Pilot Green Transport Fund

Final Report On
Trial of Electric Light Goods Vehicles for Beverage Delivery
(Swire Beverages Limited)

(5 May 2020)

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Final Report
(Trial Period: 1 September 2014 – 31 August 2016)

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. Swire Beverages Limited (Swire) was approved under the Fund for trial of two electric light goods vehicles (hereafter called EVs) with the associated charging facilities for beverage delivery. Through the tendering procedures stipulated in the Subsidy Agreement, Swire procured two Renault Kangoo Z.E. electric light goods vehicle (namely EV-1 & EV-2) for trial.

1.2 The Hong Kong Institute Vocational Education (Tsing Yi) (IVE(TY)) 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 vehicles. Two diesel light goods vehicles (i.e., DV-1 and DV-2) providing similar services were assigned as the conventional counterparts for comparing with the two EVs.

1.3 This report summarizes the performance of the EVs in the 24 months of the trial as compared with their conventional counterparts.

2 Trial Vehicles

2.1 Swire procured two Renault Kangoo Z.E. electric light goods vehicles (namely EV-1 & EV-2) and each has a gross vehicle weight (GVW) of 2,300 kg and 22 kWh battery capacity with 44 kW rated power for trial. The EVs were used for transporting document of beverage business. Swire has set up two dedicated 20A chargers for EVs at Swire's Shatin depot. The EVs were charged regularly overnight after work and it took eight hours to fully charge the batteries. The EVs were parked in Swire's Shatin depot.

2.2 Two Nissan NV350 diesel light goods vehicle (DV-1 and DV-2), each has a gross vehicle weight (GVW) of 3,300 kg and a payload of about 1,400 kg were assigned for comparison with the two EVs in this trial.

2.3 Key features of the EVs and DVs are shown in Appendix 1 and photos of the vehicles are shown in Appendix 2. Photos of charging facilities are also in Appendix 2.

3 Trial Information

3.1 The trial started on 1 September 2014 and lasted for 24 months. All EVs and DVs are stationed at Swire's Shatin depot. According to the routes of the EVs, day to day usage of

the EV-1 and EV-2 is generally up to 120 km and 90 km, respectively. The beverage delivery services operate from 0900 to 2200 on Monday to Sunday and public holidays.

4 Findings of Trial

4.1 Table 1 below summarizes the total operating costs of EVs and DVs. The total operating costs of EV-1 and EV-2 were about 70% and 61% lower than those of DV-1 and DV-2. The fleet average total operating cost for EVs was about 65% lower than that of DVs. The average fuel cost of EV-1 and EV-2 were lower than those of DV-1 and DV-2 by about 83% and about 82%, respectively while the fleet average fuel cost for EVs was about 82% lower than that of DVs.

Table 1: Key operation statistics of each vehicle (September 2014 – August 2016)

		Electric Vehicles		**Diesel Vehicles**	
		EV-1	**EV-2**	**DV-1**	**DV-2**
Total mileage (km)		30,357	17,357	41,740	37,806
Average fuel economy	(km/kWh)	5.78	4.43	-	-
	(km/litre)	-	-	9.44	7.60
	(km/MJ)	1.61	1.23	0.26 [1]	0.21 [1]
Average fuel cost (HK$/km) [2]		0.20	0.26	1.15	1.44
Fleet average fuel cost (HK$/km)		0.23		1.30	
Average total operating cost (HK$/km)		0.39	0.60	1.31	1.55
Fleet average total operating cost (HK$/km)		0.50		1.43	
Downtime (working day) [3] [4]		14	15	7	17

[1] Assuming lower heating value of 36.13 MJ/litre for diesel fuel.
[2] The market rate of fuel was used for calculation
[3] Downtime refers to the equivalent number of working days in which the vehicle is not in operation due to charging, and the period 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] Maintenance due to incidents unrelated to the performance of the vehicle were not included for comparison.

