Case Study

Aerodynamic device – Deflector

TRIAL SUMMARY

This trial sought to quantify the fuel efficiency benefit of a trailer fitted with aftermarket deflector device to reduce aerodynamic drag. The trial was conducted for one tipper and dog running a regional linehaul application in New South Wales.	**Fuel benefit (L/100 km)**	**GHG benefit (g CO_2-e/km)**	**Economic benefit ($/100 km)**
	At least 1% ↑ (>0.7 L/100 km)	**At least 1% ↑ (>19 g CO_2-e/km)**	**At least 1% ↑ (>1 ¢/km)**

↑ performance better than conventional vehicle
↓ performance worse than conventional vehicle

The *Green Truck Partnership* is designed to be a forum for the objective evaluation of the merits of clean vehicle technologies and fuels by heavy vehicle operators. This report discusses the results of an aerodynamic device trial conducted under the program in 2014.

1 AERODYNAMIC DEFLECTOR

Aerodynamic drag is created as air resists the movement of a vehicle. The vehicle engine must work harder to overcome this resistance and hence consumes more fuel. At high speeds in particular, aerodynamic drag can be a significant consumer of energy for a heavy vehicle. Aftermarket aerodynamic devices redirect air flow more efficiently, thereby reducing drag and improving fuel efficiency.

A deflector device was examined in this trial. The device may be attached over truck cabs and to the front of trailers to improve aerodynamic efficiency of vehicle combinations (Figure 1 shows the installed device used in the trial).

The literature suggests that aerodynamic devices can achieve fuel savings of 2–3% individually and up to 15–20% in combination (IEA 2012, DoI 2012, CWR 2012, US EPA 2012). For nose cone devices specifically, manufacturers claim potential fuel efficiency overall savings of 10% for the device used in the trial, but this will depend on the specific vehicle configuration and application.

2 TRIAL OBJECTIVE

This trial assessed the economic and environmental performance of an aftermarket aerodynamic device (deflector) in a truck and dog configuration. The device was trialled fitted to the front of the dog trailer. Photographs of the installed device are shown in Figure 1.

3 METHODOLOGY

DATA COLLECTION

The trial involved an in-field assessment of one truck and dog operating regional linehaul distribution routes in New South Wales over a 9-week period between March and May 2014. The differences in fuel efficiency were quantified by examining fuel efficiency during a baseline or control period, and then comparing this to a trial period after the deflector device was fitted.

Data loggers verified that the vehicle was undertaking similar work in both the control and trial period, allowing a comparison of the differences in fuel consumption.

The data collected by the loggers included:

- **DISTANCE**: kilometres travelled.
- **IDLE TIME**: time spent at idle.
- **ENGINE LOAD**: percentage theoretical maximum loading (%).

- **AVERAGE SPEED**: average speed (km/h).
- **FUEL CONSUMPTION:** total fuel consumed (L).
- **VEHICLE LOCATION:** GPS data.

Other datasets were collected but were not relevant to this particular trial.

DATA ANALYSIS

The first stage of the analysis involved validating that the fuel consumption results in the control and trial periods could be compared fairly. This was done by comparing three duty cycle descriptors (average engine load, average speed and idle time) for the truck during both periods.

The trial fleet application has considerable variation in day-to-day operation (so that speed and engine load can vary significantly from day to day). This variation was broadly consistent between the baseline and trial periods but extreme outliers were removed from the data set. As shown in Figure 2, a comparison of the engine load profiles for the remaining data during the baseline and trial periods, showed reasonable correlation. The speed profile for the truck when pulling the trailer also shows a good correlation for the remaining data (outliers removed), which suggests that the selected data for the vehicle is from periods with similar duty cycles during the baseline and trial periods (Figure 3).

Accordingly, it was concluded that the truck had been operated in a similar manner before and after installation of the aerodynamic device and that direct comparison of the fuel consumption values was valid (i.e. there were no major differences in duty cycle that were thought to significantly affect fuel consumption).

In order to examine the impact of significant variation in work carried out by the trial vehicle day to day, data from individual trips during the trial period was isolated to compare trips between the same specific locations (Albion Park to Dunmore). A set of trips was examined on this route with and without the device fitted.

4 RESULTS

Comparison of validated fuel consumption data (only for days when the duty cycles were comparable) suggests that the aerodynamic device may deliver a small fuel efficiency benefit of approximately 1% overall in this application (Figure 4).

