

Pilot Green Transport Fund

Final Report On Trial of Hybrid Light Goods Vehicle for Seafood Delivery (Kingsforce Limited)

(26 January 2021)

Prepared By:

Dr. Joe LO Ka Wah
Mr. Elvin NG Cheuk Yin
Mr. CHAN Ka Chun
Mr. Ricky CHONG Ka Ho

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. Joe K. W. LO (Team Leader)

Centre Manager

Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Mr. Elvin C. Y. NG (Team Member)

Test Engineer

Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Mr. K. C. CHAN (Team Member)

Technician

Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

Mr. Ricky K. H. CHONG (Team Member)

Executive Assistant

Jockey Club Heavy Vehicle Emissions Testing and Research Centre
Hong Kong Institute of Vocational Education (Tsing Yi)

**Pilot Green Transport Fund
Trial of Hybrid Light Goods Vehicle
for Seafood Delivery
(Kingsforce Limited)**

**Final Report
(Trial Period: 1 October 2018 – 30 September 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. Kingsforce Limited (Kingsforce) was approved under the Fund for trial of one diesel-electric hybrid light goods vehicle for seafood delivery. Through the tendering procedures stipulated in the Subsidy Agreement, Kingsforce procured one Hino 300 Series diesel-electric hybrid light goods vehicle (HV) 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 vehicle. Kingsforce assigned a Isuzu diesel light goods vehicles (DV) providing the same type of service for comparing with the HV.

1.3 This Final report summarizes the performance of the HV in the 24 months of the trial as compared with its conventional counterpart.

2 Trial and Conventional Vehicles

2.1 The HV had a gross vehicle weight (GVW) of 5,500 kg and a cylinder capacity of 4,009 cc. The DV-1 has a GVW of 5,500 kg and cylinder capacity of 4,751 c.c. The DV-2 has a GVW of 5,200 kg and cylinder capacity of 2,999 c.c. Both DV-1 and DV-2 provided the same type of service as the HV. DV-1 was broken down in early January 2019 and could not be returned for service in end March 2019. Therefore, from April 2019 onwards, Kingsforce assigned another Isuzu diesel light goods vehicle (DV-2) for comparison with the HV. The vehicles were used for providing seafood delivery service in Kowloon.

2.2 Key features of the HV and the DVs are in Appendix 1 and photos of the vehicles are in Appendix 2.

3 Trial Information

3.1 The trial started on 1 October 2018 and lasted for 24 months. Kingsforce was required to collect and provide trial information including the HV odometer reading at refueling, the date of refueling, the refueled amount, cost and operation downtime associated with scheduled and unscheduled maintenance of the HV. Similar set of monthly data of the DV

was also required. In addition to the cost information, reports on maintenance work, operational difficulties and opinions of the drivers and Kingsforce were also collected to reflect any problems of the HV.

4 Findings of Trial

4.1 Table 1 summarizes the operational statistical data of the HV and the DV. The average fuel cost of the HV was HK\$0.83/km (39%) higher than that of the DV. The average total operating cost of the HV was HK\$0.79/km (34%) higher than that of the DV. The total mileage of the HV was 58% less than that of the DV in the trial period. Since the HV was not use frequently and the batteries of the HV naturally lost their charge little by little over time. When the HV operate in the next operation, it took time for running the engine to charge up the batteries. Also, the cylinder capacity of the HV was higher than that of the DV-2, resulting in higher average fuel cost.

Table 1: Key operation statistics of each vehicle (October 2018 – September 2020)

	HV	DV
Total mileage (km)	17,362	41,043
Average fuel economy (km/litre)	4.79	6.70
Average fuel cost (HK\$/km) ^[1]	2.96	2.13
Average total operating cost (HK\$/km)	3.08	2.29
Downtime (working day) ^{[2][3]}	0	91

[1] The market fuel price was used 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 There were two scheduled maintenances for the HV and five scheduled maintenances for the DV, resulting in one day of operation downtime for the DV. In addition, there was no unscheduled maintenance for the HV, while the DV’s engine broke down resulted in one unscheduled maintenance with a total downtime of 90 working days. The utilization rates of the HV and the DV were 100% and 88% respectively.

4.3 Kingsforce had a designated driver for the HV. The HV driver shared the view that driving the HV was easier than the DV and he likes to drive HV more than DV. It was because the automatic gearbox was used in the HV, so he did not need to control the clutch for gear shift during driving, and he felt more comfortable driving in urban area. Also, the driver expressed that the HV’s power was enough for going uphill, but it could not achieve high speed.

4.4 Kingsforce informed that the engine of DV-1 was broken down in early January 2019 and could not be returned for service in end March 2019. Therefore, in April 2019, Kingsforce replaced DV-1 with DV-2 for comparison with the HV thereafter. In addition, due to insufficient business volume in June 2020, HV does not have any fuel input records. Kingsforce was satisfied with the HV’s performance. Kingsforce claimed that the HV could

help improve the roadside air quality, therefore they would encourage other transport operators to try out this type of vehicle.

4.5 To eliminate the effect of seasonal fluctuations, 12-month moving averages were used to evaluate the trend of the HV fuel economy. It was shown that the fuel economy of HV has obvious variation (varied between 3.73 km/litre and 5.07 km/litre). The result appears that the performance of the HV is deteriorating over the trial period.

