

New Energy Transport Fund

Final Report

On

Trial of Single-deck Electric Bus for

Non-franchised Public Bus Service

(Brother's Travelling Investment Limited)

(17 January 2025)

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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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(Brother's Travelling Investment Limited)**

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(Reporting Period: 1 August 2022 – 31 July 2023)**

Executive Summary

1. Introduction

1.1 The New Energy 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. Brother's Travelling Investment Limited (Brother's Travelling) was approved under the Fund for trial of one single-deck electric bus for non-franchised public bus service. Brother's Travelling, through the tendering procedures stipulated in the Agreement entered into with the Government, procured a BYD C9R single-deck electric bus (EV) for trial.

1.2 Hong Kong Productivity Council has been commissioned by the Environmental Protection Department¹ as an independent third party assessor (the Assessor) to monitor the trial and evaluate the performance of the trial vehicle. Brother's Travelling assigned an Isuzu LT434P-6S-V single-deck diesel bus (DV) providing same services as the conventional counterpart for comparison.

1.3 This Final Report summarises the performance of the EV in the 12 months of the trial as compared with its conventional counterpart, i.e. the DV.

2. Trial and Conventional Vehicles

2.1 The trial EV, BYD C9R single-deck electric bus, has a gross vehicle weight of 18,000 kg capable of carrying a driver with 65 passengers. It has a 324 kWh lithium iron phosphate battery pack and a driving range of 250 km with its battery fully charged and air-conditioning off. The DV, Isuzu LT434P-6S-V single-deck diesel bus with a passenger capacity of 61 and a cylinder capacity of 7,790 c.c. was used as the conventional counterpart for comparison in this trial. The EV and the DV were used for providing same shuttle bus services, serving round trips from Tung Chung to Kowloon Tong and round trips from Tung Chung to Tin Shui Wai.

2.2 Brother's Travelling installed two designated 80kW three-phase AC charging facilities at its own cost at the vehicle depots in Tong Yan San Tsuen, Yuen Long and in San Tin, Yuen Long for charging and recording the amount of electricity charged. Key features of the EV, the charging facility and the DV are detailed in Appendix 1 and photos of the vehicles and the

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.

charging facility are shown in Appendix 2.

3. Trial Information

3.1 The trial commenced on 1 August 2022 and lasted for 12 months. Brother's Travelling was required to collect and provide trial information including the EV's mileage reading before charging, amount of electricity consumed and time used in each charging, operation downtime due to charging, and cost and downtime associated with scheduled and unscheduled maintenances of the EV. Similar data of the DV were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the driver and Brother's Travelling were collected to reflect any problems of the EV.

4. Findings of Trial

4.1 The following table summarises the statistical data of the EV and the DV. The average fuel cost of the EV was HK\$4.49/km (about 75%) lower than that of the DV. The average total operating cost of the EV was also HK\$4.49/km (about 75%) lower than that of the DV, taking the maintenance cost into account.

Table 1: Key operation statistics of each vehicle (1 August 2022 – 31 July 2023)

		EV	DV
Total distance travelled (km)		37,640	82,023
Average daily mileage (km/working day)		127	277
Average fuel economy	(km/kWh)	0.96	-
	(km/litre)	-	3.53
	(km/MJ)	0.27	0.098 ^[1]
Average fuel cost (HK\$/km)		1.50 ^[2]	5.99 ^[3]
Average total operating cost (HK\$/km) ^[4]		1.50	5.99
Downtime (working day) ^{[4][5]}		0	0

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

[2] The electricity cost was calculated using average electricity tariff rates of HK\$1.289/kWh (Aug-22 – Oct-22); HK\$1.451/kWh (Nov-22 – Dec-22); HK\$1.544/kWh (Jan-23 – Feb-23); HK\$1.552/kWh (Mar-23 – Apr-23); HK\$1.565/kWh (May-23); HK\$1.559/kWh (Jun-23) and; HK\$1.535/kWh (Jul-23) as claimed by CLP.

[3] The market fuel price was used for calculation.

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

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

4.2 Apart from the fuel cost, maintenance cost and other indirect costs which may include parking fee, towing fee, vehicle replacement fee and cost of operation downtime due to charging and maintenance of the EV are also included in Table 1. Both the EV and the DV had one scheduled maintenance in the 12 months of the trial period. The scheduled maintenance of the EV and the DV included government annual vehicle inspection. In addition, the EV had three unscheduled maintenances in the 12 months of the trial period. The unscheduled maintenances for the EV included adjustment of vacuum pressure of passenger door, repair of the micro-switch of emergency door and repair of the rear view camera.

