

Pilot Green Transport Fund

Interim Report On Trial of Electric Inverter Air-conditioning System (IAS) for School Bus (Express Tourist Bus 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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(Express Tourist Bus Company Limited)

Interim Report
(Trial Period: 1 February 2017 – 31 January 2018)

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 (the green innovative technology), contributing to better air quality and public health for Hong Kong. Express Tourist Bus Company Limited (ETBC) was approved under the Fund for trial of one unit of electric Inverter Air-conditioning System (IAS) on a single-deck bus (coach). Through a tendering procedure stipulated in the Subsidy Agreement, ETBC appointed Tai Chang China Motor Green Power Limited to manufacture and install an IAS with model TCD08Z-II on a new diesel coach (IAV) for trial.

1.2 PolyU Technology and Consultancy Company Limited (PolyU) has been engaged by the Environmental Protection Department (EPD) as an independent third party assessor to monitor the trial and evaluate the performance of the trial vehicle. ETBC assigned another Isuzu diesel coach (CAV) with conventional air-conditioning system (CAS) as IAV's conventional counterpart for comparison in this trial.

1.3 This Interim Report summarizes the performance of the IAV in the first 12 months of the trial as compared with its conventional counterpart.

2. Trial Vehicles

2.1 Key features of the IAS, IAV and CAV are in Appendix 1 while photos of IAV and CAV are in Appendix 2. Both IAV and CAV were used mainly for providing school bus service for a school in Hong Kong Island East. In the first 12 months of the trial, daily average travel distance for providing such service was around 105 km for the IAV and 53 km for the CAV.

2.2 According to the IAS' manufacturer, the IAS comprises an electric-driven compressor and 4 electric battery packs with an inverter connected. The compressor of the IAS is driven by the energy stored in the battery packs and the energy output will be controlled by the inverter so as to reduce the fuel consumption. The cooling capacity of the IAS is 36kW. The total weight of the IAS is around 690kg while the weight of the CAS with model number TCH12U is 243kg, with cooling capacity of 38.28kW.

3. Trial Information

3.1 The trial commenced on 1 February 2017 and would last for 24 months. ETBC is required to collect and provide trial information including the IAV operation data, cost and downtime associated with scheduled and unscheduled maintenance of the IAV. Similar data from the CAV are also required. In addition to the cost information, operational difficulties and opinions of the drivers were collected to reflect any problems of the IAV.

4. Findings of Trial

4.1 Table 1 summarizes the statistical data of the IAV and the CAV in the first 12 months of the trial.

Table 1: Key operation statistics of each vehicle (1 February 2017 – 31 January 2018)

	IAV	CAV
Fuel cost (HK\$)	164,520	99,874
Maintenance cost (HK\$)	0	0
Total operating cost (HK\$)	164,520	99,874
Total mileage (km)	38,248	19,179
Average fuel cost (HK\$/km) ^[1]	4.30	5.21
Average total operating cost (HK\$/km)	4.30	5.21
Downtime (working day) ^[2]	0	0

^[1] The market fuel price was used for calculation.

^[2] Downtime refers to the working days the vehicle is not in operation due to maintenance, which counted from the first day it stops operation till the day it is returned to the operator.

4.2 The above data demonstrated the average fuel cost of the IAV was lower than that of the CAV by HK\$0.91/km (about 17%). As there was no maintenance required for both IAV or CAV in the first 12 months of the trial, the average total operating cost of the IAV was same as the average fuel cost which was HK\$0.91/km (i.e. about 17%) lower than that of CAV.

4.3 Since there was no downtime for the IAV and the CAV, the utilization rates of both vehicles were 100%.

5. Summary

5.1 During the first 12 months of the trial, the operation data collected showed that the IAV had lower fuel cost than the CAV, with an average fuel cost saving of HK\$0.91/km (ie, about 17%). As there was no maintenance required for both IAV and CAV in the first 12 months of the trial, the total operating cost of the IAV was same as its average fuel cost, so does the CAV. Also, these two kinds of costs of the IAV were HK\$0.91/km (i.e. about 17%) lower than those of the CAV. The utilization rates of both vehicles were 100%.