However, the result needs to be interpreted with care. Some fluctuation in fuel consumption could also be attributed to differences in driving technique, payload or route conditions.

Trip-by-trip analysis (restricting comparison to the same piece of road) showed there were bigger variations of 14–19% for trips between Albion Park and Dunmore with the deflector fitted. However, this saving was not consistent with other trips: Appin to Albion Park showed only a 1.8% difference in fuel efficiency.

While individual influences could be guessed or assumed (Appin to Albion Park is almost entirely downhill, so factors other than aerodynamic drag might be more significant), the most representative assessment is to average across the total test period – an overall 1% difference.

5 CONCLUSION

The findings of this trial suggest that in a truck and dog regional linehaul application, deflector aerodynamic devices may provide some fuel efficiency and GHG benefit: at least 1% in this trial overall, and potentially higher in other applications or routes (Figure 4).

Significant variability in the trial data suggests that more testing is required to confidently predict the potential savings available from different types of trucks and other duty cycles. However, it is clear that some routes or duty cycles (e.g. high average speed) will be better suited to capture the benefits of deflector aerodynamic devices.

REFERENCES

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Figure 1

Deflector installation

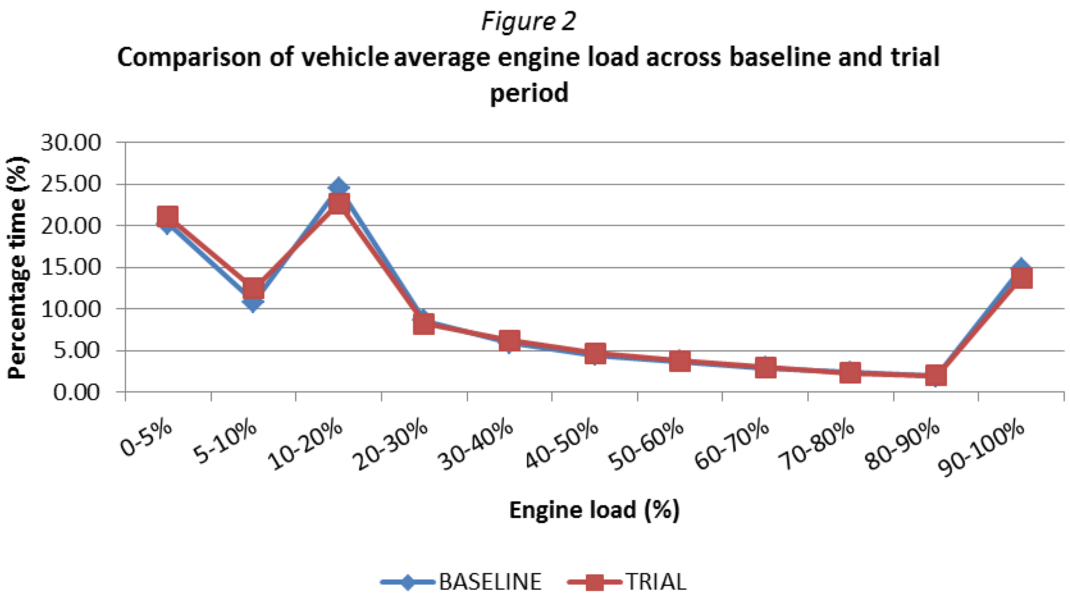
Figure 2
Comparison of vehicle average engine load across baseline and trial period
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Percentage time (%)
0-5%
5-10%
10-20%
20-30%
30-40%
40-50%
50-60%
60-70%
70-80%
80-90%
90-100%
Engine load (%)
BASELINE
TRIAL

