

**Pilot Green Transport Fund**

**Final Report**

**On**

**Trial of Single-deck Electric Bus for Coach Hiring Service**  
**(Best Power (HK) Services Limited)**

(31 December 2021)

PREPARED BY:  
Dr. C. Ng

The Monitoring and Evaluation Team's views expressed in this report do not necessarily reflect the views of the Environmental Protection Department, HKSAR.

## **List of Monitoring and Evaluation Team Members**

**Dr. C.S. CHEUNG (Team Leader)**

Department of Mechanical Engineering  
The Hong Kong Polytechnic University

**Dr. C. NG**

Department of Mechanical Engineering  
The Hong Kong Polytechnic University

**Mr. K.S. TSANG**

Department of Mechanical Engineering  
The Hong Kong Polytechnic University

**Dr. Edward W.C. Lo**

Department of Electrical Engineering  
The Hong Kong Polytechnic University

**Dr. W.T. HUNG**

PolyU Technology and Consultancy Company Limited  
The Hong Kong Polytechnic University

**Pilot Green Transport Fund  
Trial of Single-deck Electric Bus for Coach Hiring Service  
(Best Power (HK) Services Limited)**

**Final Report  
(Trial Period: 1 December 2019 – 30 November 2021)**

**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. Best Power (HK) Services Limited (Best Power) was approved under the Fund for trial of one single-deck electric bus for coach hiring service. Through the tendering procedures stipulated in the Subsidy Agreement, Best Power procured one BYD C9R single-deck electric bus (EV) for trial.

1.2 The PolyU Technology and Consultancy Company Limited (PolyU) has been engaged by the Environmental Protection Department (EPD) as an independent third party assessor (the Assessor) to monitor the trial and evaluate the performance of the trial vehicle. A single-deck diesel bus (DV) providing the same service as the EV was assigned as the conventional counterpart for comparison.

1.3 This Final Report summarizes the performance of the EV in the 24 months of the trial as compared with the DV.

**2. Trial and Conventional Vehicles**

2.1 The trial EV, BYD C9R single-deck electric bus, has a gross vehicle weight (GVW) of 18,000 kg capable of carrying a driver and 65 passengers, and it is equipped with a 324 kWh lithium iron phosphate battery pack. It has a driving range of 250 km with air-conditioning off. No designated driver was assigned to drive the EV.

2.2 Best Power had not had a single-deck diesel bus running the same route as the EV during the trial period. To have a better comparison with the EV, the Assessor has adopted a Scania diesel single-deck bus (i.e. DV) which had provided the same service in the same route as the EV during the trial period, as the conventional counterpart. The DV had a GVW of 16,000 kg capable of carrying a driver and 65 passengers and a cylinder capacity of 9,290 cc for comparison with the EV. Owing to COVID-19 pandemic, the DV has not been operated since Nov 2020. This report will use the 12-month historical data of the DV (from Nov 2019 to October 2020) to achieve a better comparison.

2.3 The EV was mainly used to provide shuttle bus service for Next Digital Limited for 24 hours every day. The service route is a fixed round-trip route. From hours 06:50 to 24:00, they provide service between Tseung Kwan O Industrial Estate and the Tiu Keng Leng MTR station; while from hours 00:00 to 06:15, they provide service between Tseung Kwan O Industrial Estate and Tseung Kwan O, Kwun Tong and Mong Kok. From 8 July

2021, Next Digital Limited had ceased operation and the shuttle bus service was also stopped, therefore the EV also stopped operation from 8 July 2021 till end of the trial (146 days in total). Best Power could not find another client to complete the trial due to economic downturn arise from the pandemic.

2.4 Best Power rented a designated 80 kW, 3-phase AC quick charging facility from BYD to charge the EV and it takes around 4 ~ 5 hours for fully charging the EV. Key features of the EV, charging facility and the DV are in Appendix 1 and their photos are shown in Appendix 2.

### 3. Trial Information

3.1 The trial commenced on 1 December 2019 and lasted for 24 months. Best Power was required to collect and provide trial information including the EV mileage reading before charging, amount of electricity consumed in each charging, time taken for charging, operation downtime due to charging, cost and downtime associated with scheduled and unscheduled maintenance of the EV and charging facility. A similar data set from the DV was also collected. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Best Power were collected and provided to reflect any problems of the EV.

### 4. Findings of Trial

4.1 Table 1 summarizes the statistical data of the EV and the DV.

Table 1: Key operation statistics of each vehicle (1 December 2019 – 30 November 2021)

		EV <sup>[1]</sup>	DV <sup>[2]</sup>
Total mileage (km)		129,002	116,045
Average daily mileage (km/working day)		223	321
Average fuel economy	(km/kWh)	1.05	-
	(km/litre)	-	3.94
	(km/MJ)	0.29	0.11 <sup>[3]</sup>
Average fuel cost (HK\$/km) <sup>[4]</sup>		1.15	3.61
Average total operating cost per km (HK\$/km)		1.43	3.74
Downtime (working day) <sup>[5]</sup>		6 <sup>[1]</sup>	4

<sup>[1]</sup> Due to Best Power's business operation arrangement, the EV had not provided any service for 146 days from 8 July to 30 November 2021.

