Transport Roads & Maritime Services

GREEN TRUCK PARTNERSHIP

# Case study

## Driver incentives for environmental driving Prime mover

## Trial summary

This trial sought to further quantify the fuel efficiency benefit of financial incentives supporting environmental driver training.

The trial analysed historic data from a fleet of B-double and single semi-trailer trucks, running in a regional pickup and delivery operation.

| Fuel benefit (L/100 km) | GHG benefit (g $CO_2$ e/km) | Economic benefit |
|---|---|---|
| 4.5%↑ | 4.5%↑ | BCR over 4.1↑ |

↑ performance better than conventional vehicle

↓ performance worse than conventional vehicle

L/100 km = litres per 100 kilometres
g $CO_2$ e/km = grams per kilometre of carbon dioxide emission
$/100 km = dollars per 100 kilometres
% = per cent

The *Green Truck Partnership* is designed to be a forum to objectively evaluate the merits of clean vehicle technologies and fuels by heavy vehicle operators. This report discusses the results of a driver incentives program conducted in 2016, which was run to support an existing ongoing driver training program.

# 1 Environmental driver training with incentives

Environmental driver training has the potential to reduce vehicle fuel consumption and wear and tear, in addition to its recognised safety benefits. The fuel efficiency element of traditional driver training programs have been repackaged under the banner of environmental driving, which essentially covers the driver-controlled functions of operating a vehicle's powertrain and support systems in a way that optimises fuel efficiency.

There have been four previous case studies in the *Green Truck Partnership* that have focused on environmental driver training, covering both rigid and prime mover trucks, with both one-off training as well as follow-up "ongoing" training. These trials found that immediate fuel efficiency results were achieved for a relatively low initial expenditure, and further gains could be found in refresher courses.

A number of Australian driver training companies promoting improved driver practices report an immediate five to 20 per cent reduction in fuel consumption, but the incremental benefit of incentivising drivers individually is relatively undocumented.

The fleet analysed in this study comprised 16 prime movers spread over two locations: one in Queensland, another in New South Wales. The trucks included both B-doubles and single trailers delivering bulk liquids (milk). Pickup was from individual regional farms, culminating in final delivery to depot destination (milk factory). Around 95 per cent of the roads used were sealed.

Trucks in the fleet were less than five years old, and were supported by a complete OEM (factory) telemetry information system, including metrics on driver performance such as "Anticipation and Braking".

There was already a rolling program of driver training in place prior to, and continuing through, the driver incentives program. The period prior to the introduction of incentives was considered the baseline or reference period; so that the improvement in efficiency after incentives were introduced could be attributed to the incentives program alone. The in-house driver trainer used by the fleet is independently certified.

# 2 Trial objective

The purpose of this case study was to assess the real-world economic and environmental performance of a program of driver incentives, on a fleet of prime movers running a regional pickup and delivery service.

This case study seeks to answer three questions:

1. Did the driver incentives program have an impact on driving behaviour, as logged by the telemetry system metrics?
2. If a change in behaviour was noted by the metrics, how does this translate to a real world fuel efficiency improvement?
3. Was the bonus system financially viable (were the bonus payouts less than the fuel saved)?

# 3 Methodology

The trial involved review and analysis of the fleet's existing company data, as well as further investigation and retrieval of additional archived data from the telemetry system.

The incentives program commenced in January 2016, and data was collected up until May for this case study. This was considered the "trial" data. Data from 2015 (prior to the introduction of incentives) was considered the "baseline" data.

Milk production and delivery to local factories varies seasonally. When production increases, the "overflow" milk is delivered into more distant factories. These trips were not only further away, some of the journeys may also be less efficient as these factories are near urban areas. When looking at the effect of incentives on driver performance, these urban deliveries were evaluated to ensure they did not mask the effect of changes in driver behaviour.

The "anticipation and braking" metric was calculated by the telemetry software, and is an indicator of momentum driving. This was the metric used by the fleet to determine bonus payments. Other metrics, such as fuel efficiency (kilometres per litre) were initially investigated, however they were not found to be equitable due to the mix of B-doubles and singles throughout the fleet. The "anticipation and braking" metric was analysed and trended for January to May, however no data was available prior to this period.

Drivers were provided with feedback on their driving performance via daily scores relayed to smartphone or iPad applications on their return to the depot.

