



| TRIAL SUMMARY   |                         |                                      |                              |
|---|-------------------------|--------------------------------------|------------------------------|
| This trial sought to quantify the fuel efficiency benefits of installing aerodynamic canopies. The trial was conducted for three vehicles running metropolitan LPUD applications in Melbourne and Sydney. | Fuel benefit (L/100 km) | GHG benefit (gCO <sub>2</sub> -e/km) | Economic benefit (\$/100 km) |
|   | 3% ↑<br>(0.8 L/100 km)  | 3% ↑<br>(22 g CO <sub>2</sub> -e/km) | 3% ↑<br>(\$1.11/100 km)      |
| ↑ performance better than conventional vehicle<br>↓ 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 canopy trial conducted under the program in 2012.

### 1 AERODYNAMIC CANOPIES

Aerodynamic drag can be a significant factor influencing heavy vehicle fuel consumption. Drag acts as a force resisting the vehicle’s movement, and increases exponentially with vehicle speed.

A truck’s profile (size, shape), its equipment and the airflow over its surfaces (including its wheels, underbody and cooling equipment) affects aerodynamic performance.

Specific equipment can be used to improve airflow and reduce aerodynamic drag. Aerodynamic canopies can improve airflow to reduce drag and reduce fuel consumption, but the extent of the benefit depends on the type of truck they are fitted to and the application it undertakes.

International trials of aerodynamic components have reported fuel efficiency savings ranging from 3% to 24%. However, the potential savings in an Australian context have been relatively unexplored, with different vehicle configurations and regulatory limits on dimensions making it difficult to translate international results.

### 2 TRIAL OBJECTIVE

The objective of this trial was to assess the economic and environmental performance of three vehicles fitted with aerodynamic canopies.

### 3 METHODOLOGY

#### DATA COLLECTION

The trial involved an in-field assessment of three rigid vehicles operating LPUD distribution routes in Sydney and Melbourne. The vehicles operated over a 17-week period between June 2012 and October 2012 to quantify differences in fuel efficiency when fitted with and without their aerodynamic canopies.

During the trial period, data loggers were used to collect data from the vehicles to ensure they were doing similar work both before and after the intervention, so that results could be compared. The data collected by the loggers included:

- **DISTANCE:** kilometres travelled.
- **IDLE TIME:** time spent at idle.
- **AVERAGE SPEED:** average speed (km/h).
- **STOPS:** number of stops per kilometre travelled.

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

During the trial period, fleet fuel records were used to capture fuel consumption data (as this could not be captured from the vehicles using data loggers). The fuel data included:

- **FUEL CONSUMPTION:** Total fuel (litres) consumed.

#### DATA ANALYSIS

The first stage of the analysis involved validating that the fuel consumption results could be compared before and after the trial. This was done by comparing three duty cycle descriptors (average speed, idle time and stopping intensity) for each of the trucks during both phases of the trial.

As shown in Figure 1, a comparison of the speed profiles for the vehicles with and without their canopies revealed a strong correlation. The stopping intensity for all vehicles also shows a strong correlation, which suggests the vehicles were subject to similar duty cycles (Figure 2).

Accordingly, the study team concluded that the operation of the vehicles with and without their canopies was very similar 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).

Following data validation, the fuel consumption of the vehicles was compared. The results are summarised in Section 4 and Table 1.

## 4 RESULTS

Two key observations from the results were that:

- all three trucks showed a fuel efficiency improvement with the canopy fitted;
- the quantum of the improvement was small.

Comparison of the fuel consumption results before and after the aerodynamic canopies were fitted shows that fuel efficiency improved by between 2.6% and 4.1% (Figure 3).

There did not appear to be a correlation between vehicle size (or weight) and the fuel saving achieved – although the lightest truck did show the least improvement.

Of the three trucks, Truck 1 showed the best correlation in speed profile before and after the intervention, and it also achieved the highest fuel saving (4.1%). One interpretation of this is that slight differences in duty cycle (before and after the canopy was fitted) may have masked some of the fuel efficiency benefit in the other trucks. However, such small differences might also be attributed to variations in payload, vehicle condition, driving technique or season.