5.2 The drivers had no problem in operating the IAV, but opined its climbing uphill performance poorer than that of the CAV which is possibly due to the additional weight of the battery packs and IAC components. When the IAV is fully occupied and goes uphill, the problem is obvious.

5.3 The findings of this report only reflect the performance of the IAV in the first 12 months of the trial. More time is needed to test the performance and reliability of the IAV.

Appendix 1: Key Features of Vehicles and IAS Involved in the Trial

1. Diesel Vehicle (IAV) Installed with Trial Electric Inverter Air-conditioning System (IAS)

(a) Trial Electric IAS

Number of IAC :	2 sets
Model :	TCD08Z-II
Make :	Tai Chang China Motor Green Power Limited
Number of battery :	4 battery packs for 2 sets IAS
Total cooling capacity :	36 kW
IAC weight :	450 kg for 2 sets IAS
Battery packs weight :	240 kg

(b) IAV

Registration mark:	GM9909
Make:	Isuzu
Model:	LT434PF-6S-V
Class:	Public bus
Gross vehicle weight:	14,800 kg
Seating capacity:	driver + 65 passengers
Cylinder capacity:	7,790 cc
Year of manufacture:	2015

2. Diesel Vehicle (CAV) Installed with Conventional Air-conditioning System (CAS) Used for Comparison

(a) CAS

Number of CAS:	1
Model	TCH12U (provided upon purchase of the CAV)
Total cooling capacity	38.28 kW

(b) CAV

Registration mark:	KH5755
Make:	Isuzu
Model:	LT134P-6S-V
Class:	Public bus
Gross vehicle weight:	14,500 kg
Seating capacity:	driver + 60 passengers
Cylinder capacity:	7,790 cc
Year of manufacture:	2012

Appendix 2: Photos of Vehicles

1. IAV installed with IAS

 <p>A front-facing view of a red and white Isuzu bus, model GM9909, parked in a lot. The bus has 'ISUZU' and 'GM 9909' on the front. A timestamp '09/02/2018 10:11' is in the bottom right.</p>	 <p>A rear-facing view of the same red and white Isuzu bus, model GM9909. It features a 'CAUTION CHILDREN' sign and a 'Green Bus' logo. The license plate is 'GM 9909'. A timestamp '09/02/2018 10:12' is in the bottom right.</p>
GM9909 – front view	GM9909 – end view
 <p>A side profile view of the red and white Isuzu bus, model GM9909, facing left. The side has 'JACKSON BUS CO. LTD.' and 'www.jacksonbus.com' written on it. A timestamp '09/02/2018 10:11' is in the bottom right.</p>	 <p>A side profile view of the red and white Isuzu bus, model GM9909, facing right. The side has 'JACKSON BUS CO. LTD.' and 'www.jacksonbus.com' written on it. A timestamp '09/02/2018 10:12' is in the bottom right.</p>
GM9909 – side view 1	GM9909 – side view 2

2. CAV installed with CAS

 A front-facing view of a white and red Isuzu bus, license plate KH 5755. The bus is parked in a lot with other buses visible in the background. A timestamp '09/02/2018 10:18' is in the bottom right corner.	 A rear-facing view of the same bus, showing the back window and a 'CAUTION CHILDREN' sign. The license plate KH 5755 is visible. A timestamp '09/02/2018 10:19' is in the bottom right corner.
KH5755 – front view	KH5755 – end view
 A side profile view of the bus from the front-left. The side of the bus features the text 'www.JACKSONBUS.COM'. A timestamp '09/02/2018 10:19' is in the bottom right corner.	 A side profile view of the bus from the front-right. The side of the bus features the text 'www.JACKSONBUS.COM'. A timestamp '09/02/2018 10:20' is in the bottom right corner.
KH5755 – side view 1	KH5755 – side view 2