4.2 During the trial period, both EVs had four scheduled maintenances each. EV-1 had one unscheduled maintenance that required replacement of the electronic board, static single-phase two wire watt-hour meter and socket interface. As for the DVs, each had two scheduled and no unscheduled maintenances. The total downtime for EV-1 and EV-2 were 14 days and 15 days, respectively while the total downtime for DV-1 and DV-2 were 7 days and 17 days, respectively. Utilization rates of EV-1 and EV-2 were therefore about 98% and 97%, respectively and that of DV-1 and DV-2 were about 99% and 97%, respectively.

4.3 The drivers found no problem in operating the EVs and felt the EVs were quiet and environment friendly. However, the drivers found that the EVs did not have sufficient power when driving up steep roads.

4.4 Swire agreed that, in general, using electric vehicle was good because it provided a greener and quieter environment compared with the diesel vehicles. However, due to the limitation on the battery range, Swire needed to plan for the journeys in advance and select suitable service locations for the EVs. Such planning reduces the flexibility in their business operations. Swire expected that the battery range of EVs and related technology could be improved in future.

4.5 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the EVs' fuel economy. The fuel economy varied from 5.62 to 5.96

km/kWh) for EV-1 and from 4.39 to 4.66 km/kWh for EV-2. During the 24-month trial period, the variation in fuel economy of the EVs is insignificant and hence there is no indication that the fuel economy and the batteries have deteriorated during the trial period.

4.6 The carbon dioxide equivalent (CO_2e) emissions from the EV-1 and EV-2 were 2,929 kg and 2,174 kg, respectively, while those from DV1 and DV2 were 8,915 kg and 6,332 kg, respectively. Hence there is a reduction of 5,986 kg (about 67%) and 4,158 kg (about 66%) CO_2e emission for EV-1 and EV-2 in the trial. The total reduction of CO_2e is thus 10,144 kg (about 67%) by using EV.

5 Summary

5.1 The day-to-day usage of the EV-1 and EV-2 is generally up to 120 km and 90 km, respectively. The fleet average total operating cost for EVs was about 65% lower than that of DVs while the fleet average fuel cost for EVs was about 82% lower than that of DVs. The utilization rates of EV-1 and EV-2 were 98% and 97%, respectively and that of DV-1 and DV-2 were 99% and 97%, respectively. There is a total reduction of 10,114 kg (i.e. 67%) CO_2e emission by using EVs in the trial.

5.2 The drivers found no problem in operating the EVs and felt the EVs were quiet and environment friendly. However, the drivers found that the EVs did not have sufficient power when driving up steep roads. Swire agreed that, in general, using electric vehicle was good because it provided a greener and quieter environment compared with the diesel vehicles. The trial showed that under local operating conditions where air-conditioning is essential, the EVs are suitable for use with shorter daily mileage and planned routes. There is no indication that the fuel economy and the batteries have deteriorated during the trial period.

5.3 At present, the price of electric vehicle is higher than that of a conventional vehicle, so the accumulated fuel saving may not be able to offset the higher vehicle cost shortly. However, with the growth of the market, the scale of production will drive the cost downward and the price difference between electric vehicle and conventional vehicle will become smaller, whereby making the electric vehicles more affordable to the transport trade.

Appendix 1: Key Features of Vehicles Involved in the Trial

1. Trial EVs & EV Charging Facility

(a) Trial EVs

Registration Mark:	**SV 9443 and SV 9493**
Make:	Renault
Model:	Kangoo Z.E.
Class:	Light goods vehicle
Gross vehicle weight:	2,300 kg
Seating Capacity:	driver + 4 passengers
Rated Power:	44 kW
Travel range:	170 km on full charge and air-conditioning off
Maximum speed:	130 km/h
Battery material:	Lithium ion
Batteries capacity:	22 kWh
Charging time:	8 hours with max. charging current of 16A
Year of manufacture:	2014

