

# **Pilot Green Transport Fund**

## **Final Report On Trial of Hybrid Light Buses for Green Public Light Bus Service (Teamwise Corporation 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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**Pilot Green Transport Fund**  
**Trial of Hybrid Light Buses for Green Public Light Bus Service**  
**(Teamwise Corporation Limited)**

**Final Report**  
**(Trial Period: 1 November 2014 – 31 October 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. Teamwise Corporation Limited (Teamwise) was approved under the Fund for trial of two diesel-electric hybrid light buses for green public light bus service. Through the tendering procedures stipulated in the Subsidy Agreement, Teamwise procured two Dongfeng Gemini diesel-electric hybrid light buses for trial.

1.2 The Hong Kong Institute of Vocational Education (Tsing Yi) 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 buses providing the same type of service were assigned as the conventional vehicles for comparing with the HVs.

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

### **2. Trial Vehicles**

2.1 Teamwise procured two Dongfeng Gemini EQ6700LS5HEVY diesel-electric hybrid light buses (namely HV-1 and HV-2) and each has a gross vehicle weight (GVW) of 7000 kg with 150 kW rated power for the trial. The HVs were used to provide green public light bus (GPLB) services.

2.2 Two Toyota diesel light buses (namely DV-1 and DV-2) with a GVW of 4350 kg each were assigned for comparison with the two HVs in this trial. The HVs and DVs were used in GPLB Route 6 running from Whampoa Garden to Tsim Sha Tsui and Yau Yat Chuen.

2.3 Key features of the HVs and DVs are shown in Appendix 1 and their photos are shown in Appendix 2.

### **3. Trial Information**

3.1 The trial started on 1 November 2014 and lasted for 24 months. Teamwise was required to collect and provide trial information including the HVs mileage reading before refuelling, operation downtime associated with scheduled and unscheduled maintenance of the HVs. Similar monthly data from the DVs were also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Teamwise were collected to reflect any problems of the HVs. The service hours of the vehicles are from 06:15 to 00:05 on Monday to Sunday.

#### 4. Findings of Trial

4.1 Table 1 summarises the key operation statistics of the HVs and DVs. The average fuel costs of HV-1 and HV-2 were HK\$0.15/km (about 5%) and HK\$0.24/km (about 8%) higher than those of DV-1 and DV-2 respectively, and the fleet average fuel cost of the HVs was HK\$0.2/km (about 7%) higher than that of the DVs. The average total operating costs of HV-1 and HV-2 were HK\$0.27/km (about 8%) and HK\$1.23/km (about 39%) higher than DV-1 and DV-2 respectively and the fleet average total operating cost of the HVs was about HK\$0.75/km (about 23%) higher than that of the DVs.

Table 1: Key operation statistics of each vehicle (November 2014 – October 2016)

	HVs		DVs	
	HV-1	HV-2	DV-1	DV-2
Total mileage (km)	82,769	84,530	130,241	128,364
Average fuel economy (km/litre)	3.44	3.19	3.62	3.45
Fleet average fuel economy (km/litre)	3.32		3.54	
Average fuel cost (HK\$) <sup>[1]</sup>	3.14	3.37	2.99	3.13
Fleet average fuel cost (HK\$/km)	3.26		3.06	
Average total operating cost (HK\$/km)	3.60	4.42	3.33	3.19
Fleet average total operating cost (HK\$/km)	4.01		3.26	
Downtime (working day) <sup>[2] [3]</sup>	136	183	22	6

[1] The market rate was adopted for calculation.

[2] Downtime refers to the equivalent number of working days in which 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.

[3] Maintenance due to incidents unrelated to the performance of the vehicle was not included for comparison.

4.2 During the trial period, HV-1 and HV-2 had 7 and 4 scheduled maintenances respectively for regular check-ups, resulting in 39 and 16 days of operation downtime respectively. There were 48 and 57 unscheduled maintenances for HV-1 and HV-2 respectively, resulting in 97 and 167 days of operation downtime respectively. DV-1 and DV-2 had 5 and 6 scheduled maintenances respectively for regular check-ups, resulting in 3 and 4 days of operational downtime respectively. There were 4 and 5 unscheduled maintenances for DV-1 and DV-2 respectively, resulting in 19 and 2 days of operational downtime respectively. These led to 136, 183, 22 and 6 days of operational downtime for HV-1, HV-2, DV-1 and DV-2 respectively. Utilization rates of HV-1, HV-2, DV-1 and DV-2 were 81%, 75%, 97% and 99% respectively.