The incentive comprised a financial bonus that was driver-specific, and awarded at the end of each month. The driver's score of that month was averaged, and compared against set score brackets. Drivers would either get a full bonus, a partial bonus, or no bonus at all. The score brackets and payments associated with each bracket did not vary throughout the program.

The primary fuel and distance data was captured from the fleet's fuel card records, aggregated monthly. This was then cross referenced with the telemetry data.

## 3.1 Data collection

There were four main data sets collated and analysed, with each logging different metrics.

1. **The "driver performance dataset" was logged on a daily basis for the trial period. It included:**
   - DAILY SCORE: anticipation and braking score, logged daily, as well as a monthly average
   - BONUS: full, partial, or no bonus.
2. **The "fuel dataset" logged monthly intervals for 2015 and 2016, for individual trucks, and included:**
   - FUEL USED: litres from fuel card data
   - DISTANCE TRAVELLED: measured in kilometres, from the odometer data.

3. **The "milk production" dataset was aggregated on a monthly basis, and included:**
   - MILK PRODUCTION: measured in litres.

4. **The vehicle telemetry system archived data for each truck. It was able to aggregate these either weekly or monthly, for 2015 and 2016. This was used to cross reference and verify the fuel card data, including:**
   - FUEL EFFICIENCY: measured in litres per kilometre (L/km)
   - TOTAL FUEL EFFICIENCY SCORE: a single metric calculated from other data, including "anticipation and braking" as one element.

Due to the nature and timing of the trial, the on-board telemetry was captured by the OEM data system, and not an independent data logger.

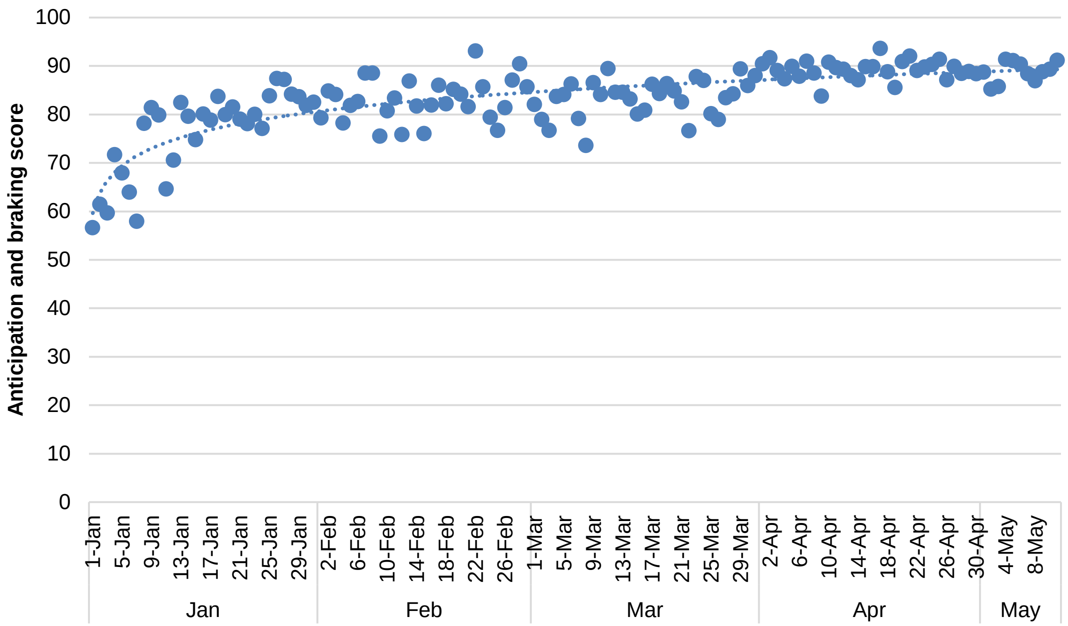
## 3.2 Data analysis

The data was analysed to determine the answer to the three questions set as the objective of this case study.

**Question 1: Did the driver incentives program have an impact on driving behaviour as logged by the telemetry systems metrics?**

The "driver performance dataset" was analysed to determine if incentives had an impact on driver behaviour. Figure 1 shows the daily average score for the entire fleet.