(b) EV Charging Facility

Charging standard :	IEC62196 Type 2
Charging mode:	220V / 20A, A/C

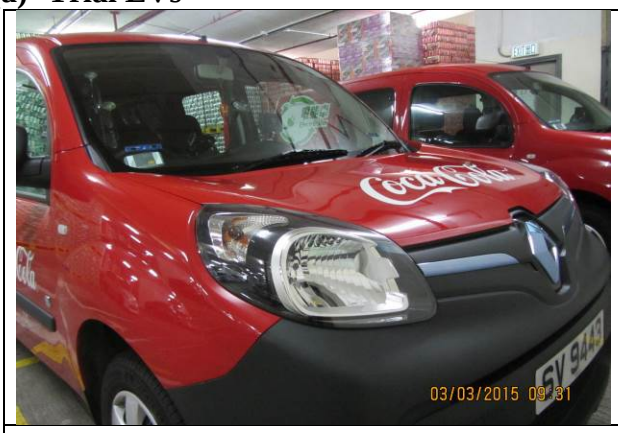
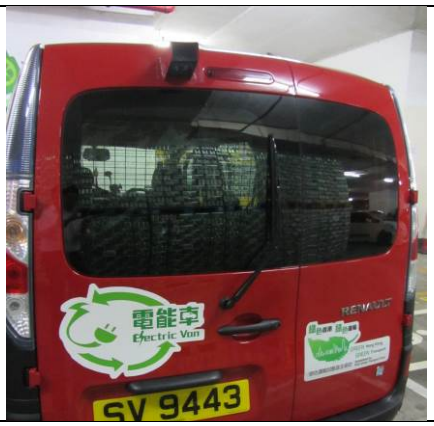
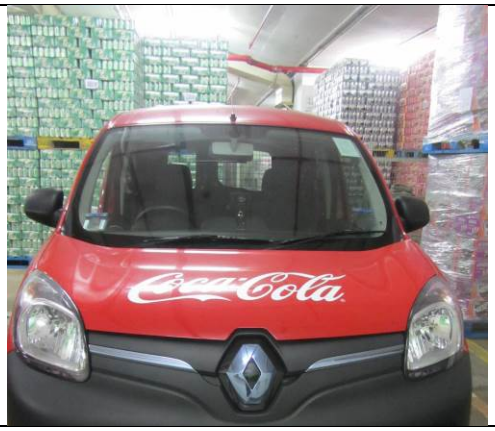
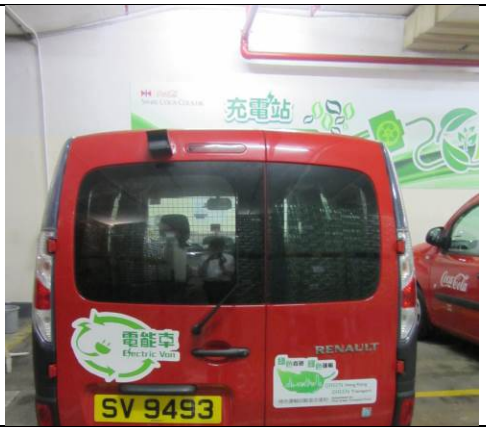
2. DVs used for comparison