<sup>[2]</sup> Owing to COVID-19 pandemic, the DV stopped operation on 31 October 2020. The 12-month data of the DV (from Nov 2019 to October 2020) were used for comparison purpose.

<sup>[3]</sup> Assuming lower heating value of 36.13 MJ/litre for diesel fuel.

<sup>[4]</sup> The market fuel price was used for calculation.

<sup>[5]</sup> Downtime refers to the equivalent number of working days that 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 During the 24 months of the trial, the total mileage and the average daily mileage of the EV were 129,002 km and 223 km/day, respectively while those of the DV were 116,045 km and 321 km/day, respectively. The average fuel cost of the EV was HK\$2.46/km (68%) lower than that of the DV. The average total operating cost of the EV was HK\$2.31/km (62%) lower than that of the DV.

4.3 In this trial, the utilization rates of the EV and the DV were 99.0% and 98.9%, respectively.

4.4 To remove the effect of seasonal fluctuations, the 12-month moving average were used to evaluate the trend of the EV's fuel economy. The 12-month moving average fuel economy varied narrowly from 1.04 to 1.07 km/kWh. There was no sign of deterioration in fuel economy over the trial period.

4.5 Based on the total mileage of the EV and the fuel economy of the DV, the equivalent carbon dioxide (CO<sub>2</sub>e) emission from the DV could be estimated for comparison purpose. The CO<sub>2</sub>e emissions from the EV and DV were 46,100 kg and 86,349 kg, respectively and hence the EV emitted 40,249 kg CO<sub>2</sub>e (47%) less than the DV in this trial.

4.6 The operation of the EV was smooth. The EV drivers had no problem in operating the EV and considered it was clean and quiet. Both the drivers and Best Power were satisfied with the EV performance. Passengers were also satisfied with or had no comment on its performance.

## **5. Summary**

5.1 In this trial, the average daily distance travelled of the EV and the DV were 223 km and 321 km, respectively.

5.2 The EV had lower fuel cost than the DV, with an average fuel cost saving of about 68%. Accounting the maintenance costs incurred for both the EV and the DV, the average total operating cost saving of the EV was about 62% lower than that of the DV.

5.3 The utilization rates of the EV and the DV were 99.0% and 98.9%, respectively. In the trial period, there was no sign of deterioration in fuel economy of the EV.

5.4 Compared with the DV, there was about 47% CO<sub>2</sub>e emission reduction by using the EV.

5.5 The drivers had no problem in operating the EV and considered it was clean and quiet. Passengers were also satisfied with or had no comment on its performance. Best Power was also satisfied with the EV performance in general.

5.6 As electric bus market is expanding and the technology is improving, the price difference between the EV and its conventional counterpart is narrowing down. Electric bus will be more affordable to the transport trade.

## Appendix 1: Key Features of Vehicles and Charging Facility

### 1. Trial EV and Charging Facility

#### (a) EV

<b>Registration mark</b>	<b>WK9249</b>
Make:	BYD
Model:	C9R
Class:	Public bus
Gross vehicle weight:	18,000 kg
Seating capacity:	Driver + 65 passengers
Rated power:	300 kW
Travel range:	250 km (air conditioning off)
Maximum speed:	100 km/h
Battery material:	Lithium iron phosphate
Battery capacity:	324 kWh
Year of manufacture:	2018

#### (b) Charging Facility (Rented from BYD)

Make:	BYD
Model:	EVA080KG/01
Power:	80 kW, 3-phase AC
Charging standard:	GB/T 20234.2
Weight:	30 kg
Year of manufacture:	2018

### 2. DV Used for Comparison

<b>Registration mark:</b>	<b>SS5402</b> <sup>[1]</sup>
Make:	Scania
Model:	K280IB4X2NB
Class:	Single deck bus (Public bus)
Gross vehicle weight:	16,000 kg
Seating capacity:	Driver + 65 passengers
Cylinder capacity:	9,290 cc
Year of manufacture:	2013

<sup>[1]</sup> Owing to COVID-19 pandemic, the DV stopped operation on 31 October 2020. The 12-month data of the DV (from Nov 2019 to October 2020) were used for comparison purpose.

## Appendix 2: Photos of Vehicles and Charging Facility

### 1. Trial EV and Charging Facility

	
Front view of EV	Rear view of EV
	
Left side view of EV	Right side view of EV
 <p data-bbox="204 1832 767 1901">80 kW, 3-phase AC quick charging facility (Rented from BYD)</p>	



## 2. DV for Comparison



Front view of DV



Rear view of DV



Left side view of DV



Right side view of DV