*Figure 1: 2016 Daily average score of "anticipation and braking"*



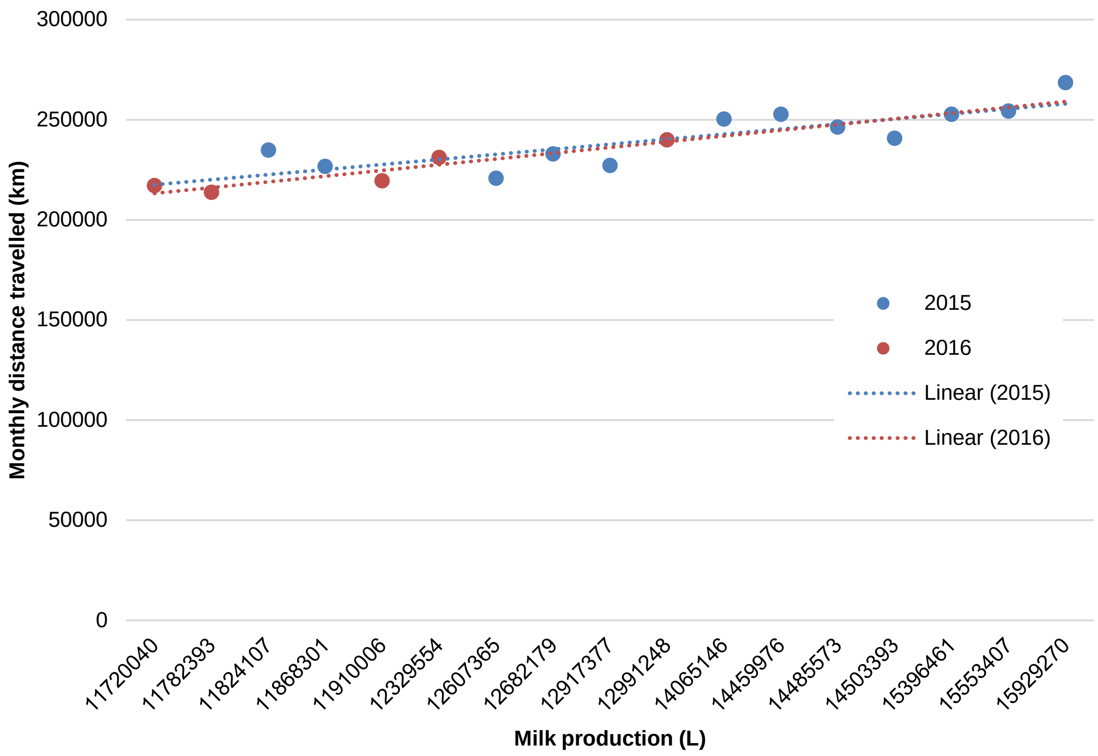
**Question 2: If a change in behaviour was noted by the metrics, how does this translate to a real world fuel efficiency improvement?**

What do changes in this abstract score translate to actual fuel savings? This was more complex and required multiple levels of analysis.

The first level involved understanding the duty cycle variation, before then determining if 2016 trial data was comparable to the 2015 baseline. As noted earlier, as milk production increases so too does the distance travelled, and fuel efficiency can drop if urban trips are required.