The most significant observation, however, is that LPUD is not the ideal application for an aerodynamic canopy if fuel savings are to be maximised. A high proportion of operating time spent at speeds below 40 km/h (as seen in Figure 1) falls outside the operating range where the canopy is likely to be most effective (above 60 km/h). It would therefore be more effective in a regional haul or interstate linehaul application.

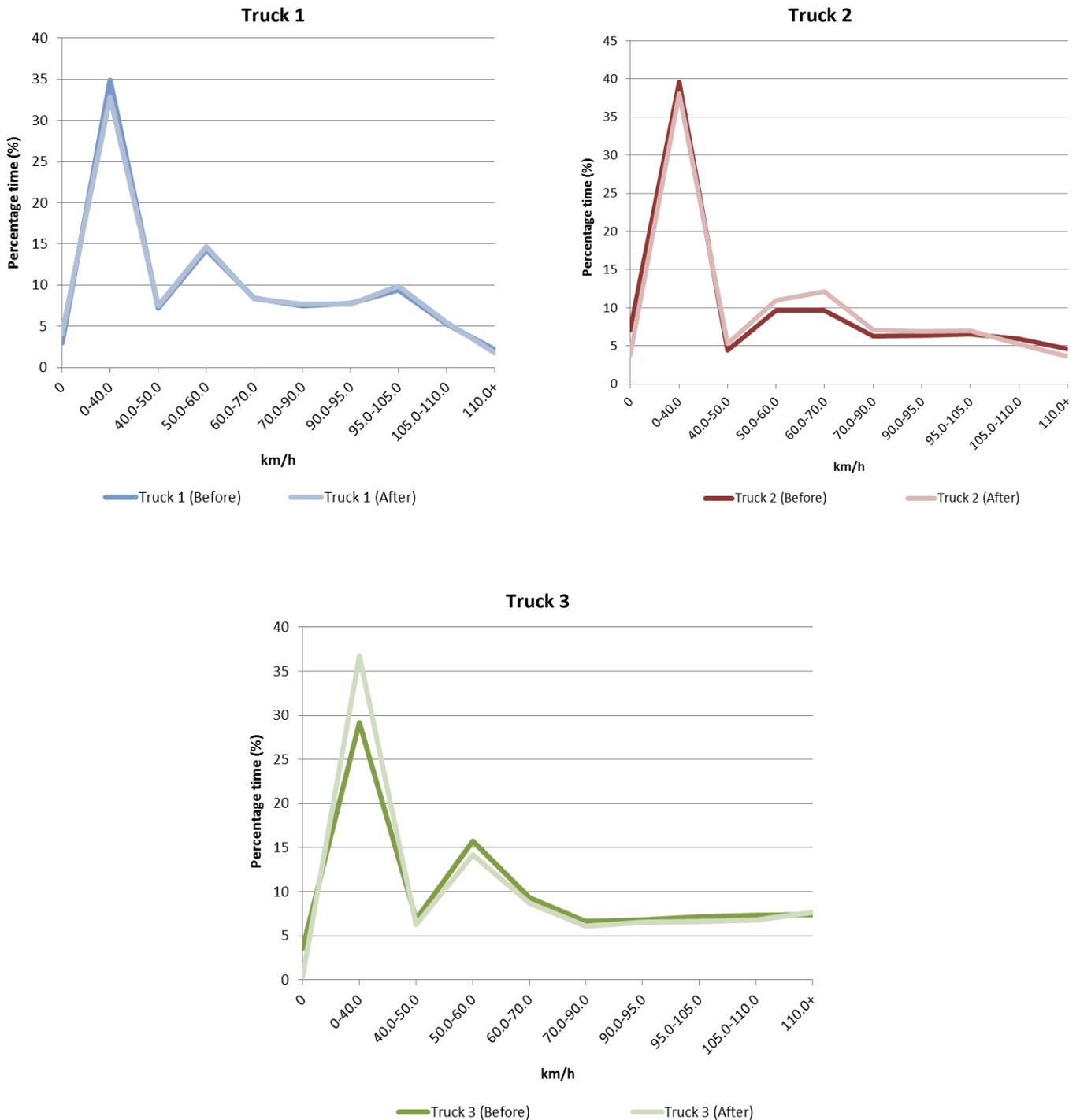
## 5 CONCLUSION

The findings of this trial suggest that the use of an aerodynamic canopy in an urban LPUD application may provide a small fuel efficiency and GHG benefit (in this case up to 29g CO<sub>2</sub>-e/km or 4%) (Figure 4).