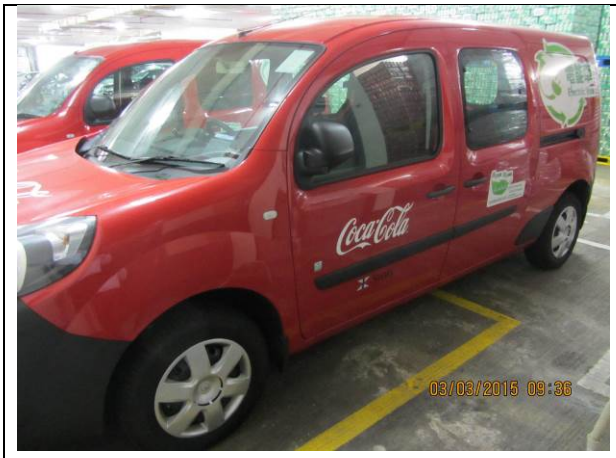
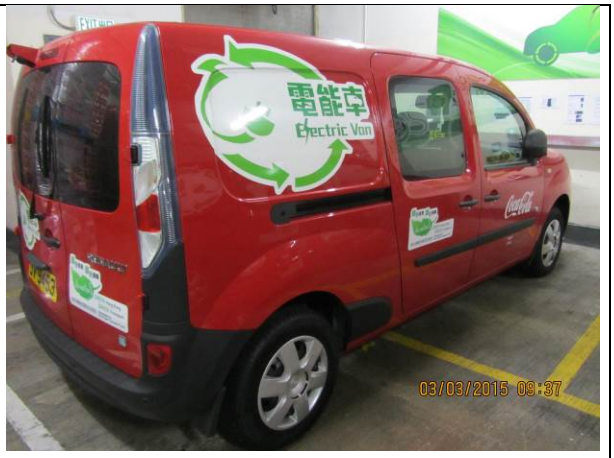
Registration Mark:	**SG8707 and SG9225**
Make:	Nissan
Model:	NV350
Class:	Light goods vehicle
Seating Capacity:	driver + 5 passengers
Gross vehicle weight:	3,300 kg
Cylinder capacity:	2,488 c.c.
Year of manufacture:	2013

Appendix 2: Photos of Vehicles and Charging Facilities

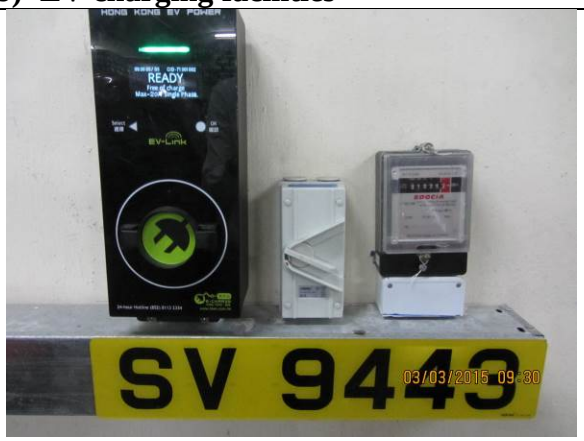
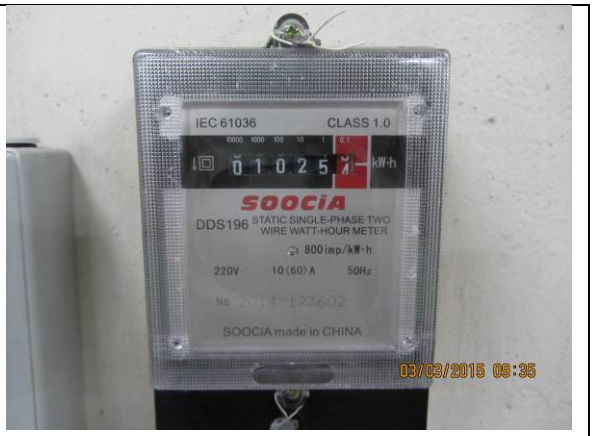
1. Trial EVs and EV charging facilities

