

Pilot Green Transport Fund

Final Report On Trial of Hybrid Light Goods Vehicle for Retail Industry (Kau Kee Development Limited)

(4 February 2021)

PREPARED BY:

Dr. W.T. Hung

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. KS Tsang

Department of Mechanical Engineering
The Hong Kong Polytechnic University

Dr. Edward WC 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

Dr. David Yuen

PolyU Technology and Consultancy Company Limited
The Hong Kong Polytechnic University

**Pilot Green Transport Fund
Trial of Hybrid Light Goods Vehicle for Retail Industry
(Kau Kee Development Limited)**

**Final Report
(Trial Period: 1 December 2018 – 30 November 2020)**

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. The Fund has subsidized Kau Kee Development Limited (Kau Kee) to try out one diesel-electric hybrid light goods vehicle (HV) for logistics services.

1.2 PolyU Technology and Consultancy Company Limited (the assessor) has been engaged by the Environmental Protection Department (EPD) as an independent third party assessor to monitor the trial and evaluate the performance of the trial vehicle. The assessor regularly visited Kau Kee to collect information for evaluating the performance of the HV as compared with Kau Kee 's diesel light goods vehicle (DV) which provided the same service. The information collected included the said vehicles' operation data, fuel bills, maintenance records, reports on operation difficulties, and opinion of the HV driver and Kau Kee from survey questionnaires.

1.3 This Final Report summarizes the performance of the HV in the 24-month trial as compared with its conventional counterpart, i.e. the DV.

2. Trial and Conventional Vehicles

2.1 Kau Kee procured a Hino 300 series diesel-electric hybrid light goods vehicle (HV) with 5,500 kg gross vehicle weight (GVW) and 4,009 cc cylinder capacity for trial.

2.2 An Isuzu NPR series diesel light goods vehicle of 5,500kg GVW and 5,193 cc cylinder capacity (DV), was assigned for comparison with the HV. It was retired and replaced by another Isuzu DV but had the same license plate number in the 24-month trial. All vehicles were equipped with air-conditioning units.

2.3 Key features and photos of the HV and DV are in Appendices 1 and 2 respectively

3. Trial Information

3.1 The 24-month trial started on 1 December 2018. The HV and DV were stationed in Tsuen Wan depot. HV served Causeway Bay in the morning but Aberdeen/ Ap Li Chau in the afternoon. DV served Admiralty or Central in the morning but Causeway Bay in the afternoon. There was no fixed route. The delivery was conducted from Monday to Saturday, excluding Sunday and public holidays. The operating hours were from 08:00 to 19:00.

4. Findings of Trial

4.1 Table 1 shows a summary of all the key statistics for each vehicle. The average fuel cost of HV was lower than that of DV by HK\$0.28/km (12%). The average total operating cost of HV was HK\$0.17/km (7%) lower than that of DV.

Table 1: Key operation statistics of each vehicle (December 2018 – November 2020)

	HV	DV
Total distance traveled (km)	76,718	51,007
Average daily distance traveled (km/day)	130	86
Average fuel economy (km/litre)	6.80	6.00
Average fuel cost (HK\$/km) ^[1]	2.10	2.38
Average total operating cost (HK\$/km) ^[2]	2.27	2.44
Downtime (working day) ^{[2] [3]}	8.5	5.5

[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 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.

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

4.2 Besides fuel costs, maintenance cost and other costs associated with breakdowns, such as replacement of components and parts, were also accounted for in calculating the total operating cost. It should be noted that the maintenance cost of the HV did not include labour cost as the vehicle was still under warranty, the labour cost was waived and only the parts to be replaced were charged.

4.3 During the 24 months of the trial, HV had three scheduled maintenances including two annual vehicle examinations and one regular check-up as well as one unscheduled maintenance. DV had one scheduled maintenance relating to annual vehicle examination as well as two unscheduled maintenances, excluding those maintenances unrelated to vehicle performance. Out of the 592 working days in the trial, there were 8.5 days of operation downtime for HV while DV had 5.5 days of operation downtime, excluding the downtime unrelated to the vehicle performance. The utilization rates for the HV and DV were 98.6% and 99.1% respectively.

4.4 Kau Kee had a designated driver for the HV. The driver found no problem in operating the HV and in general felt the HV was clean and less polluted. However, he reflected that the HV responded slower and was less powerful than DV especially in upslope driving mode.

4.5 Kau Kee was satisfied with the HV but would not consider replacing the entire vehicle fleet with HV because the HV was not markedly better performed than the DV in particular the fuel economy.

4.6 To remove the effect of seasonal fluctuations, 12-month moving averages are used to evaluate the trend of the HV's fuel economy. The results show that fuel economy of the HV fluctuated slightly over the 24-month trial period. It appears that the engine of the HV was still in normal working conditions and the fuel economy could be maintained through proper maintenance.

4.7 The carbon dioxide equivalent (CO_{2e}) emission from HV was 31,295 kg while that from the conventional vehicle DV on HV mileage would be 35,466 kg. There was thus a total CO_{2e} emission reduction of 4,171 kg (12%) in the trial by using the HV compared with the DV.

5. Summary

5.1 With a total of 592 working day in the 24-month trial period, the average daily mileage of HV was 130 km while that of DV was 86 km. The HV had a better fuel economy than the DV. The average fuel cost of the HV was 12% lower than that of the DV. Including the maintenance costs, the average total operating cost of the HV was 7% lower than that of the DV. There was a 12% CO_{2e} reduction by using HV during the 24-month trial period as compared with DV.

5.2 Excluding those maintenances unrelated to vehicle performance, the HV had three scheduled maintenances and one unscheduled maintenance, while the DV had one scheduled maintenance and two unscheduled maintenances. Out of the 592 working days in the trial, the HV and DV had 8.5 and 5.5 days of operation downtime respectively, excluding the downtime unrelated to the vehicle performance. The utilization rates were 98.6% for HV and 99.1% for DV.

5.3 No deterioration in the performance of the HV was observed during the trial period.

5.4 The driver had no problem in operating the HV except that the HV responded slower than the DV and had less power than the DV especially when driving upslope. Kau Kee was satisfied with the HV, but would not consider replacing the entire vehicle fleet with the HV because it was not markedly better performed than the DV in fuel economy.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration Mark:	EN1110
Make:	Hino
Model:	300 SERIES HYBRID XKU720R HKUQS3
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	driver + 2 passengers
Cylinder capacity:	4,009 cc
Year of manufacture:	2018
Maximum output (ps/rpm):	150/2,500
Battery type:	Nickel-Metal Hydride Battery

2. DV used for comparison

(From December 2018 to March 2019)

Registration Mark:	NT7843¹
Make:	Isuzu
Model:	NPR75HH
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	driver +2 passengers
Cylinder capacity:	5,193 cc
Year of manufacture:	2009





(From April 2019 onwards)

Registration Mark:	NT7843
Make:	Isuzu
Model:	NPR75HH-V1-C
Class:	Light goods vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	driver +2 passengers
Cylinder capacity:	5,193 cc
Year of manufacture:	2019

¹ This DV was retired in April 2019 and was replaced by a new DV bearing with same license plate number

Appendix 2: Photos of the Trial Vehicles

1. Trial HV – EN1110

	
<p>Front view of HV</p>	<p>Right side view of HV</p>
	
<p>Left side view of HV</p>	<p>Rear view of HV</p>

2. DV for comparison – NT7843



Front view of DV



Right side view of DV



Left side view of DV



Rear view of DV