In financial terms, the best case from this study would result in a 1.5 ¢/km saving from the use of the canopy (using diesel costs at the time of the trial). Over an annual mileage of 40,000 km p.a. in an LPUD application, this could translate to a \$600 fuel saving. It should be noted, however, that the economic outcomes over the life of the vehicle need to assess these fuel savings against the cost of the equipment and any variation in repair and maintenance costs.

It is also likely that such canopies would produce greater benefits in higher speed applications.

Figure 1  
Comparison of vehicle average speed  
across baseline and trial periods



*Table 1*  
**Vehicle performance with aerodynamic canopies**

| Truck   | Vehicle size | Fuel saving (L/100 km) | Relative fuel saving (%) | GHG benefit (g CO <sub>2</sub> -e/km) | Economic benefit (\$/100 km) |
|---------|--------------|------------------------|--------------------------|---------------------------------------|------------------------------|
| Truck 1 | 6 t          | 1.08                   | 4.1                      | 29                                    | 1.51                         |
| Truck 2 | 4 t          | 0.51                   | 2.6                      | 14                                    | 0.71                         |
| Truck 3 | 7 t          | 0.80                   | 3.4                      | 22                                    | 1.12                         |

*Figure 2*  
**Comparison of vehicle stopping intensity with and without aerodynamic canopies**