4.3 In the 12 months of the trial period, neither the EV nor the DV had any downtime of maintenance related to vehicle performance. Hence, the utilisation rates of the EV and the DV

were both 100%. Based on the above, the average daily driving distances of the EV and the DV were 127 km and 277 km, respectively.

4.4 The driver of the EV liked driving the EV and had no problem in operating the EV. He agreed that the EV is quieter than the DV. Overall, he was satisfied with the performance of the EV and would promote the EV to other drivers. Brother's Travelling was satisfied with the EV since the EV could meet the operational requirements and save the operation cost. Given the opportunity, Brother's Travelling would consider replacing all existing conventional vehicles with EVs and encourage other transport operators to try the EVs.

4.5 It is observed that the amount of electricity stored in the battery after a full charging operation could be maintained at the level of 324 kWh after the 12-month trial period. The deterioration in battery capacity within the 12-month trial period, if any, would be insignificant and did not affect the operation of the EV.

4.6 Based on the total mileage of the EV and the fuel economy of the DV, the equivalent carbon dioxide (CO_{2e}) emission from the DV could be estimated for comparison purpose. In the 12-month trial period, the CO_{2e} emission from the EV and the DV were 15,312 kg and 28,130 kg respectively. Hence, there was a 12,818 kg (about 46%) reduction of CO_{2e}, with the replacement of the DV by the EV in the trial.

5. Summary

5.1 The average fuel cost and the average total operating cost of the EV were HK\$4.99/km (about 75%) lower than that of the DV. The utilisation rates of the EV and the DV were both 100%. There was a 12,818 kg (about 46%) reduction of CO_{2e}, with the replacement of the DV by the EV in the trial.

5.2 It is observed that the amount of electricity stored in the battery after a full charging operation could be maintained at the level of 324 kWh after the 12-month trial period. The deterioration in battery capacity within the 12-month trial period, if any, would be insignificant and did not affect the operation of the EV.

5.3 The driver of the EV liked driving the EV and had no problem in operating the EV. Overall, he was satisfied with the performance of the EV. Brother's Travelling was satisfied with the EV since the EV could meet the operational requirements and save the operation cost. Given the opportunity, Brother's Travelling would consider replacing all existing conventional vehicles with EVs and encourage other transport operators to try the EVs.

5.4 The findings showed single-deck electric bus are becoming more affordable and feasible to the transport trade for saving operating cost and reducing CO_{2e} emissions, provided that the vehicles can get easy access to charging facilities.

Appendix 1: Key Features of Vehicles and Charging Facility

1. Trial EV and Charging Facility

EV

Registration mark:	YA7398
Make:	BYD
Model:	C9R
Class:	Public bus
Gross vehicle weight:	18,000 kg
Seating capacity:	Driver + 65 passengers
Rated power:	300 kW
Driving range:	250 km (air conditioning off)
Battery material:	Lithium iron phosphate
Battery capacity:	324 kWh
Year of manufacture:	2018

EV Charging Facility (at Recipient's own cost)

No. of Charging Facility:	2
Make:	BYD
Model:	EVA080KG/01
Power:	80 kW, 380V three-phase AC / max 126A
Charging standard:	GB Mode

2. DV Used for Comparison

Registration mark:	TD2649
Make:	Isuzu
Model:	LT434P-6S-V
Class:	Public bus
Gross vehicle weight:	14,800 kg
Seating capacity:	Driver + 61 passengers
Cylinder capacity:	7,790 c.c.
Year of manufacture:	2014

Appendix 2: Photos of Vehicles and Charging Facility

1. Trial EV (YA7398) and Charging Facility

	
Front view of EV	Rear view of EV
	
Left side view of EV	Right side view of EV
	
80 kW three-phase AC charging facility in Tong Yan San Tsuen (at Recipient's own cost)	80 kW three-phase AC charging facility in San Tin (at Recipient's own cost)

2. DV (TD2649) used for Comparison

 A front-facing view of a red and white double-decker bus. The bus has a large windshield, a white grille with green and yellow horizontal stripes, and a license plate that reads "TD 2649". It is parked on a paved area with trees in the background.	 A rear-facing view of the same red and white double-decker bus. The bus has a large rear window, a white panel with green and yellow horizontal stripes, and a license plate that reads "TD 2649". It is parked on a paved area with trees in the background.
Front view of DV	Rear view of DV
 A side profile view of the red and white double-decker bus from the left side. The bus has a white upper body with green and yellow horizontal stripes and a red lower body. It is parked on a paved area with trees in the background.	 A side profile view of the red and white double-decker bus from the right side. The bus has a white upper body with green and yellow horizontal stripes and a red lower body. It is parked on a paved area with trees in the background.
Left side view of DV	Right side view of DV