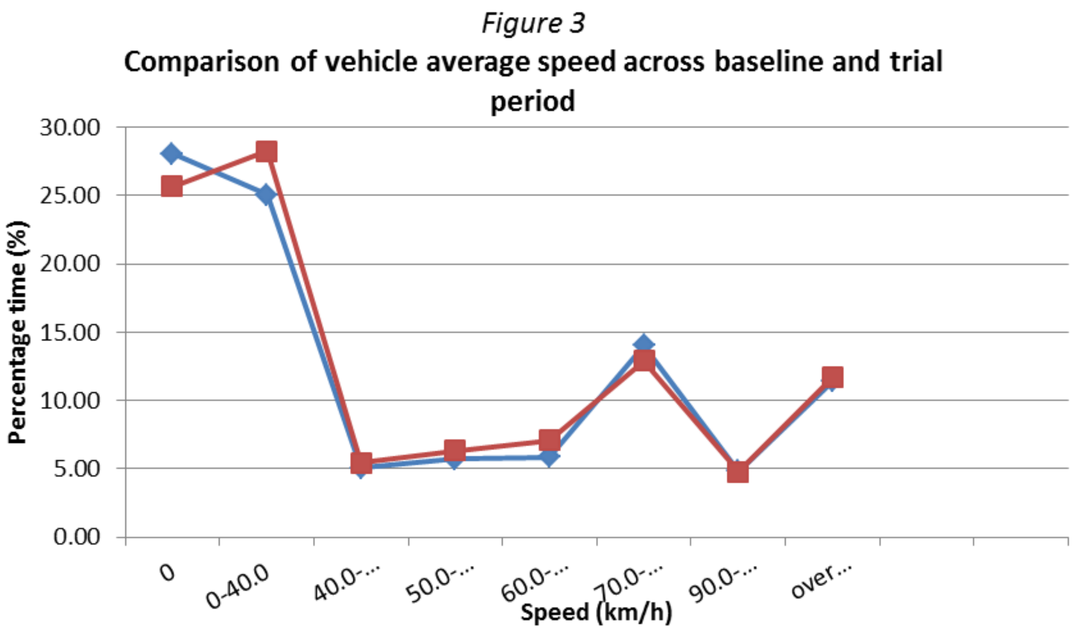
Figure 3
Comparison of vehicle average speed across baseline and trial period
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Percentage time (%)
0
0-40.0
40.0-...
50.0-...
60.0-...
70.0-...
90.0-...
over...
Speed (km/h)

Figure 4
Comparison of vehicle fuel consumption during baseline and trial periods

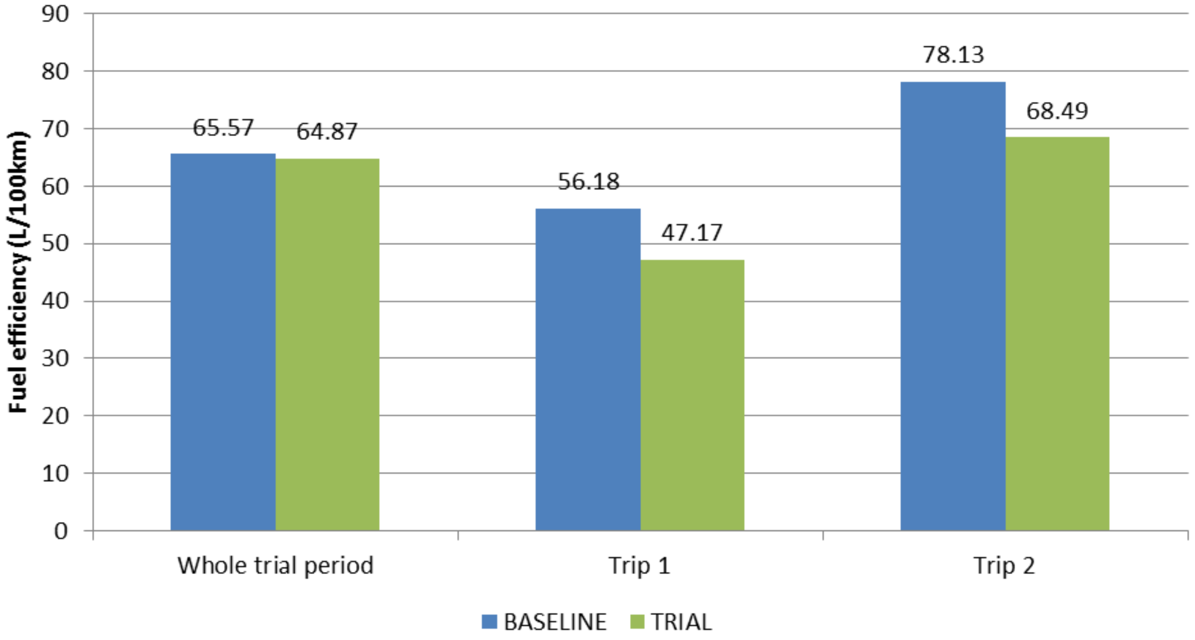

Figure 5
Comparison of vehicle GHG emissions during baseline and trial periods