4.6 Based on the total mileage of the HV in the 24 months of the trial, the carbon dioxide equivalent (CO₂e) emission from the HV was 10,049 kg while that from the DV was 7,184 kg. Therefore, the CO₂e emission of the HV was 2,865 kg (40%) more than the DV. It was because the cylinder capacity of HV (4,009 c.c.) was higher than that of DV-2 (2,999 c.c.) by 34%. Therefore, the fuel economy and the environmental benefits of the HV were unobvious.

5 Summary

5.1 According to the drivers' feedback to the questionnaires, the HV driver shared the view that driving the HV was easier than the DV and he likes to drive HV more than DV. It was because the automatic gearbox was used in the HV, so he did not need to control the clutch for gear shift during driving, and he felt more comfortable driving in urban area. Kingsforce was satisfied with the HV's performance, therefore they would encourage other transport operators to try out this type of vehicle.

5.2 The utilization rates of the HV and the DV were 100% and 88% respectively. However, the usage of the HV was on the low side as reflected by the difference in the total mileage travelled between the HV (17,362 km, i.e. 24 km on average per working day) and the DV (41,043 km, i.e. 64 km on average per working day) in the 24 months of trial.

5.3 The average fuel cost of the HV was HK\$0.83/km (39%) higher than the DV, and the average total operating cost of the HV was HK\$0.79/km (34%) higher than that of the DV. Compared with the DV, the economic advantage of the HV was unobvious. Also, the CO₂e emission of the HV was 2,865 kg (40%) more than that of the DV. It was because the cylinder capacity of HV was higher than that of DV-2 by 34%. Therefore, if the DV-2 was to replace the HV, the fuel economy and the environmental benefits of the HV were unobvious. More trials and comparison with diesel light goods vehicle with cylinder capacity more or less the same as the HV are desired.

5.4 The result showed that performance of the HV has deteriorated over the trial period.

Appendix 1: Key Features of Vehicles

1. Trial HV

Registration mark	BH980
Make:	HINO
Model:	300 SERIES HYBRID XKU640R-HKUMS3
Class:	Light Goods Vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	Driver + 2 passengers
Engine capacity:	4,009 c.c.
Battery type:	Nickel-metal hydride
Year of manufacture:	2018

2. DV for comparison

DV-1

Registration mark	CX196 (for comparison from October to December 2018)
Make:	ISUZU
Model:	NPR70LU-5J
Class:	Light Goods Vehicle
Gross vehicle weight:	5,500 kg
Seating capacity:	Driver + 2 passengers
Engine capacity:	4,751 c.c.
Year of manufacture:	2002

DV-2

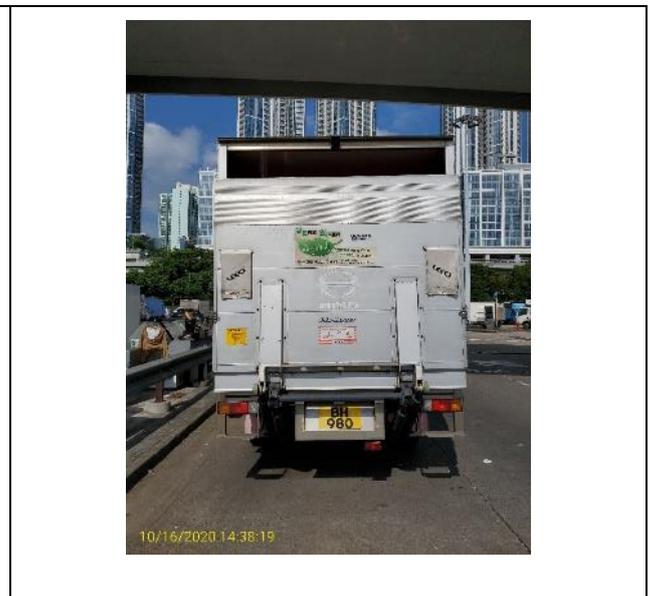
Registration mark	JM302 (for comparison from April 2019 onwards)
Make:	ISUZU
Model:	NMR85E-V
Class:	Light Goods Vehicle
Gross vehicle weight:	5,200 kg
Seating capacity:	Driver + 2 passengers
Engine capacity:	2,999 c.c.
Year of manufacture:	2012

Appendix 2: Photos of Vehicles

1. Trial HV



Front view of HV



Rear view of HV



Left side view of HV



Right side view of HV

2. DV for comparison

DV-1 (CX196: for comparison from October to December 2018)

 <p>A front-facing photograph of a white Isuzu truck with a blue canopy. The truck has 'ISUZU' on the grille and 'CX 196' on the license plate. A yellow timestamp '2019/04/15 09:40' is in the bottom right corner.</p>	 <p>A rear-facing photograph of the blue canopy of the truck. The license plate 'CX 196' is visible. A yellow timestamp '2019/04/15 09:40' is in the bottom right corner.</p>
<p>Front view of DV-1</p>	<p>Rear view of DV-1</p>
 <p>A side-view photograph of the truck from the left. The blue canopy is prominent. A yellow timestamp '2019/04/15 09:40' is in the bottom right corner.</p>	 <p>A side-view photograph of the truck from the right. The blue canopy is prominent. A yellow timestamp '2019/04/15 09:40' is in the bottom right corner.</p>
<p>Left side view of DV-1</p>	<p>Right side view of DV-1</p>

DV-2 (JM302: for comparison from April 2019 onwards)



Front view of DV-2



Rear view of DV-2



Left side view of DV-2



Right side view of DV-2