Pilot Green Transport Fund

Interim Report
On
Trial of Hybrid Medium Goods Vehicles for Transportation of Recycling Materials (On Mei Tak)

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Interim Report
(Trial Period: 1 February 2013 – 31 January 2014)

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 On Mei Tak Environmental Technology Limited (On Mei Tak) to try three hybrid medium goods vehicles for transportation of recycling materials.

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 On Mei Tak to collect information for evaluating the performance of the hybrid medium goods vehicles (HVs) as compared with the diesel medium goods vehicles (DVs) which provided the same service in similar areas or with similar road conditions. 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 Interim Report summarizes the performance of the HVs for transportation of recycling materials in the first twelve months of the trial as compared with their conventional counterparts.

2 Trial Vehicles

2.1 On Mei Tak procured three 7.5 tonnes GVW Mitsubishi FUSO Canter Eco Hybrid medium goods vehicles (HV-1, HV-2 and HV-3) of 2988 cc cylinder capacity for trial.

2.2 Three diesel medium goods vehicles of similar service areas or with similar road conditions were assigned for comparison with the three HVs(HV-1, HV-2 and HV-3). DV-1 is a Nissan make and has 10.4 tonnes GVW and a 7684cc cylinder capacity. DV-2 is a Hino make and has 10.4 tonnes GVW and a 7961cc cylinder capacity. DV-3 is a Isuzu make and has 9 tonnes GVW and a 5193cc cylinder capacity.

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 February 2013. All HVs and DVs are stationed at a car park at Kwai Wo Street, which is near to On Mei Tak's company office in Kwai Fong. Among them, On Mei Tak could only find a control vehicle (i.e. DV-1) that operates in the same service areas with HV-1 but not for the other two. Despite operating in different service areas, DV-2 and DV-3 are still considered acceptable control vehicles for HV-2 and HV-3 because their routes are similar to those of HV-2 and HV-3. The vehicles provide service from Monday to Saturday according to the daily plan. The vehicles would not stop working on gazetted holidays except the Lunar New Year holidays, in other words, the vehicles operate six full days per week.

3.2 During this twelve-month report period, HV-1, HV-2 and HV-3 travelled about 29,339 km, 20,104 km and 38,194 km respectively whereas DV-1, DV-2 and DV-3 travelled about 36,838 km, 26,679 km and 36,402 km respectively. The performance of the HVs, and their average operating costs as compared with the DVs in the first twelve months of the trial are summarized below:

Table 1: Average fuel economy and average fuel cost of trial vehicles

	Hybrid Medium Goods Vehicle			**Diesel Medium Goods Vehicle**		
	HV-1	**HV-2**	**HV-3**	**DV-1**	**DV-2**	**DV-3**
Average fuel economy	4.12 km/litre	4.29 km/litre	4.91 km/litre	4.23 km/litre	3.16 km/litre	4.33 km/litre
Average fuel cost [1]	$3.02/km	$2.93/km	$2.55/km	$2.96/km	$3.96/km	$2.87/km
Average total operating cost [1], [2]	$3.21/km	$3.20/km	$2.69/km	$3.32/km	$4.97/km	$3.47/km

[1] The market fuel price was used for calculation

[2] Including costs incurred from maintenance. On Mei Tak did not pay for the labour cost of the first two scheduled maintenance of the HVs.

3.3 The average fuel costs of HV-2 and HV-3 were lower than their conventional counterparts by 26% and 11% respectively but the average fuel cost of HV-1 was higher than DV-1 by 2%. In fact, the vehicle operating conditions and the drivers' driving habit would affect its fuel saving performance. According to the manufacturer's information, the trial vehicle could save up to about 20% fuel per km as compared with its diesel counterpart if it travels in urban areas at an average speed of 20 km/h with frequent start-stops. If it travels in suburban areas or on highways at an average speed of 44 km/h, the fuel saving performance would however be reduced to about 12% because the energy recovered by the electric generator at start-stops is much reduced. It should be noted that the HVs are Mitsubishi make while the DVs are of different make which have different engine design, therefore the manufacturer's fuel saving information is less applicable to this case. All the trial HVs travelled partly on suburban and highways, and hence it was anticipated that they were unable to achieve the best fuel saving performance according to the manufacturer because of less start-stops to recover the energy by the electric generator as compared to traveling in urban areas. However, HV-2 and HV-3 on an average saved 19% of fuel as compared to DV-2 and DV-3, a possible explanation for the higher fuel saving performance of these HVs is that they have smaller GVW than their counterparts. In general, the heavier the vehicle, the lower will be the fuel economy. HV-1 consumed 2% more fuel than DV-1, this might be attributed to the service areas of these two vehicles which required them to travel more on highways, reducing the energy recovered by HV-1. Besides, the drivers' driving habit might affect the fuel consumption as well.

3.4 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. It should be noted that in the first two scheduled maintenance of the hybrid vehicles, the labour cost was waived and only the parts to be replaced were charged. The total operating cost per km of HV-3 was 22% lower than DV-3. For HV-2, it was much lower than DV-2 (by 36%) because DV-2 was 13 years old and required frequent maintenance. HV-1 is 3% lower than DV-1.