(a) Trial EVs

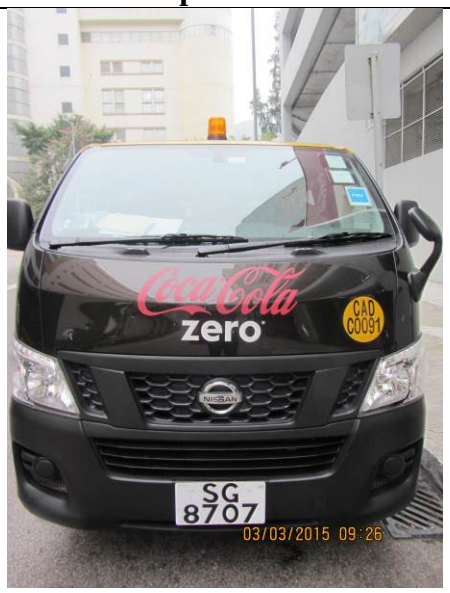
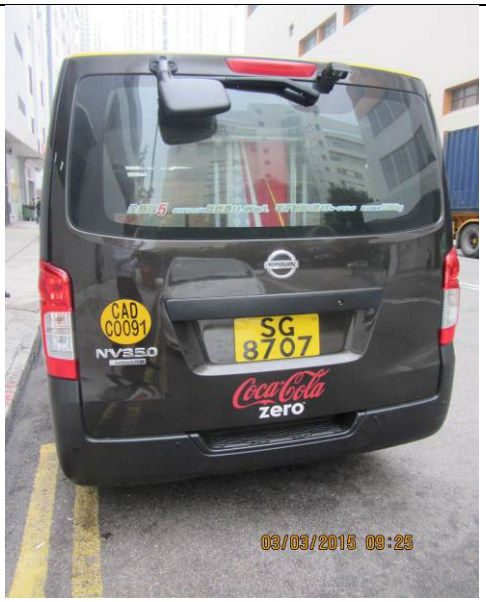
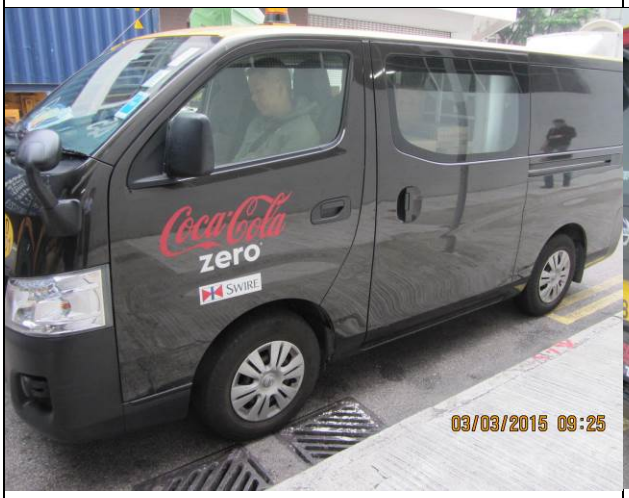
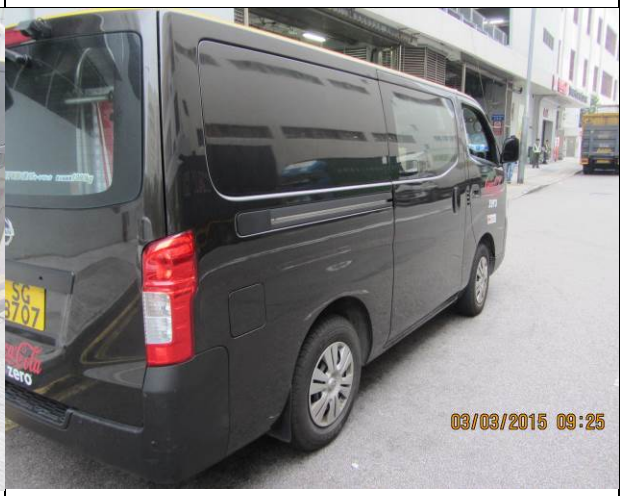
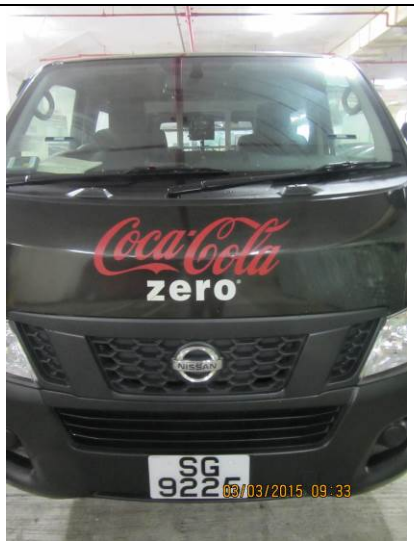
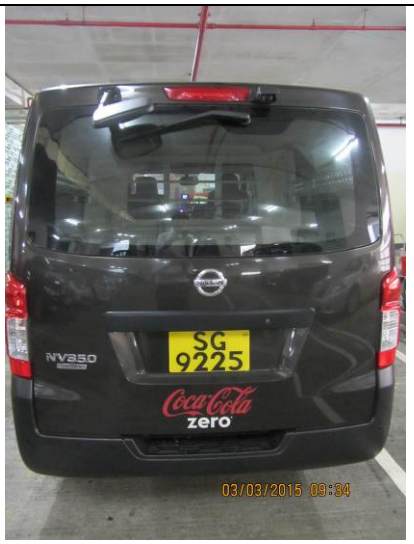
	
