



TRIAL SUMMARY

This trial sought to quantify the fuel efficiency benefit of an aftermarket device fitted to trailers to reduce aerodynamic drag. The trial was conducted for one truck and dog running a regional linehaul application in New South Wales.	Fuel benefit (L/100 km)	GHG benefit (g CO₂-e/km)	Economic benefit (\$/100 km)
	5–8% ↑ (5.2 L/100 km)	5–8% ↑ (140 g CO ₂ -e/km)	5–8% ↑ (7 ¢/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 TRAILER TABS

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. Particularly at high speeds, 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 vortex generator device was examined in this trial. The device may be attached to both trucks and trailers to reduce drag at critical points (usually at the truck-trailer gap and at the rear of the vehicle). These devices work by breaking up the air flow into counter rotating vortices, thereby dispersing the energy more evenly. They are easily attached – essentially glued to the vehicle in a vertical strip at the crucial drag production points. Affixed to the rear of the trailer as in the trial application, vortex generators are designed to change the dominant flow pattern from the alternating formation of large vertical eddies to a line of dozens of small vigorous horizontal ones.

This reduces vehicle sway, improves stability in gusty cross-wind conditions and increases fuel economy.

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, USEPA 2012). For vortex generator devices specifically, manufacturers claim potential fuel efficiency savings of 3–5% up to 11% depending on the specific vehicle configuration and application.

2 TRIAL OBJECTIVE

This trial assessed the economic and environmental performance of an aftermarket aerodynamic device (vortex generator) in a truck and dog configuration. The device was trialed fitted simultaneously both to the rear of the truck and to the rear of the 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 to a trial period after the vortex generators were fitted.

AERODYNAMIC DEVICE – VORTEX GENERATORS



Figure 1
**Aerodynamic device
installed on trailer**

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 its operation (the speed profile and engine load vary significantly from day to day). This variation was broadly consistent between the baseline and trial periods, however, and extreme outliers were removed from the dataset.

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 in both the baseline and trial periods also shows a good correlation for the remaining data (outliers removed), which suggests that the selected data is from periods with similar duty cycles (Figure 3).

Accordingly, it was concluded that the truck had been operated in a broadly 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 exclude the impact of significant variations in day-to-day operations, data from individual trips during the trial period was isolated to compare trips only between the same specific locations (Albion Park to Banksmeadow). A set of trips was examined on this route with and without the vortex generators fitted.

4 RESULTS

Comparison of validated fuel consumption data (only when the duty cycles were comparable) shows that overall there was an 8% fuel efficiency improvement between the baseline and trial periods (Figure 4), with a corresponding emissions reduction (Figure 5).

However, the result needs to be interpreted with care. Some fluctuation in fuel consumption could also be attributed to slight variations in speed, payload or driving technique, or to different energy requirements on different routes.

Restricting the analysis to only like-for-like trips from the dataset showed an average of 5% improvement over 8 trips (4 baseline and 4 trial trips). However, the sample size is small, the trips were relatively short, and the variation in results was significant – ranging from 1.24 to 1.33 km/L baseline fuel efficiencies and 1.20 to 1.35 km/L with the device fitted – indicating other factors may also have influenced fuel consumption.

5 CONCLUSION

The findings of this trial suggest that in a truck and dog regional linehaul application, vortex generators may provide some fuel efficiency and GHG benefit. While the truck in this trial showed a 5–8% improvement after the devices were fitted (Figure 3), there was considerable variation between individual trips.

In financial terms, this would represent a 7 ¢/km saving on the truck used in this trial (using net diesel costs at the time of the trial of \$1.40/L).

Over an annual mileage of 150,000 km p.a. in a regional linehaul application, this could translate to a fuel saving of over \$10,900. In addition, the device is inexpensive, requires low maintenance and takes only about one hour to install.

While this trial indicates vortex generators may reduce fuel use, further examination in a more consistent application (less day-to-day variation in work carried out) would give better certainty around the expected benefit. The benefit is also likely to vary significantly in different types of trucks and trailers.

