1 was 37 days while for HV-2 was 13 days. The utilization rates of HV-1 and HV-2 were 94% and 98% (592 working days) respectively, which were close to the DVs (99%).

4.2 Performance and Reliability

4.2.1 The drivers opined that the HVs were comfortable with adequate air conditioning. It was automatic compared to the manual diesel counterparts. The response of the HVs to acceleration was slower than diesel vehicle. The HVs were found to be less powerful compared with the conventional trucks. According to the supplier, this is because the processor in the HV at the ECO driving mode controls the optimum power output in order to achieve higher fuel efficiency, and in turn giving a feeling to driver that the vehicle is less powerful. The HV can give the driver a more powerful feeling when driving out of the ECO mode.

4.2.2 UPS agreed that using hybrid vehicle was good; the technology can provide a greener environment. UPS was satisfied with the performance of the two HVs. However, UPS was not certain about fuel cost saving of the two HVs.

4.2.3 To remove the effect of seasonal fluctuations, 12-month moving averages are used to evaluate the trend of the HVs' fuel economy. It is shown that there is no indication of deteriorating fuel economy. It appears that the engine of the HVs were still in normal working conditions and the fuel economy could be maintained through proper maintenance.

4.2.4 The equivalent CO₂ emissions from HV-1 and HV-2 were 5,029 kg and 3,994 kg respectively. As indicated above, as HVs and DVs were operated in different road conditions and comparison on fuel savings between them is considered inappropriate, therefore no reduction in CO₂ emission could be derived here.

5. Conclusion

5.1 The vehicle operating conditions and the drivers' driving habit would affect the fuel saving performance of the hybrid vehicles. The HVs operated in urban areas with low speed and the short daily mileage. The DVs travelled on high speed roads and the daily mileage was long. Due to the significant difference in road condition between the HVs and DVs, a direct comparison for fuel savings is inappropriate for this trial. The average fuel cost of the HVs was \$3.85/km, and their average total operating cost was \$6.41/km.

5.2 The HV drivers reflected that the HVs were comfortable with adequate air conditioning. The response of the HVs to acceleration was slower than the diesel vehicle. The HVs were found to be less powerful compared to the conventional trucks.

5.3 The HVs had regular scheduled maintenance similar to the DVs. HV-1 had problems with the engine control and had 37days downtime out of the 592 working days in the 24-month trial period. HV-2 lost 13 days. The utilization rate of HV-1 and HV-2 were 94% and 98% respectively. However, as the HVs and DVs serve very different areas, it is not appropriate to compare their performance.

5.4 No deterioration in the performance of the HVs was observed from the reported data.

Appendix 1: Key Features of Vehicles

1. Trial HVs

Registration Mark: SA6686 (HV-1)
Make: Hino
Model: Hino 300 Series Hybrid
Class: Light goods vehicle
Gross vehicle weight: 5500 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 4009 cc
Year of manufacture: 2013

Registration Mark: SA6707 (HV-2)
Make: Hino
Model: Hino 300 Series Hybrid
Class: Light goods vehicle
Gross vehicle weight: 5500 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 4009 cc
Year of manufacture: 2013

2. DVs used for comparison

Registration Mark: PR603 (DV-1)
Make: Isuzu
Model: NPR75KH-V
Class: Light goods vehicle
Gross vehicle weight: 5500 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 5193cc
Year of manufacture: 2010

Registration Mark: NL2149 (DV-2)
Make: Mitsubishi Fuso
Model: Canter FE83DGZSRDAA
Class: Light goods vehicle
Gross vehicle weight: 5500 kg
Seating Capacity: driver + 2 passengers
Cylinder capacity: 4899cc
Year of manufacture: 2008

Appendix 2: Photos of Vehicles

1. Trial HVs

 <p>01/06/2015 13:07</p>	 <p>01/06/2015 13:07</p>
<p>HV-1 (SA6686) (front view)</p>	<p>HV-1 (SA6686) (side view)</p>
 <p>01/06/2015 13:06</p>	 <p>2/9/2013</p>
<p>HV-1 (SA6686) (rear view)</p>	<p>HV-2 (SA6707) (front view)</p>
 <p>2/9/2013</p>	 <p>2/9/2013</p>
<p>HV-2 (SA6707) (side view)</p>	<p>HV-2(SA6707) (rear view)</p>

2. DVs used for Comparison



DV-1 (PR603) (front view)



DV-1 (PR603) (side view)



DV-2 (NL2149) (front view)



DV-2 (NL2149) Side view