Case Study

LIGHTWEIGHT TRAILER

TRIAL SUMMARY

This trial sought to quantify the fuel efficiency benefit of a lightweight, reduced-height trailer. The trial was conducted for one prime mover and a custom-designed, lightweight (reduced-height) tipper trailer running in a regional linehaul application in NSW.	Fuel benefit (L/100 km)	GHG benefit (g CO_2-e/km)	Economic benefit ($/100 km)
	1% ↑ (0.56 L/100 km)	1% ↑ (15 g CO_2-e/km)	1% ↑ ($0.007/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 used by heavy vehicle operators. This report discusses the results of a lightweight trailer trial conducted under the program in 2013.

1 LIGHTWEIGHT TRAILER

Many truck and trailer components are typically made of cheaper (and heavier) grades of steel, which influences not only vehicle tare weight, but also fuel consumption.

Although vehicle manufacturers continue to design new trucks with reduced weight and improved performance, opportunities still exist in relation to the design and weight of truck bodies and trailers.

Reducing a truck's weight, either through lightweight materials or customised design, can benefit fuel consumption.

Overseas studies (such as Freight Best Practice UK) suggest that with every 10% drop in vehicle weight, fuel efficiency can be improved by around half that amount. However, actual savings depend on the extent of complementary modification, and the potential savings in an Australian context have been relatively untested.

2 TRIAL OBJECTIVE

This trial assessed the economic and environmental performance of a custom-designed, low-height, lightweight tipper trailer pulled by a prime mover.

3 METHODOLOGY

DATA COLLECTION

The trial involved an in-field assessment of one prime mover operating regional linehaul distribution routes in NSW over a 6-week period between April and May 2013. The differences in fuel efficiency were quantified by trialling a regular tipper trailer, and a lightweight trailer. The specifications of both trailers are shown in Table 1. In summary, the test trailer was 35 cm lower in height, and 420 kg lighter.

Table 1 Trailer specifications

	Baseline trailer	Lightweight trailer
Tare weight (t)	17.98	17.56
Height (m)	4.20	3.85
Length (m)	12.90	12.90

Data loggers verified that the vehicle was undertaking similar work with both trailers, 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).

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 using both trailers could be compared fairly. This was done by comparing two duty cycle descriptors (average engine load, average speed) for the truck when pulling both trailers.

As shown in Figure 1, a comparison of the engine load profiles for the truck when pulling the lightweight trailer and the baseline trailer showed good correlation. The speed profile for the truck when pulling both trailers also shows a strong correlation, which suggests that the vehicle was subject to similar duty cycles during the baseline and trial periods (Figure 2).

Accordingly, it was concluded that the truck had been operated in a similar manner with each trailer 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).

4 RESULTS

The height of the lightweight trailer was 35 cm lower than the conventional baseline trailer, and both trailers were 12.90 m long. The reduced height of the lightweight trailer resulted in a tare weight reduction of 0.42 t when compared to the conventional trailer (a difference of 2%).

Comparison of validated fuel consumption data (only when the duty cycles were comparable) revealed that the lightweight trailer delivered a small fuel efficiency benefit of 1% (Figure 3).

This level of fuel saving is roughly in line with the expected savings based on international studies of light-weighting for other kinds of vehicles.

However, the result needs to be interpreted with care. Such a small fluctuation in fuel consumption could also be attributed to slight variations in speed or driving technique, or to the reduced aerodynamic drag of a lower trailer height. It could also be argued that the fuel saving is not statistically significant because the 1% saving is well below the variation in fuel consumption figures from one day to the next.

5 CONCLUSION

The findings of this trial suggest that the use of a lightweight (and lower height) tipper trailer in a regional linehaul application may provide a small fuel efficiency and GHG benefit (in this case up to 15 g CO_2-e/km, or 1%) (Figure 4).

