

Pilot Green Transport Fund

Final Report On
Trial of Electric New Territories Taxi
(Sunny Engineering)

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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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**Pilot Green Transport Fund
Trial of Electric New Territories Taxi (Sunny Engineering)**

**Final Report
(Trial Period: 1 September 2013 – 31 August 2015)**

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. Sunny Engineering Company (Sunny) was approved under the Fund for trial of one electric vehicle for taxi service with the associated charging facilities. Through the tendering procedures stipulated in the Subsidy Agreement Sunny entered into with the Government, Sunny procured one BYD e6 electric vehicle (EV) for trial.

1.2 PolyU Technology and Consultancy Company Limited has been engaged by the Environmental Protection Department as an independent third party assessor to monitor the trials and evaluate the performance of the green innovative transport technologies under trial as compared with their conventional counterparts. Sunny assigned one LPG vehicle (CV) that provided similar services as the conventional vehicles for comparing with the EV.

1.3 This Final Report summarizes the performance of the EV in the twenty four months of the trial and compares them with its conventional counterpart.

2. Trial Vehicles

2.1 Key features of the EV and CV are in Appendix 1 and photos of the vehicles are in Appendix 2. According to the manufacturer, the EV has a travel range of 300 km with its batteries fully charged and air-conditioning off. Both vehicles provided taxi services in the New Territories daily, including public holiday, from 6:00 am to 11:00 pm.

2.2 Sunny had set up at its owner's residence a charging point with a 63A electricity outlet to charge the batteries of the EV. The outlet was equipped with a wall mounted control box and a single phase Watt-hour meter to monitor the charging. The charging facility is shown in Appendix 2. It took about 2 hours to charge the batteries from 0 to 100%. The EV was normally charged at this charging point. Occasionally, it would be charged at the airport's taxi queuing area where free charging points were set up by BYD for the e6 taxis. This EV was charged at least twice a day: at lunch time and overnight after business hours.

3. Trial Information

3.1 The trial started on 1 September 2013 and lasted for 24 months. Since the EV replaced the CV, data from the CV was collected from October 2012 to May 2013 before the EV was delivered for use. Sunny was required to collect and provide trial information including the EV mileage reading before charging, amount electricity consumed and time used in each charging, and operation downtime due to charging. Maintenance records include cost and downtime associated with scheduled and unscheduled maintenance of the EV and the charging facility. Similar data from the CV was also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and passengers were collected to reflect any problems of the EV.

4. Findings of Trial

4.1 Operating Costs

4.1.1 The following table summarizes the statistical data of the EV and CV. The fuel cost saving of EV compared to CV was \$0.236/km (39.7%).

Table 1: Key operation statistics of each vehicle (September 2013 to August 2015)

		EV	CV [historical]
Total mileage/km		111,416	55,043
Average fuel economy	(km/kWh)	3.33	-
	(km/litre)	-	8.24
	(km/MJ)	0.925	0.348 ^[1]
Average fuel cost/(\$/km)		0.359	0.595
Average total operating/(\$/km)		0.359	0.595 ^[3]
Average downtime ^[2] /day		6.5	8

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

^[2] Downtime refers to the period the vehicle was not in operation, which was counted from the first day it stopped operation till the day it was discharged from the repair garage to the operator.

^[3] Maintenance cost was not included as Sunny could not provide the information.

4.1.2 Apart from the fuel costs, the table also shows that average total operating cost which includes maintenance and other indirect costs such as towing fee, vehicle replacement fee. During the trial period, the EV was maintained free-of-charge as it was still under warranty and Sunny could not provide the cost for the maintenance of the CV. The total operating cost was the same as the fuel cost.

4.1.3 The utilization rate of the EV was 99% and that of the CV was 97%.

4.2 Performance and Reliability

4.2.1 The driver had no problem operating the EV. He preferred driving this EV than the CV. However, he opined that the charging time, up to 2 hours to fully charge the battery, was too long. The charging frequency did not indicate any deterioration in the battery performance.

