Pilot Green Transport Fund

Final Report On
Trial of Single-deck Hybrid Bus for
Coach Rental Service
(Hang Po Transportation Company 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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(Hang Po Transportation Company Limited)

Final Report
(Trial Period: 1 September 2018 – 31 August 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. Hang Po Transportation Company Limited (Hang Po) was approved under the Fund for trial of one single-deck diesel-electric hybrid bus for coach rental service. Through the tendering procedures stipulated in the Subsidy Agreement, Hang Po procured one SAIC single-deck diesel-electric hybrid bus (hereafter called 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. One single-deck diesel bus (DV) providing the same type of service was assigned as the conventional vehicle for comparing with the HV.

1.3 This Final report summarizes the performance of the HV in the 24 months of the trial as compared with its conventional counterpart, i.e. the DV.

2. Trial and Conventional Vehicles

2.1 The HV has a gross vehicle weight (GVW) of 17,500 kg and a cylinder capacity of 6,692 c.c. The DV has a GVW of 16,000 kg and a cylinder capacity of 7,790 c.c. The vehicles were used for providing coach rental service to large housing estates.

2.2 Key features of the HV and the DV are in Appendix 1 and photos of the vehicles are in Appendix 2.

3 Trial Information

3.1 The trial started on 1 September 2018 and lasted for 24 months. Hang Po was required to collect and provide trial information including the HV odometer reading before 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 DV was also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver and Hang Po were also collected to reflect any problems of the HV.

4 **Findings of Trial**

4.1 Table 1 summarizes the statistical data of the HV and the DV. The average fuel cost of the HV was HK$0.28/km (6%) higher than that of the DV, and the average total operating cost of the HV was HK$1.12/km (25%) higher than that of the DV. It is possible that the extra fuel consumed due to the additional weight of batteries of the hybrid system is higher than the fuel saved by using the hybrid system. Thus, the fuel consumption of the HV was higher than that of the DV during the reporting period.

Table 1: Key Operation Statistics of Each Vehicle (1 September 2018 – 31 August 2020)

		HV[4]	**DV**
Total mileage	(km)	99,352	156,705
Average fuel economy	(km/litre)	3.02	3.18
Average fuel cost (HK$/km) [1]		4.73	4.45
Average total operating cost/ (HK$/km) [2]		5.57	4.45
Downtime (working day) [3]		70.5	0

[1] Market rate was adopted for calculation.
[2] Maintenance due to incident unrelated to the performance of the vehicle was not included for comparison.
[3] Downtime refers to the equivalent number of working days in which the vehicle was not in operation due to maintenance, counting from the first day it stopped operation till the day it was returned to the operator.
[4] The HV's odometer was failed from December 2018 to April 2019 and hence odometer data were not available in the said period.

4.2 During the 24 months of the trial, the HV had three scheduled maintenances resulting in 11 working day of downtime while the DV had no scheduled maintenance.

4.3 Also, the HV had fifteen unscheduled maintenances resulting in 59.5 working days of downtime, while the DV has no unscheduled maintenance in this reporting period.

4.4 In the 24 months of the trial, the utilization rates of the HV and the DV were 89% and 100% respectively.

4.5 Hang Po had a designated driver for the HV. The HV driver expressed that the acceleration pedal of the HV did not have much power during overtake or going uphill. Also, the suspension system of the HV did not make him feel comfortable. Furthermore, the steering wheel was not smooth when turning and the steering angle was not enough. The response time of automatic gearbox was also slow

4.6 In general, Hang Po considered the performance of HV could meet the operational requirements, but was only fairly satisfied with the performance of the HV.

4.7 The feedbacks from the passengers were in general on the positive side. They felt that the HV was quieter, less polluted and helped to improve the roadside air quality. They liked the HV and supported replacing the existing diesel buses with hybrid buses if there was an environmental benefit.

4.8 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the HV's fuel economy. It is shown that the deterioration of the fuel economy is consistent throughout 24-month trial (varied between 3.33 km/litre and 2.79 km/litre).

4.9 For comparison purpose, the relative carbon dioxide equivalent (CO_2e) emission from the DV in the 24 months of trial could be evaluated based on the total distance of the HV and the CO_2e emission per litre of diesel consumed by the DV in the trial. The CO_2e emission from the HV was 86,892 kg while that from the DV was 82,461 kg. There was about 5% increase in CO_2e emission by using the HV.