In financial terms, the best case from this study would result in a 0.007 ¢/km saving when using the lightweight trailer (using diesel costs at the time of the trial). Over an annual mileage of 150,000 km p.a. in a regional linehaul application, this could translate to a $1176 fuel saving. However, a whole-of-life economic analysis needs to assess these fuel savings against the cost of the equipment, changes in repairs and maintenance, and any impact on payload carried.

Most importantly, it is unclear whether the fuel saving observed in this trial was the result of reduced weight, reduced aerodynamic drag or merely statistical variation. This could be confirmed with a subsequent trial involving a greater weight reduction.

Figure 1
Comparison of vehicle average engine load across baseline and trial periods

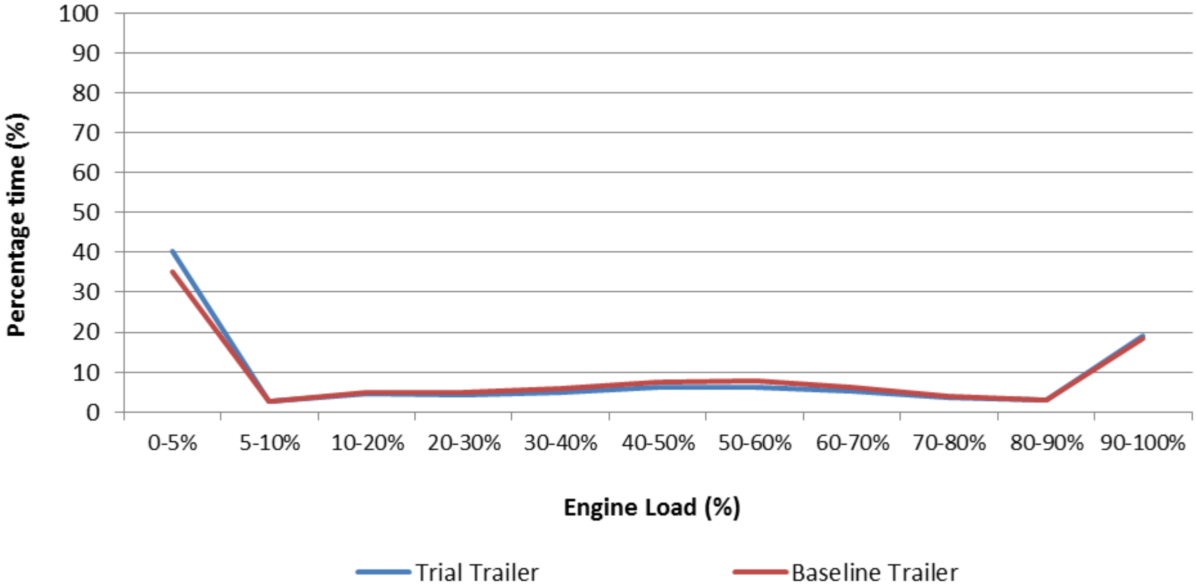

Figure 2
Comparison of vehicle average speed across baseline and trial periods

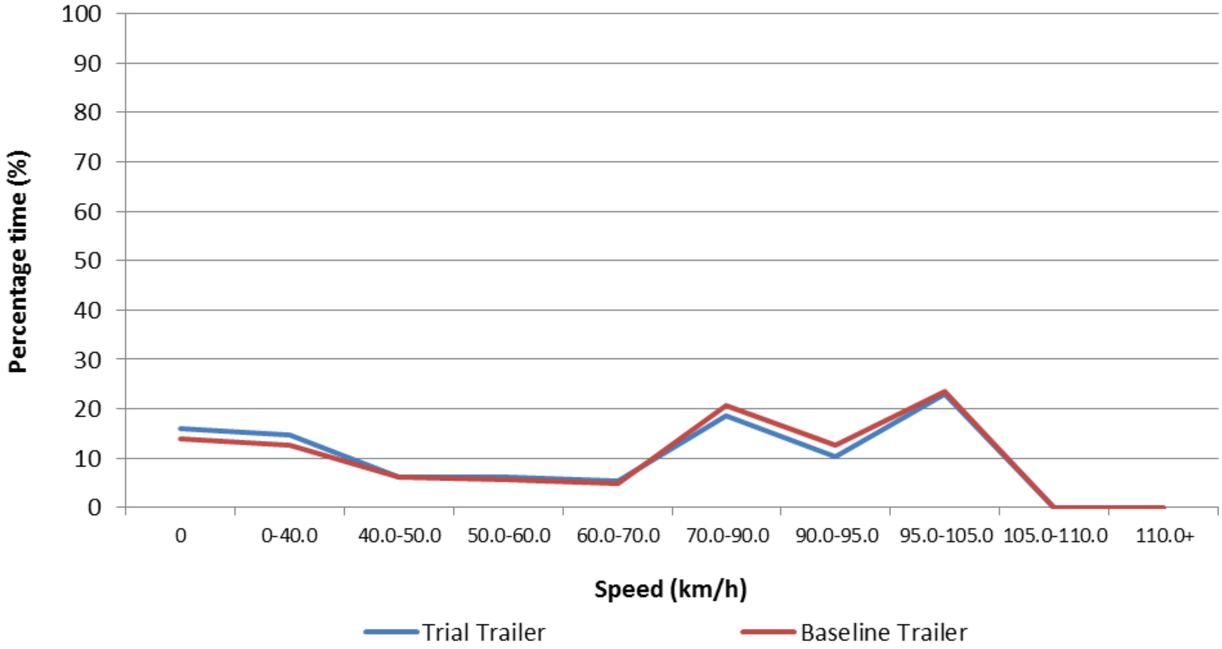

Figure 3
Comparison of vehicle fuel consumption across baseline and trial periods

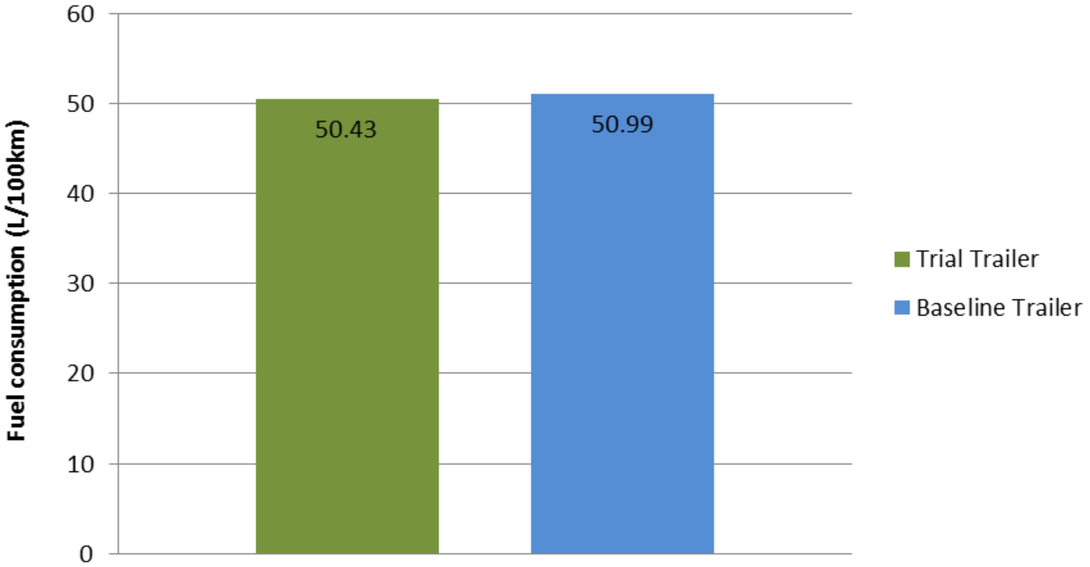

Figure 4
Comparison of vehicle GHG emissions across baseline and trial periods