4.2.2 Sunny agreed that, in general, using electric vehicle was good because it provided a greener environment compared with the CV. He was not satisfied with the inadequate charging stations in the areas where he provided his service. He was uncertain if using EV would save cost and he would like to see priority for electric taxis to pick up passengers at the airport as it was a cleaner vehicle compared with conventional taxi.

4.2.3 26 out of 27 responded passengers were impressed by this EV. In general, they all supported replacing the existing LPG taxis by electric vehicles. Seven passengers suggested Government providing stronger support such as more charging facilities and one passenger suggested subsidy for switching to electric taxi to facilitate their wider use. Two passengers opined that the noise level and the air quality inside the EV were similar to those of the LPG taxis.

4.2.4 The EV had a total reduction of 2,615 kg (11.5 %) CO₂ equivalent emission in the trial.

5. Summary

5.1 The average fuel cost of the EV was 39.7% (\$0.236/km) less than the CV. Their utilization rates were comparable, close to 100%. The EV had no downtime due to charging since it was charged at lunch time and after business hours.

5.2 The average fuel economy was 3.33 km/kWh for the EV. The fuel economy and thus the travel range are affected by various factors such as driving behaviour, road gradient, traffic condition and air-conditioning load. There was no discernible deterioration in the EV fuel economy in the 24-months trial period.

5.3 The trial showed that BYD e6 could be used in taxi operations to serve the New Territories. If the charging time required could be shortened and the number of charging stations could be increased in the serving area, more drivers would be willing to use this vehicle as taxis in the New Territories.

Appendix 1: Key Features of Vehicles

1. Trial EV

Registration Mark:	EH9186
Make:	BYD
Model:	e6
Class:	Taxi (NT)
Seating Capacity:	Driver + 4 passengers
Rated Power:	75 kW
Travel range:	300 km on full charge with air-conditioning off on flat road conditions
Maximum speed:	140 km/h
Battery material:	Lithium iron phosphate
Batteries capacity:	61.4 kWh
Charging time:	2 hours [63A]
Year of Manufacture:	2013

2. CV used for comparison

Registration Mark:	KN816
Make:	Toyota
Model:	YXS10RAESBN
Class:	Taxi (NT)
Seating Capacity:	Driver + 5 passengers
Cylinder capacity:	1,998 cc
Year of manufacture:	2002

Appendix 2: Photos of Vehicles and Charging Facilities

1. Trial Electric Taxi and Charging Facilities

 <p>A front-facing view of a green BYD electric taxi. The car has a 'TAXI' sign on the roof and a license plate that reads 'EH 9186'. A blue circular sticker on the front bumper says 'TAXI 4 SEATS'. A red date stamp '4/12/13' is visible in the bottom right corner.</p>	 <p>A side-profile view of the same green BYD electric taxi. It features a 'TAXI' sign on the roof and a license plate 'EH 9186'. A blue circular sticker on the front bumper says 'TAXI 4 SEATS'. A red date stamp '4/12/2013' is visible in the bottom right corner.</p>
<p>EV - Front view</p>	<p>EV- Side view</p>
 <p>A rear-facing view of the green BYD electric taxi. The license plate 'EH 9186' is clearly visible. A blue circular sticker on the rear bumper says 'TAXI 4 SEATS'. A red date stamp '4/12/13' is visible in the bottom right corner.</p>	
<p>EV- Rear view</p>	
 <p>A black charging station is mounted on a light-colored wall. It has a green charging port and a white electrical control box below it. A black charging cable is plugged into the station. A red date stamp '4/12/2013' is visible in the bottom right corner.</p>	 <p>A close-up view of a watt-hour meter. The meter is housed in a clear plastic enclosure and shows a digital display reading '003964'. It is labeled 'SKRA' and '3-Phase 4-Wire'. A red date stamp '4/12/2013' is visible in the bottom right corner.</p>
<p>Charging station at the EV owner's residence</p>	<p>Watt-hour meter for the charging station</p>

2. Conventional LPG Taxi for Comparison



CV – Front view