5. Summary

5.1 In the 24 months of the trial, the average fuel cost of the HV was HK$0.28/km (6%) higher than that of the DV and the average total operating cost of the HV was HK$1.12/km (25%) higher than that of the DV. There was no economic benefit from using the HV in this trial. Besides, the utilization rates of HV and DV were 89% and 100% respectively.

5.2 In general, Hang Po considered the performance of HV could meet the operational requirements, but was only fairly satisfied with the performance of the HV. The passengers felt that the HV was quieter and less polluted. However, the HV driver expressed that the acceleration pedal of the HV did not have much power during overtake or going uphill. Also, the suspension system of the HV did not make him feel comfortable. Furthermore, the steering wheel was not smooth when turning and the steering angle was not enough. The response time of automatic gearbox was also slow.

5.3 The CO2e emission from the HV was 86,892 kg while that from the DV was 82,461 kg. There was about 5% increase in CO2e emission by using the HV.

5.4 The result appears that the performance of the HV is deteriorating over the trial period.

Appendix 1: Key Features of Vehicles

1. Trial HV

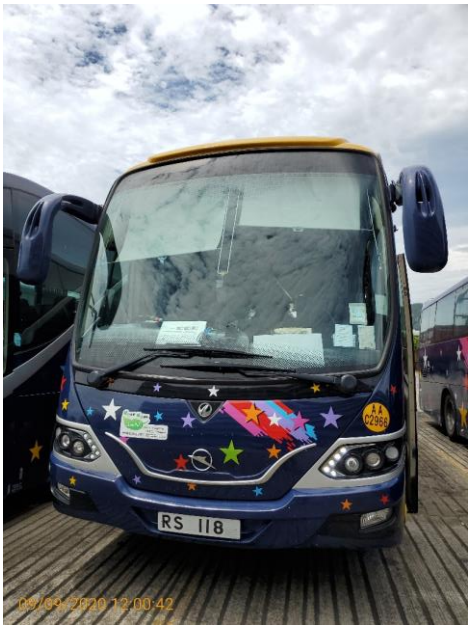
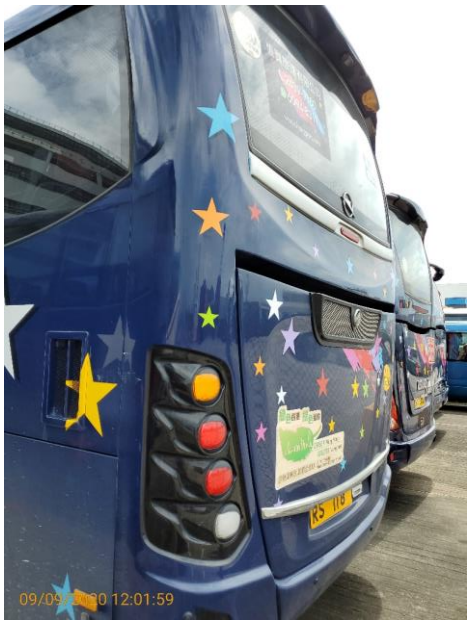
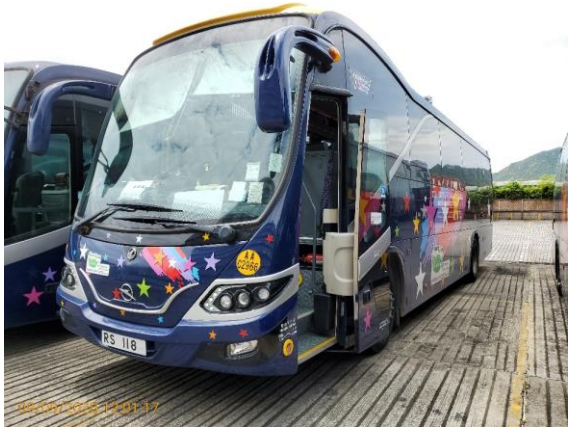
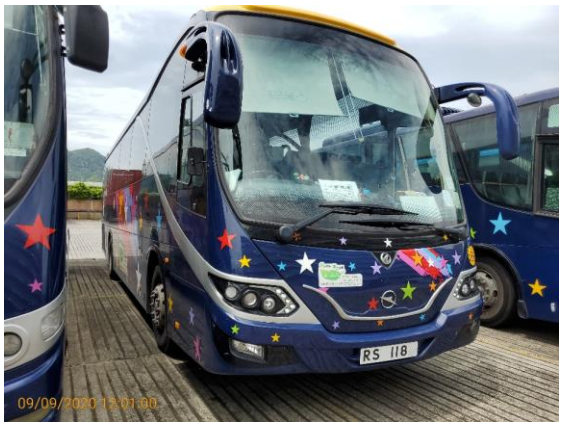
Registration Mark	**RS118**
Make:	SAIC
Model:	SK6110H
Class:	Single deck bus
Gross vehicle weight:	17,500 kg
Seating capacity:	Driver + 65 passengers
Cylinder capacity:	6,692 c.c.
Maximum Output (ps/rpm):	245/2,300
Battery Type:	Lithium Manganese Oxide battery
Year of manufacture:	2018