EV-1 – front view	EV-1 – rear view
	
EV-1 – Left side view	EV-1 – Right side view
	
EV -2 – Front view	EV -2 – Rear view

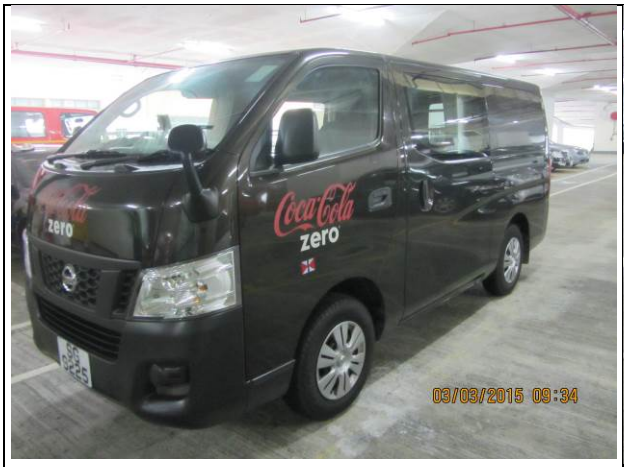
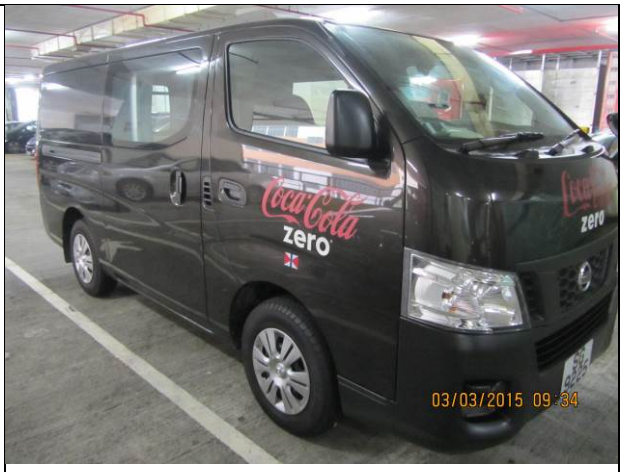
	
EV-2 – Left side view	EV-2 – Right side view

(b) EV charging facilities

	
EV-1 – Charging station	EV-1 – Electricity meter
	
EV-2 – Charging station	EV-2 – Electricity meter

2. DVs for Comparison

	
DV-1 – Front view	DV -1 – Rear view
	
DV-1 – Left side view	DV-1 – Right side view
	
DV-2 – Front view	DV-2 – Rear view

	
DV-2 – Left side view	DV-2 – Right side view