

Pilot Green Transport Fund

**Final Report On
Trial of Hybrid Light Bus for
Green Public Light Bus Services
(Big Three 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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Trial of Hybrid Light Bus for Green Public Light Bus Services
(Big Three Limited)**

**Final Report
(Trial Period: 1 August 2015 – 31 July 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. Big Three Limited (Big Three) 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, Big Three procured one Dongfeng Gemini EQ6700LS5HEVY diesel-electric hybrid light bus (HV) for trial.

1.2 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. Big Three assigned one diesel light bus providing the same type of public service 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 diesel counterpart.

2 Trial and Conventional Vehicles

2.1 Big Three procured one Dongfeng Gemini EQ6700LS5HEVY diesel-electric hybrid light bus (i.e. HV) with a gross vehicle weight (GVW) of 7,000 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 diesel public light bus (DV) with a GVW of 4,800 kg was assigned for comparison with the HV in this trial.

2.3 The HV and DV were used in GPLB Route 39M running between Yue On Court and Tin Hau Station.

2.4 Key features of the HV and the DV are shown in Appendix 1 and their photos are shown in Appendix 2.

3. Trial Information

The trial started on 1 August 2015 and lasted for 24 months. Big Three was required to collect and provide trial information including the HV odometer reading at refueling, the date of refueling, the refueled amount, cost and operation downtime associated with scheduled and unscheduled maintenance of the HV. Similar set of data from the DV was also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver, passengers and Big Three were also collected to reflect any problems of the HV. The service hours of the vehicles are from 07:00 to 20:00 and 06:30 to 00:00 for the HV and DV respectively from Monday to Sunday.

4. Findings of Trail

4.1 Table 1 summarizes the key operation statistics of the HV and the DV. The average fuel cost of the HV was HK\$0.12/km (about 6%) higher than that of the DV. The average total operating cost of the HV was HK\$0.18/km (about 6%) lower than that of the DV.

Table 1: Key operating statistic of each vehicle (August 2015 – May 2017^[1])

	HV	DV
Total mileage (km)	104,584	171,065
Average fuel economy (km/litre)	4.81	5.07
Average fuel cost (HK\$/km) ^[2]	2.27	2.15
Average total operating cost/ (HK\$/km)	2.61	2.79
Downtime (working day) ^{[3][4]}	80	28

[1] The HV had a serious traffic accident on 24 May 2017 and was scrapped thereafter, so only 22 months of operational data were collected during the 24 months of the trial.

[2] Market rate was adopted for calculation.

[3] 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.

[4] Unscheduled maintenance due to incidents unrelated to the performance of the vehicle were not included for comparison.

4.2 During the trial period, the HV had 4 scheduled maintenances and 28 unscheduled maintenances, resulting in a total of 80 days of operation downtime. The DV had 1 scheduled maintenance and 68 unscheduled maintenances, resulting in a total of 28 days of operation downtime. The HV had a serious traffic accident on 24 May 2017 and was scrapped thereafter, only 22 months of operational data were collected during the 24 months of the trial. The utilization rates of the HV and DV were 88% and 96% respectively.

4.3 Although the driver adapted to the HV operation, he was disappointed with the acceleration and the throttle response time of the HV when compared with the DV.

4.4 Overall, Big Three was not satisfied with the performance of HV since the battery system and the air conditioning compressor were unstable causing relatively long operation downtime. Also, the HV fuel cost was higher than expected.

4.5 The passengers were not satisfied with the driving performance and engine noise made by the HV. They felt that the HV was not as comfortable as the DV and the HV did not provide environmental benefit.

4.6 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 4.59 to 4.93 km/litre (i.e. about 7% variation). During the trial period, the variation of the fuel economy was not significant, indicating the deterioration of the HV during the trial period was minor.

4.7 Based on the total distance travelled by the HV, the relative carbon dioxide equivalent (CO_{2e}) emission from the DV could be evaluated based on the CO_{2e} emission per litre of diesel consumed. The CO_{2e} emission from the HV was 60,304kg, while from the DV it was 57,222kg. Hence, there was about 3,082kg (about 5%) increase of emission from the HV compared with the DV in the trial.

5 Summary

5.1 Although the driver adapted to the HV operation, he was disappointed with the acceleration and the throttle response time of the HV when compared with the DV. Big Three was also not satisfied with its performance since the battery system and the air conditioning compressor were unstable causing relatively long operation downtime. Also, the HV fuel cost was higher than expected.

5.2 The passengers were not satisfied with the driving performance and engine noise made by the HV. They felt that the HV was not as comfortable as the DV and the HV did not provide environmental benefit.

5.3 The HV had a serious traffic accident on 24 May 2017 and was scrapped thereafter, so only 22 months of operational data were collected during the 24 months of the trial. The utilization rates of HV and DV were 88% and 96% respectively. During the trial period, the variation in the fuel economy of the HV was not significant, indicating the deterioration of HV was minor. However, usage of the HV was on the low side as reflected in the difference in the total mileage travelled between the HV (104,584 km) and the DV (171,065 km).

5.4 The HV incurred a higher average fuel cost of HK\$0.12/km (about 6%) compared to the DV. Taking into account the maintenance costs, the average total operating cost of the HV was about HK\$0.18/km (about 6%) lower than that of the DV. The CO_{2e} emission from the HV was 3,082kg (about 5%) higher than that from the DV during the trial period.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark	TM7916
Make:	DongFeng
Model:	Gemini EQ6700LS5HEVY
Class:	Public Light Bus
Gross vehicle weight:	7,000 kg
Seating capacity:	driver + 16 passengers
Rated Power:	150 kW
Battery type:	Lithium iron phosphate battery
Year of manufacture:	2014

2. DV for comparison

Registration Mark	KX2347
Make:	TOYOTA
Model:	BB50RZEMQZHH
Class:	Public Light Bus
Seating capacity:	driver + 16 passengers
Gross vehicle weight:	4,800 kg
Cylinder capacity:	4,104 cc
Year of manufacture:	2002

Appendix 2: Photos of Vehicles

1. Trial HV



Front view of HV



Rear view of HV



Left side view of HV



Right side view of HV

2. DV for comparison



Front view of DV



Rear view of DV



Left side view of DV



Right side view of DV