REFERENCES

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Figure 2

Comparison of vehicle average engine load across baseline and trial periods

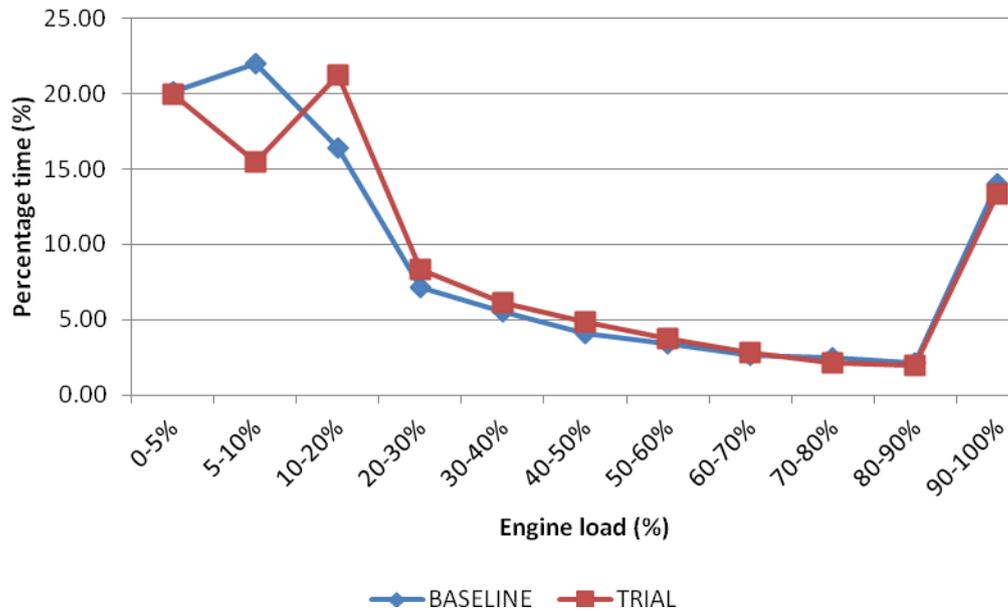


Figure 3

Comparison of vehicle average speed across baseline and trial periods

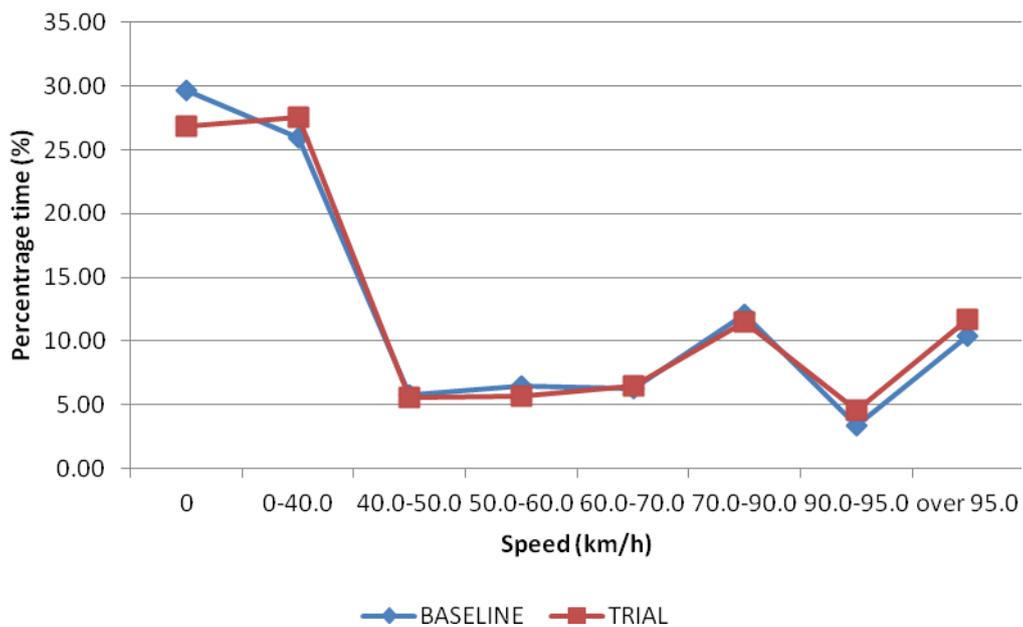


Figure 4

Comparison of vehicle fuel consumption across baseline and trial periods

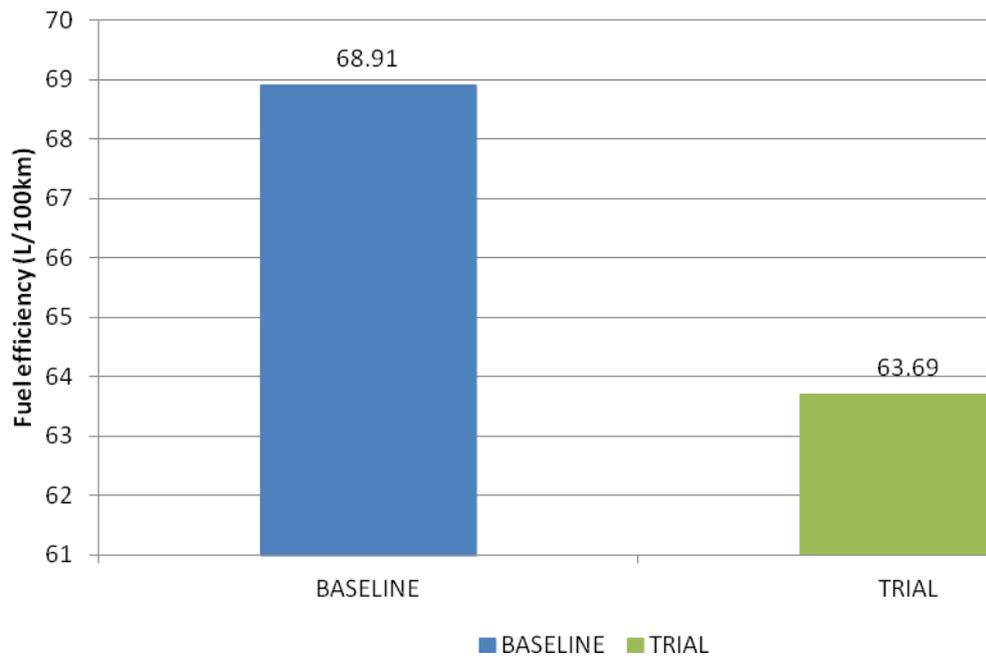


Figure 5

Comparison of vehicle GHG emissions across baseline and trial periods