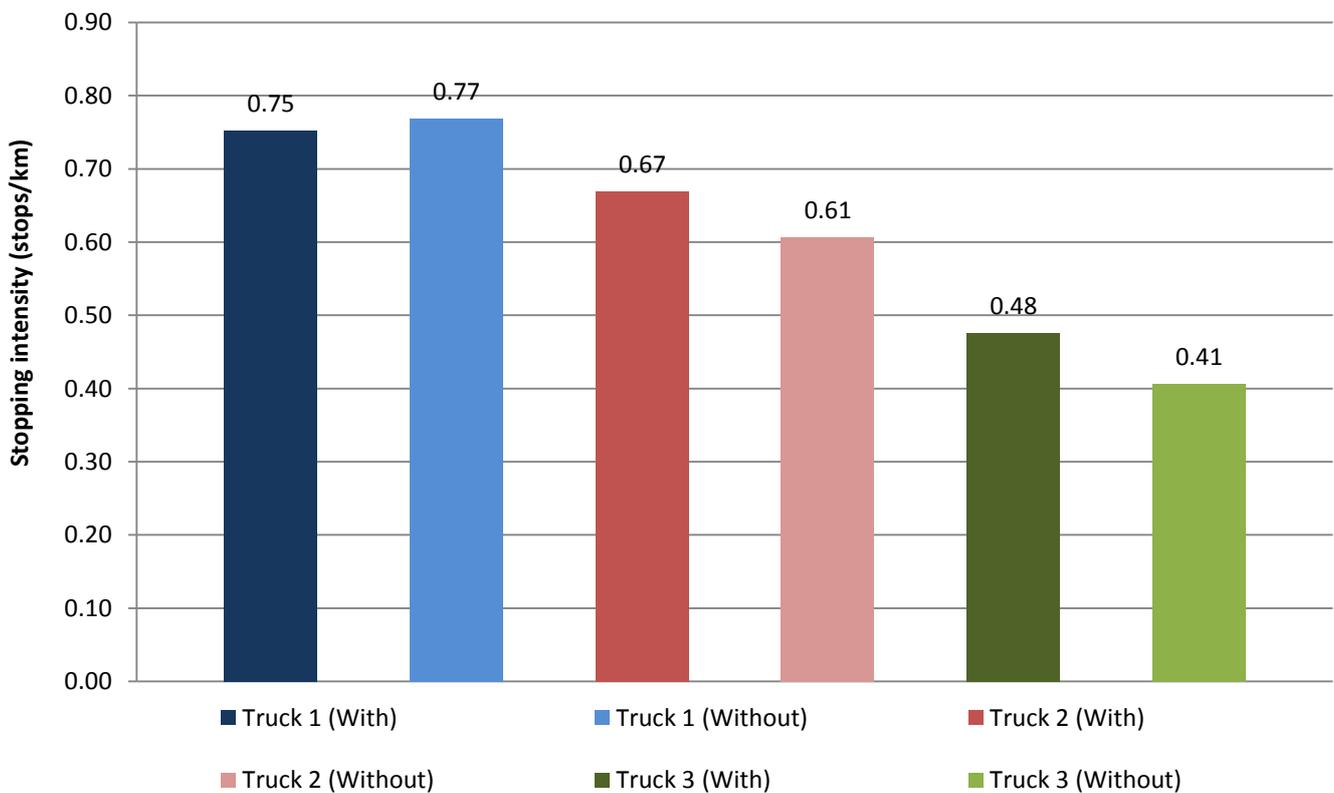


Figure 3

**Comparison of vehicle fuel consumption with and without aerodynamic canopies**

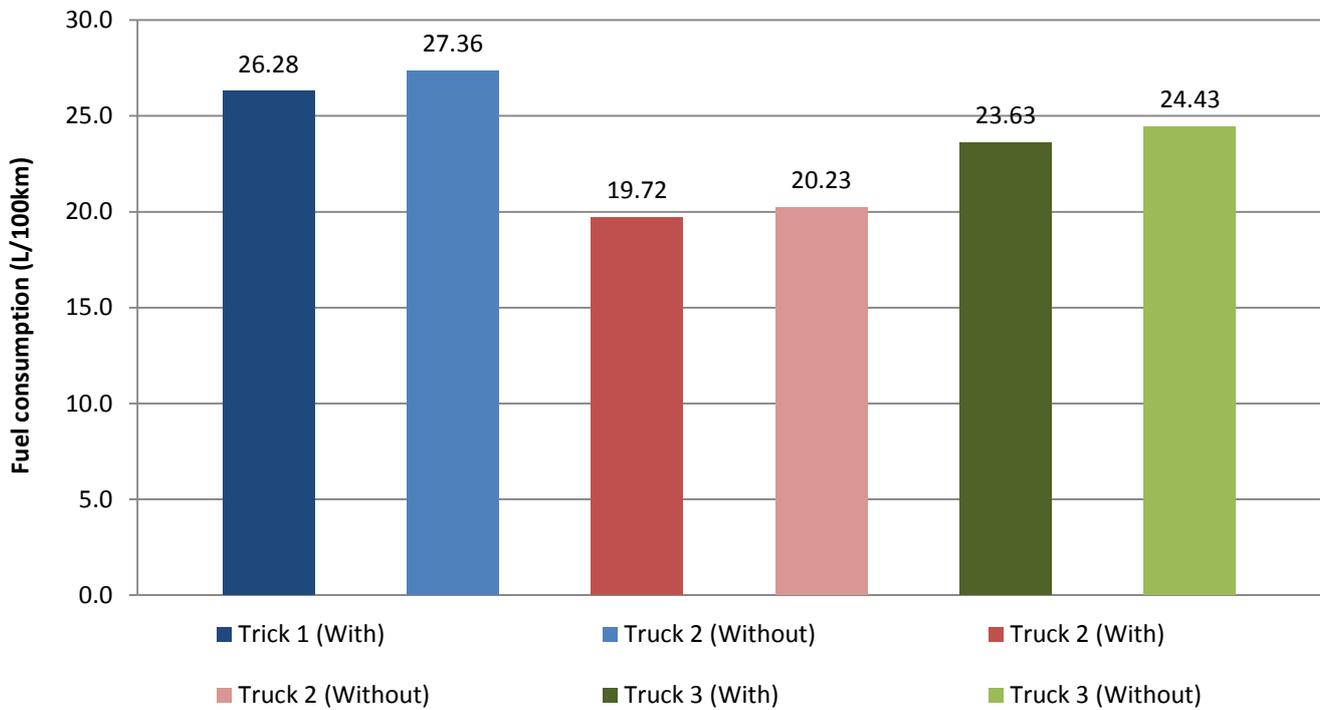


Figure 4

**Comparison of vehicle GHG emissions with and without aerodynamic canopies**

