Pilot Green Transport Fund

Final Report On
Trial of Hybrid Light Bus
for Green Public Light Bus Service
(Nam Kee Transport Co.)

(31 July 2020)

PREPARED BY:

Dr. Joe LO Ka Wah
Mr. Elvin NG Cheuk Yin
Mr. CHAN Ka Chun
Mr. Ricky CHONG Ka Ho

List of Monitoring and Evaluation Team Members

Dr. Joe K. W. LO (Team Leader)
Centre Manager
Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Mr. Elvin C. Y. NG (Team Member)
Test Engineer
Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Mr. K. C. CHAN (Team Member)
Technician
Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Mr. Ricky K. H. CHONG (Team Member)
Executive Assistant
Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Pilot Green Transport Fund
Trial of Hybrid Light Bus for Green Public Light Bus Service
(Nam Kee Transport Co.)

Final Report
(Trial Period: 1 May 2018 – 30 April 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. Nam Kee Transport Co. (Nam Kee) was approved under the Fund for trial of one diesel-electric hybrid light bus for green public light bus service.

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. Nam Kee assigned a Toyota liquefied petroleum gas (LPG) public light bus (GV) providing similar service as the conventional vehicle for comparing with the trial vehicle.

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

2 Trial Vehicle

2.1 Through the tendering procedures stipulated in the Agreement, Nam Kee procured one GMI Gemini GM6700GAREEV diesel-electric hybrid light bus (HV) for trial.

2.2 Key features of the HV and the GV are in Appendix 1 and photos of the vehicles are in Appendix 2, respectively. The vehicles were used for providing green public light bus service between Lok Wah Estate and Kwun Tong Yue Man Square in Kwun Tong. According to the HV's manufacture, the HV had a gross vehicle weight (GVW) of 7,000 kg and a cylinder capacity of 2,776 cc.

3 Trial Information

3.1 The trial started on 1 May 2018 and lasted for 24 months. Nam Kee was required to collect and provide trial information including the HV odometer reading at refueling, the date of refueling, and the refueled amount, cost and operation downtime associated with scheduled and unscheduled maintenance of the HV. A similar set of data from the GV was also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver and Nam Kee were also collected to reflect any problems of the HV.

4 Findings of Trial

4.1 Table 1 below summarizes the statistical data of the HV and the GV. The average total operating cost of the HV was about HK$3.12/km (128%) higher than that of the GV. The average fuel cost of the HV is $2.73/km (116%) higher than that of the GV. It is because the HV and the GV consumed diesel and LPG respectively, and the average unit price of diesel was higher than that of the LPG by around 314%.

Table 1: Key Operation Statistics of each Vehicle (May 2018 to April 2020)

		HV	**GV**
Total mileage (km)		69,958	88,408
Average fuel economy	(km/litre)	2.76	1.44
	(km/MJ) [1]	0.076	0.061
Average fuel cost (HK$/km) [2]		5.09	2.36
Average total operating cost (HK$/km)		5.55	2.43
Downtime (working day) [3] [4]		29	2

[1] Assuming lower heating value of 36.13 MJ/litre for diesel fuel and 23.67 MJ/litre for LPG fuel.
[2] The market fuel price was used for calculation.
[3] Downtime refers to the equivalent number of working days in which the vehicle is not in operation due to charging, and the period 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] Maintenance due to incidents unrelated to the performance of the vehicle was not included for comparison.

4.2 There were 7 scheduled maintenances and 10 unscheduled maintenances for the EV while the GV had no scheduled maintenance and 1 unscheduled maintenance in this reporting period. The scheduled and unscheduled maintenances had led to 29 days and 2 days of operational downtime for the HV and the GV respectively. There were 731 working days in the trial period, the utilization rates of HV and GV were 96.0% and 99.7% respectively.

4.3 The driver had no problem in operating the HV and felt that the HV was environment-friendly. However, the driver felt that the HV ran quietly when it was not charging, but it was noisy while charging. The situation has been reported to the manufacturer and mitigation measures, such as filling in engine compartment with sound absorbing materials, filling the body/chassis crevices with sound sealant and slightly adjusting the engine power, etc., were taken to tackle the battery box noise problem. After two years of continuous maintenance and improvement by GMI, the noise problem of HV has been greatly improved, and the driver had already been accustomed to drive the HV, so the noise problem will no longer have a significant impact on daily operations.

4.4 The passengers felt that the HV was environment-friendly and improved the roadside air quality. They liked the HV and supported on replacing the existing conventional vehicles by hybrid vehicles.

4.5 Nam Kee agreed that, in general, using HV was good because it provided a greener environment compared with the GV. Nam Kee claimed that the performance of the HV met the operational requirements, therefore they would encourage other transport operators to try out the hybrid public light bus and believed that HV can continuously provide public light bus services for a long time. In general, Nam Kee and the driver were satisfied with the performance of the HV.

4.6 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the HV fuel economy. In the 24 months of the trial, it is shown that the fuel economy was stable (between 2.69 km/litre and 2.84 km/litre). It appears that the engine of the HV was still in normal working conditions and the fuel economy could be maintained through proper maintenance.

4.7 Based on the total distance travelled by the HV in the trial, the carbon dioxide equivalent (CO_2e) emission from the HV was 70,272 kg while that from the GV was 81,822 kg. Hence there was an emission reduction of 11,551 kg CO_2e (i.e. about 14%) in the trial.

5 Summary

5.1 The HV driver expressed that he had no problem in operating the HV and felt that the HV was environment-friendly. After two years of continuous maintenance and improvement by GMI, the noise problem of HV has been greatly improved, and the driver had already been accustomed to drive the HV, so the noise problem will no longer have a significant impact on daily operations. In general, Nam Kee and the driver were satisfied with the performance of the HV.

5.2 The passengers felt that the HV was environment-friendly and improved the roadside air quality. They liked the HV and supported on replacing the existing conventional vehicles by hybrid vehicles.

5.3 The average unit price of diesel was much higher than that of the LPG, resulting in higher average fuel cost of the HV than that of the GV by $2.73/km (116%). The average total operating cost of the HV was HK$3.12/km (128%) higher than that of the DV. In the 24 months of the trial, the average daily mileage of the HV was 100 km, while that of the GV was 121 km. The utilization rates of the HV and the GV were 96.0% and 99.7% respectively.

5.4 The CO_2e emission from HV was 70,272 kg while that from the GV was 81,822 kg. Therefore, there was a total reduction of 11,551 kg CO_2e (i.e. around 14%) in the trial by using HV.

5.5 No deterioration in the performance of the HV was observed during the trial period.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark	**VG4255**
Make:	GMI
Model:	Gemini GM6700GAREEV
Class:	Public Light Bus
Gross vehicle weight:	7,000 kg
Seating capacity:	Driver + 19 passengers
Engine capacity:	2,776 c.c.
Battery Type:	Lithium iron phosphate
Year of manufacture:	2017

2. GV for comparison

Registration Mark	**DG6306**
Make:	Toyota
Model:	BZB40RZCMSCYY
Class:	Public Light Bus
Gross vehicle weight:	4,350 kg
Seating capacity:	Driver + 16 passengers
Engine capacity:	4,104 c.c.
Year of manufacture:	2005

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. GV for comparison

	
Front view of GV	Rear view of GV
	
Left side view of GV	Right side view of GV