4 Maintenance and Downtime

4.1 During the report period, HV-1 had undergone three scheduled maintenance and two unscheduled maintenance due to failure of air conditioning system, the oil pump and battery. There was an unexpected long delay of more than one month in the arrival of a new oil pump from the manufacturer to replace the damaged one. The total operation downtime for HV-1 was 52 days. HV-2 had undergone three scheduled maintenance but no unscheduled maintenance. The total operation downtime for HV-2 was 4 days. HV-3 had undergone three scheduled maintenance and one unscheduled maintenance due to the malfunctioning of the air conditioning system. The total operation downtime for HV-3 was 5 days. The utilization rate of HV-1, HV-2 and HV-3 was 83%, 99% and 98% respectively. The utilization rates of HV-2 and HV-3 were close to that of the DVs.

5 Summary of Findings

5.1 The vehicle operating conditions and the drivers' driving habit would affect the fuel saving performance of the hybrid vehicles. On an average, HV-2 and HV-3 saved 19% of fuel as compared to DV-2 and DV-3 which have higher GVW. For HV-1, the fuel cost was 2% higher than that of DV-1, which might be attributed to less energy recovered by HV-1 running more on highways. Besides, the drivers' driving habit might affect the fuel consumption as well.

5.2 The HV drivers reflected that they had to adjust their driving habits in the first month but after familiarization with the vehicle, they had no problem in its operation.

5.3 The HVs had regular scheduled maintenance and seldom had any failure. Out of the 310 working days in the twelve month trial period, HV-1, HV-2 and HV-3 had lost 52, 4, and 5 days and the utilization rate of HV-1, HV-2 and HV-3 was 83%, 99% and 98% respectively.

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

5.5 The findings only reflect the performance of the HVs in the first twelve months of the trial. More time is needed to test the fuel saving performance and the reliability of the HVs.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark:	**RV8182 (HV-1)**
Make:	Mitsubishi Fuso
Model:	Canter Eco Hybrid FEB74GR3SDAG
Class:	Medium goods vehicle
Gross vehicle weight:	7,500 kg
Seating Capacity:	2
Cylinder Capacity:	2998 cc
Year of manufacture:	2012

Registration Mark:	**RV7005 (HV-2)**
Make:	Mitsubishi Fuso
Model:	Canter Eco Hybrid FEB74GR3SDAG
Class:	Medium goods vehicle
Gross vehicle weight:	7,500 kg
Seating Capacity:	2
Cylinder Capacity:	2998 cc
Year of manufacture:	2012

Registration Mark:	**RV9805 (HV-3)**
Make:	Mitsubishi Fuso
Model:	Canter Eco Hybrid FEB74GR3SDAG
Class:	Medium goods vehicle
Gross vehicle weight:	7500 kg
Seating Capacity:	2
Cylinder Capacity:	2998 cc
Year of manufacture:	2012

2. DV used for comparison

Registration Mark:	**PP5760 (DV-1)**
Make:	Nissan
Model:	MKB3YBLHRA
Class:	Medium goods vehicle
Gross vehicle weight:	10400 kg
Seating Capacity:	2
Cylinder capacity:	7684 cc
Year of manufacture:	2007

Registration Mark:	**KC9342 (DV-2)**
Make:	Hino
Model:	FD2JLKA
Class:	Medium goods vehicle
Gross vehicle weight:	10,400 kg
Seating Capacity:	2
Cylinder capacity:	7961 cc
Year of manufacture:	2001

Registration Mark:	**PN2139 (DV-3)**
Make:	Isuzu
Model:	NQR75PNM
Class:	Medium goods vehicle
Gross vehicle weight:	9,000 kg
Seating Capacity:	2
Cylinder capacity:	5193 cc
Year of manufacture:	2007

Appendix 2: Photos of Vehicles

1. Trial HVs

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<td>Hybrid Vehicle HV-1 (RV8182) (front view)</td>
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<td>Hybrid Vehicle HV-1 (RV8182) (side view)</td>
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Hybrid Vehicle HV-2 (RV7005) (front view)	Hybrid Vehicle HV-2 (RV7005) (end view)
	
Hybrid Vehicle HV-2 (RV7005) (side view)	Hybrid Vehicle HV-2 (RV7005) (side view)

	
Hybrid Vehicle HV-3 (RV9805) (front view)	Hybrid Vehicle HV-3 (RV9805) (end view)
	
Hybrid Vehicle HV-3 (RV9805) (side view)	Hybrid Vehicle HV-3 (RV9805) (side view)

2. DVs used for comparison

	
Diesel Vehicle DV-1 (PP5760) (front view)	Diesel Vehicle DV-1 (PP5760) (end view)
	
Diesel Vehicle DV-1 (PP5760) (side view)	Diesel Vehicle DV-1 (PP5760) (side view)

	
Diesel Vehicle DV-2 (KC9342) (front view)	Diesel Vehicle DV-2 (KC9342) (end view)
	
Diesel Vehicle DV-2 (KC9342) (side view)	Diesel Vehicle DV-2 (KC9342) (side view)

	
Diesel Vehicle DV-3 (PN2139) (front view)	Diesel Vehicle DV-3 (PN2139) (end view)
	
Diesel Vehicle DV-3 (PN2139) (side view)	Diesel Vehicle DV-3 (PN2139) (side view)