2. DV for comparison

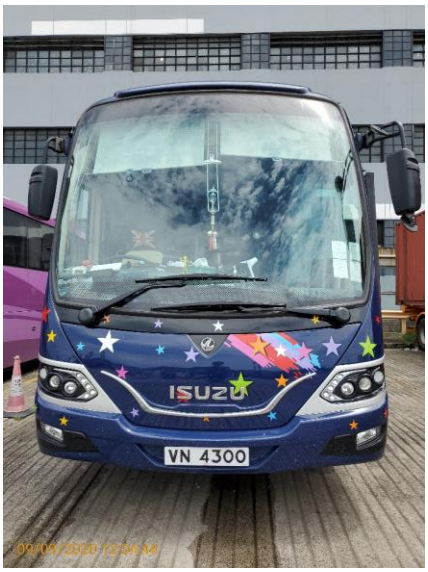
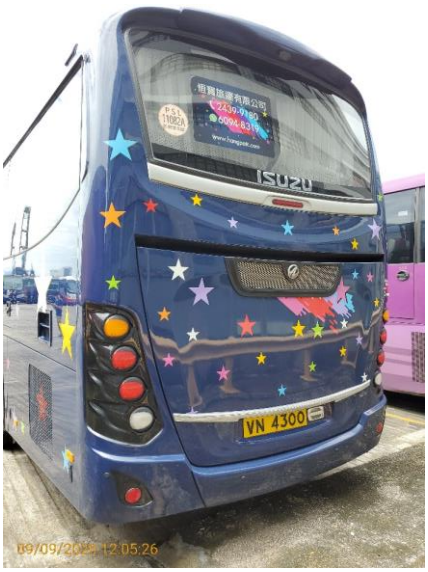
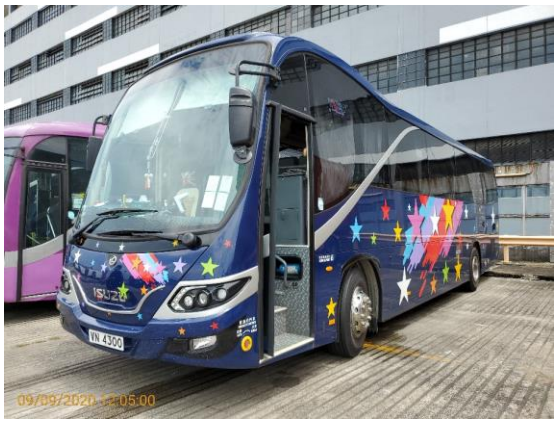
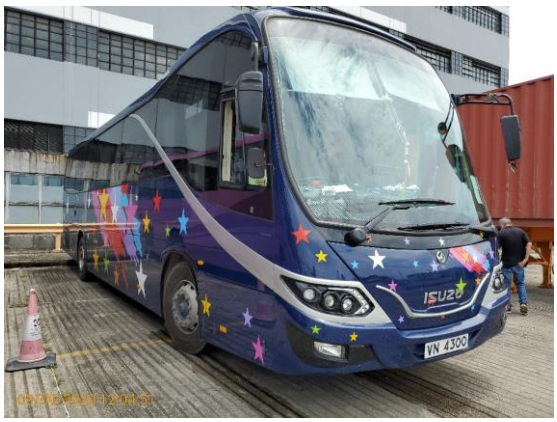
Registration Mark	**VN4300**
Make:	ISUZU
Model:	LT434C-6S-VI-AT
Class:	Single deck bus
Gross vehicle weight:	16,000 kg
Seating capacity:	Driver + 65 passengers
Cylinder capacity:	7,790 c.c.
Year of manufacture:	2018

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