Pilot Green Transport Fund

Final Report On
Trial of Hybrid Light Buses for
Green Public Light Bus Service
(Yan Yan Motors Limited)

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Final Report
(Trial Period: 1 March 2015 – 28 February 2017)

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. Yan Yan Motors Limited (Yan Yan) was approved under the Fund for trial of one diesel-electric hybrid light bus for green public light bus service. Through the tendering procedures stipulated in the Subsidy Agreement, Yan Yan procured one Dongfeng Gemini EQ6700LS5HEVY diesel-electric hybrid light bus (HV) for trial.

1.2 The Hong Kong Institute of Vocational Education (Tsing Yi) has been engaged by the Environmental Protection Department as an independent third-party assessor to monitor the trial and evaluate the performance of the trial vehicle. One liquified petroleum gas (LPG) light bus (GV) providing the same public service was assigned as the conventional vehicle for comparing with the HV.

1.3 This report summarizes the performance of the HV in the 24 months of the trial as compared with its conventional counterpart.

2. Trial and Conventional Vehicles

2.1 Yan Yan procured one Dongfeng Gemini EQ6700LS5HEVY diesel-electric hybrid light bus (i.e. HV) which has a gross vehicle weight (GVW) of 7000 kg and 150 kW rated power, for the trial. The HV was used to provide green public light bus (GPLB) services.

2.2 One Toyota LPG light bus (i.e. GV) with a GVW of 4350 kg was assigned for comparison with the HV in this trial. The HV and GV were used in GPLB Route 43 running from Tuen Mun Town Centre (Ho Pong Street) to So Kwun Wat.

2.3 Key features of the HV and GV are shown in Appendix 1 and their photos are shown in Appendix 2.

3. Trial Information

3.1 The trial started on 1 March 2015 and lasted for 24 months. Yan Yan was required to collect and provide trial information including the HV's mileage reading at refuelling, date of refuelling and refuelled amount, costs and operation downtime associated with scheduled and unscheduled maintenance of the HV. Similar monthly data from the GV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Yan Yan were collected to reflect any problems of the HV. The service hours of the vehicles are from 06:30 to 22:30 on Monday to Sunday.

4. Findings of Trial

4.1 Table 1 summarises the key operation statistics of the HV and GV. The average fuel cost of the HV was HK$1.53/km (133%) higher than that of the GV. The average total operating cost of the HV was HK$2.06/km (179%) higher than that of the GV. The average fuel economy of the HV was 6.7% higher than that of the GV. The much higher fuel cost of the HV compared to the GV was because the average price of diesel (HK$10.85/litre) was much higher (278%) than that of the LPG (HK$2.87/litre).

Table 1: Key operation statistics of each vehicle (March 2015 – February 2017)

	HV	**GV**
Total mileage (km)	113,258	196,518
Average fuel economy (km/litre)	4.05	2.49
Average fuel economy (km/MJ)	0.112 [4]	0.105 [5]
Average fuel cost (HK$) [1]	2.68	1.15
Average total operating cost (HK$/km)	3.11	1.15
Downtime (working day) [2] [3]	92	2

[1] The market rate was adopted for calculation.
[2] Downtime refers to the equivalent number of working days in which the vehicle is not in operation due to maintenance, counting from the first day it stops operation till the day it is returned to the operator.
[3] Maintenance due to incidents unrelated to the performance of the vehicle was not included for comparison.
[4] Assuming lower heating value of 36.13 MJ/litre for diesel fuel.
[5] Assuming lower heating value of 23.67 MJ/litre for LPG fuel.

4.2 During the trial period, the HV had 10 scheduled maintenances for regular check-ups, resulting in 29 days of operation downtime. There were 20 unscheduled maintenances for the HV, resulting in 63 days of operation downtime. The GV had 1 scheduled maintenance for regular check-ups, resulting in 2 days of operational downtime. There were no unscheduled maintenances for the GV. This led to 92 and 2 days of operational downtime for the HV and GV respectively. Utilization rates of the HV and GV were 84.7% and 99.7% respectively.

4.3 Although the drivers had adapted to driving the HV, they were disappointed with the the acceleration capability and the throttle response time of the HV when compared to the GV. In addition, there had been many problems relating to the gearbox and engine during the driving. The driving performance of the HV was not as good as that of the GV.

4.4 At the start of the trial most passengers felt that the HV was greener, cleaner, of benefit to the environment and there should be more of these vehicles. However, they felt that the HV was not as quiet as a conventional GV. At the end of the trial, the majority of passengers did not prefer the HV to the GV and thought it was not significantly greener than the GV. However, they still thought that the HV could improve the air quality and should be used to replace existing conventional vehicles. Overall, Yan Yan was not satisfied with the performance of the HV as too much operating time was lost due to repairs and the fuel savings were not as expected.

4.5 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the HV's fuel economy. The fuel economy of the HV varied from 3.93 to 4.08 km/l (i.e. 3.7% variation). During the 24-month trial period, the variation in the fuel economy of the HVs was not significant, indicating the deterioration of the HV during the trial period was minor.

4.6 The carbon dioxide equivalent (CO_2e) emission from the HV was 77,584 kg while that from GV was 76,606 kg. Hence, the total CO_2e emission from the HV was 977 kg (1.3%) higher than that from the GV during the trial period.

5. Summary

5.1 The drivers adapted to the differences in the HV operation. However, they were disappointed with the acceleration capability and the throttle response time of the HV when compared to the GV. At the start of the trial, most passengers felt that the HV was greener, cleaner, of benefit to the environment and there should be more of these vehicles. However, they felt that the HV was not as quiet as a conventional GV. At the end of the trial, the majority of passengers did not prefer the HV to the GV and thought it was not significantly greener than the GV. However, they still thought that the HV could improve the air quality and should be used to replace existing conventional vehicles. From the point of view of Yan Yan, they were not satisfied with performance of the HV as too much operating time was lost due to repairs and the fuel savings were not as expected.

5.2 The utilization rates of the HV and GV were 87.4% and 99.7% respectively. During the 24-month trial period, the variation in the fuel economy of the HV was not significant, indicating the deterioration of HV was minor. However, the usage of the HV was on the low side as reflected by the difference in the total mileage travelled between the HV (113,258 km) and GV (196,518 km).

5.3 The HV incurred a higher average fuel cost of HK$1.53/km (133%) compared to that of the GV. Taking into account the maintenance costs, the average total operating cost of the HV was HK$2.06/km (179%) higher than that of the GV. The CO_2e emission from the HV was 977 kg (1.3%) higher than that from the GV in the trial.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark	**KP100**
Make:	Dongfeng
Model:	Gemini EQ6700LS5HEVY
Class:	Public Light Bus
Gross vehicle weight:	7000 kg
Seating capacity:	driver + 16 passengers
Rated Power:	150 kW
Battery type:	Lithium iron phosphate battery
Year of manufacture:	2014

2. GV for comparison

Registration Mark	**MD3397**
Make:	Toyota
Model:	BZB4CRZCMSCYY
Class:	Public Light Bus
Seating capacity:	driver + 16 passengers
Gross vehicle weight:	4,350 kg
Cylinder capacity:	4,104 cc
Year of manufacture:	2005

Appendix 2: Photos of Vehicles

1. Trial HV

	
HV – front view	HV – rear view
	
HV – left side view	HV – right side view

2. GV for comparison

	
GV – front view	GV – rear view
	
GV – left side view	GV – right side view