4.3 The drivers were not satisfied with the performance of the HVs as there had been many problems relating to the electrical control systems and batteries during the driving. The performance of HVs was not as good as that of the conventional public light buses. For example, a negative observation was the excessive noise generated while the HVs engine was running when recharging the batteries, and the poor performance and response time of the electrical driving systems.

4.4 Overall, Teamwise was not satisfied with the performance of the HVs as too much operating time was lost due to repairs and the fuel savings were not as expected.

4.5 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the HVs' fuel economies. The fuel economies varied for HV-1 from 3.38 to 3.63 km/l and for HV-2 from 3.05 to 3.55 (i.e. about 7% and 14% variation respectively). During the 24-month trial period, the variation in the fuel economies of the HVs was not significant, indicating the deterioration of HVs during the trial period was minor.

4.6 Based on the total distance travelled by the HVs in the trial, the carbon dioxide equivalent (CO<sub>2e</sub>) emission from HV-1 was 66,626 kg and from HV-2 was 73,365 kg while that from DV-1 was 63,424 kg and from DV-2 was 67,868 kg. Hence, the total CO<sub>2e</sub> from the HVs was 8,699 kg (about 7%) higher than that from the DVs during the trial period.

## 5. Summary

5.1 The drivers experienced various problems in operating the HVs and did not feel the HVs were quiet and environment friendly. The drivers consistently expressed disappointment with the HVs' driving performance and reliability due to many breakdowns.

5.2 The utilization rates of HV-1, HV-2, DV-1 and DV-2 were 81%, 75%, 97% and 99% respectively. During the 24-month trial period, the variation in the fuel economies of the HVs was not significant, indicating the deterioration of HVs was minor. However, the usage of the HVs was on the low side as reflected by the difference in the total mileage travelled between the HVs and DVs - HV-1 (82,769 km), HV-2 (84,530 km), DV-1 (130,241 km) and DV-2 (128,364 km).

5.3 The HVs incurred a higher fleet average fuel cost of HK\$0.2/km (about 7%) compared to that of the DVs. Taking into account the maintenance costs, the fleet average total operating cost of the HVs was HK\$0.75/km (about 23%) higher than that of the DVs. The CO<sub>2e</sub> emission from HV-1 and HV-2 were 3,203 kg (about 5%) and 5,497 kg (about 8%) higher than that DV-1 and DV-2 respectively in the trial. Hence, the total CO<sub>2e</sub> from the HVs was 8,699 kg (about 7%) higher than that from the DVs during the trial period.

## Appendix 1: Key Features of Vehicles Involved in the Trial

### 1. Trial HV-1

<b>Registration Mark</b>	<b>DC3873</b>
Make:	Dongfeng
Model:	Gemini EQ6700LS5HEVY
Class:	Public Light Bus
Gross vehicle weight:	7 tonnes
Seating capacity:	driver + 16 passengers
Rated Power:	150 kW
Battery type:	Lithium iron phosphate battery
Year of manufacture:	2014

### 2. Trial HV-2

<b>Registration Mark</b>	<b>EE 5069</b>
Make:	Dongfeng
Model:	Gemini EQ6700LS5HEVY
Class:	Public Light Bus
Gross vehicle weight:	7 tonnes
Seating capacity:	driver + 16 passengers
Rated Power:	150 kW
Battery type:	Lithium iron phosphate battery
Year of manufacture:	2014

### 3. DV-1 used for comparison

<b>Registration Mark</b>	<b>EH8663</b>
Make:	Toyota
Model:	XZB40RZCMSY
Class:	Public Light Bus
Seating capacity:	driver + 16 passengers
Gross vehicle weight:	4.35 tonnes
Cylinder capacity:	4,104 cc
Year of manufacture:	2010

### 4. DV-2 used for comparison

<b>Registration Mark</b>	<b>FN8945</b>
Make:	Toyota
Model:	XZB40RZCMSY
Class:	Public Light Bus
Seating capacity:	driver + 16 passengers
Gross vehicle weight:	4.35 tonnes
Cylinder capacity:	4,104 cc
Year of manufacture:	2010

## Appendix 2: Photos of Vehicles

1.



HV-1 – front view



HV-1 – rear view



HV-1 – left side view



HV-1 – right side view

2. Trial HV-2



HV-2 – front view



HV-2 – rear view



HV-2 – left side view



HV-2 – right side view

### 3. DV-1 for comparison



DV-1 – front view



DV-1 – rear view



DV-1 – left side view



DV-1 – right side view

4. DV-2 for Comparison



DV-2 – front view



DV-2 – rear view



DV-2 – left side view



DV-2 – right side view