

Pilot Green Transport Fund

Final Report
On
Trial of Hybrid Public Light Bus for
Green Minibus Service
(Ma Shui Hing)

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The Monitoring and Evaluation Team's views expressed in this report do not necessarily reflect the views of the Environment and Ecology Bureau (Environment Branch), HKSAR.

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Trial of Hybrid Public Light Bus for Green Minibus Services
(Ma Shui Hing)**

**Final Report
(Trial Period: 1 July 2021 – 30 June 2023)**

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. The Fund has subsidized Ma Shui Hing to trial out a hybrid public light bus (HV) for green minibus services.

1.2 PolyU Technology and Consultancy Company Limited (PTeC) has been engaged by the Environmental Protection Department¹ as an independent third party assessor to monitor the trial and evaluate the performance of the trial vehicles. The Assessor regularly visited Ma Shui Hing to collect information for evaluating the performance of the HV and compared it with the performance of a LPG vehicle (GV) which provided the same service in the same areas. The information collected included the said vehicles' operation data, fuel bills, maintenance records, reports on operation difficulties, and opinions of the HV driver, the public light bus passengers, and Ma Shui Hing through survey questionnaires.

1.3 This Final Report summarizes the performance of the HV for green minibus services in the 24-months trial as compared with the GV.

2. Trial and Conventional Vehicles

2.1 Ma Shui Hing procured one GMI Gemini 19-seats diesel-electric hybrid public light bus (i.e., HV) with gross vehicle weight (GVW) 7,000 kg and cylinder capacity 2,776 cc for trial. One Toyota 16-seats LPG public light bus (i.e., GV) of GVW 4,350 kg cylinder capacity 4,104 c.c. operating in the same service areas was assigned for comparison with the HV.

2.2 Both HV and GV were used for green minibus services serving a fixed route 22M between Kwun Tong MTR station and Lok Wah South Estate. They provided services 24 hours everyday, 365 days per year.

¹ The Administration of the New Energy Transport Fund was migrated to the Environment Branch of the Environment and Ecology Bureau [EEB (Environment Branch)] since 1 January 2023 after internal re-organisation of EEB (Environment Branch) and EPD.

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

3. Trial Information

3.1 The trial started on 1 July 2021 and lasted for 24 months. Ma Shui Hing was required to collect and provide trial information including the distance travelled, fuel consumed, fuel cost as well as costs and 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, passengers, and Ma Shui Hing were collected and provided to reflect any problems of the HV.

4. Findings of Trial

4.1 Table 1 summarizes the statistical data of the HV and the GV. The average fuel economy of the HV was 0.015km/MJ (26%) higher than that of the GV. However, since the market fuel price of diesel was much higher than that of LPG and the HV carried 3 more passengers than the GV hence with a higher loading, the average fuel cost of the HV was higher than that of the GV by HK\$4.37/km (140%). If the fuel price discount was taken into account, the average fuel cost of the HV would be about 22% higher than that of the GV. The HV had two scheduled maintenances and one unscheduled maintenance yet no charge was incurred within the warranty period, whereas the GV had two scheduled but no unscheduled maintenance. Thus, the average total operating costs were HK\$4.11/km (about 122%) higher than that of the GV. When the fuel price discounts were taken into account, the average total operating cost of the 19-seat HV would be about 11% higher than that of the 16-seat GV.

Table 1: Key operation statistics of each vehicle (1 July 2021 – 30 June 2023)

	HV	GV	
Total mileage (km)	70,187	69,274	
Average daily mileage (km/working day)	99	95	
Average fuel economy	(km/litre)	2.65	1.38
	(km/MJ) ^[1]	0.073	0.058
Average fuel cost (HK\$/km) ^[2]	7.48	3.11	
Average total operating cost (HK\$/km) ^[3]	7.48	3.37	
Downtime (working day) ^{[3][4]}	20.5	4	

^[1] Assuming lower heating value of 36.13 MJ/litre for diesel fuel and 23.67 MJ/litre for LPG.

^[2] The market fuel price was used for calculation.

^[3] Maintenance due to incident not related to the performance of the vehicle was not included for comparing the performance.

^[4] 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.

4.2 The HV had two scheduled and one unscheduled maintenances incurring 20.5 days of downtime while the GV had two scheduled and no unscheduled maintenance incurring 4 days of downtime, the utilization rate of the HV and the GV was 97.2% and 99.5% respectively.

4.3 To remove the effect of seasonal fluctuations, 12-month moving averages are used to evaluate the trend of the HV's fuel economy. The results show that the fuel economy of the HV had no sign of deterioration.

4.4 The carbon dioxide equivalent (CO_{2e}) emission from the HV was 73,335 kg while that from the GV on HV mileage would be 85,460 kg. There was a reduction of 12,125 kg CO_{2e} emissions (about 14%) by using the HV. Therefore, the adoption of the HV shows environmental benefit in this trial.

4.5 The HV drivers had no problem in operating the HV and felt the HV was more environmentally friendly compared to the GV. The passengers felt that the air was cleaner within the HV. Ma Shui Hing was satisfied with the performance of the HV and did not detect any deterioration in the performance of the HV.

5. Summary

5.1 In the 24-month trial period, the average daily mileage of the HV was 99 km, while that of the GV was 95 km. Taking the fuel price discounts into account, the average fuel cost and the average total operating cost of the HV was about 22% and 11% higher than that of the GV, but the HV had 26% higher average fuel economy than that of the GV and carrying 3 more passengers. There was 12,125 kg CO_{2e} emissions (about 14%) reduction by using the HV as compared with the GV.

5.2 Excluding the downtime of vehicles unrelated to the performance due to the scheduled and unscheduled maintenances, the HV and GV had 20.5 days and 4 days downtime respectively in the 24-month trial period, the utilization rate of the HV and the GV was 97.2% and 99.5% respectively.

5.3 No sign of deterioration in the fuel economy of the HV was observed in the trial.

5.4 In the 24-month trial period, the operation of the HV was smooth. The HV drivers, passengers and Ma Shui Hing were satisfied with the performance of the HV and felt that it was more environmentally friendly.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark:	EY7853
Make:	GMI
Model:	Gemini
Class:	Public Light Bus
Gross vehicle weight:	7,000 kg
Seating capacity:	driver + 19 passengers
Cylinder capacity:	2,776 cc (diesel)
Year of manufacture:	2020

2. GV for Comparison

Registration Mark:	HV2203
Make:	Toyota
Model:	COASTER LPG SWB
Class:	Public Light Bus
Gross vehicle weight:	4,350 kg
Seating capacity:	driver + 16 passengers
Cylinder capacity:	4,104 cc (LPG)
Year of manufacture:	2014

Appendix 2: Photos of Vehicles

1. Trial HV



2. GV for Comparison