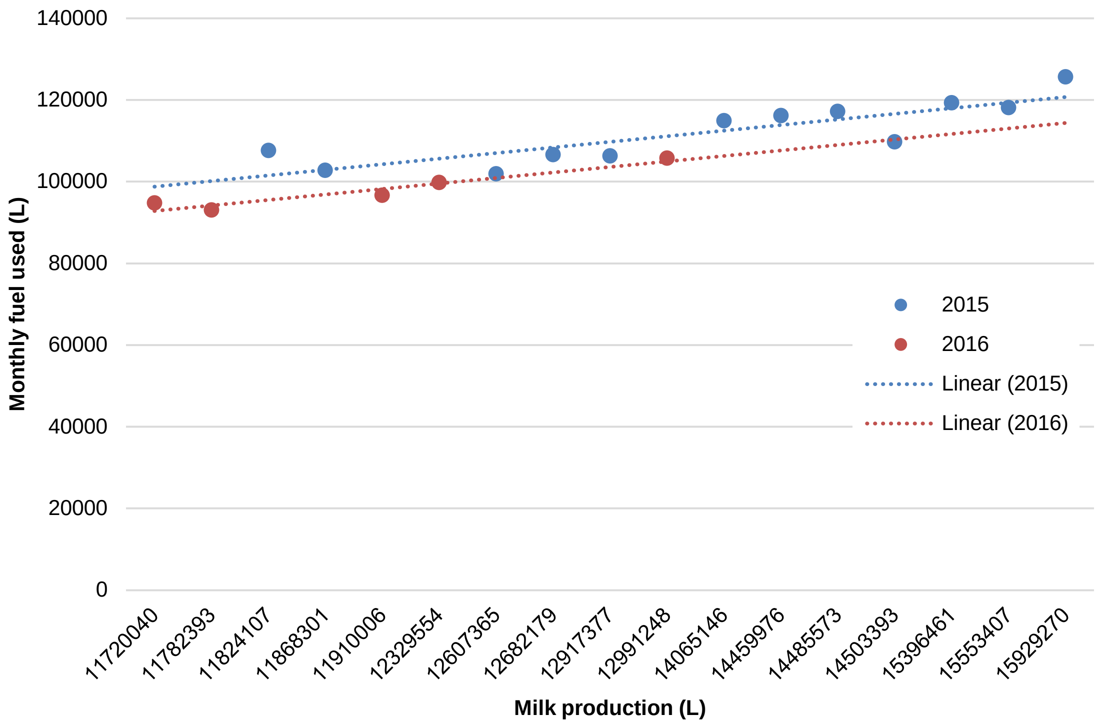
So, the first step checked was that the distance travelled was comparable between the two periods. Figure 2 shows the correlation between milk production and distance for 2015, showing that 2016 trended in the exact same way as 2015. Therefore, it can be said that 2016's duty cycle is typical in this regard.

*Figure 2: Distance travelled vs milk production (fleet monthly total)*




The second level analysed the correlation between milk production and total fuel used. Figure 3 shows that as 2015's milk production increased, so too did total fuel consumption. It also shows that 2016 had the same gradient as 2015, however the total fuel required was trending as lower.

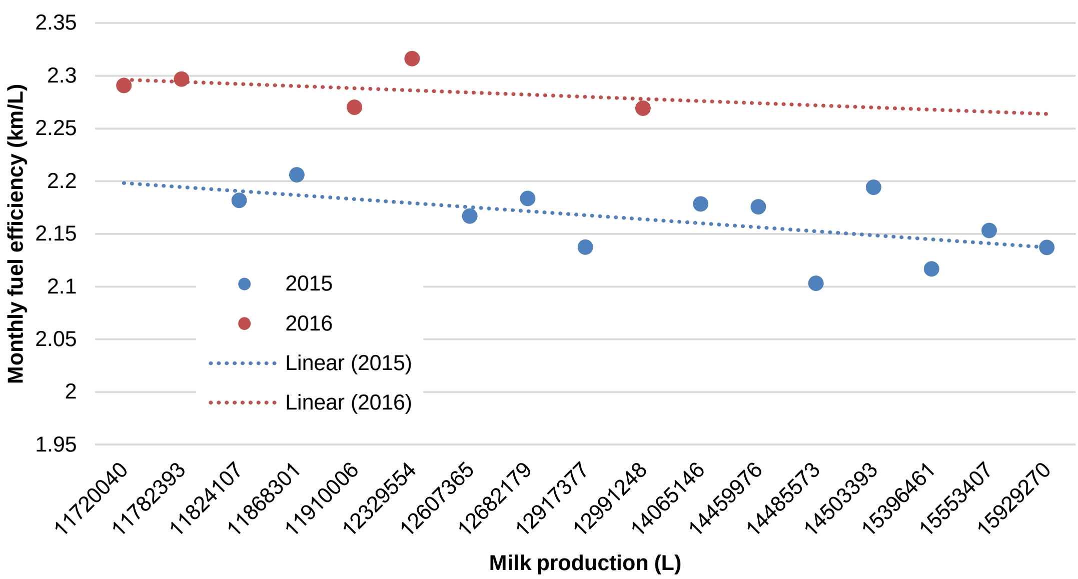
*Figure 3: Fuel used vs milk produced (fleet monthly total)*




This could indicate improvements in fuel efficiency (possibly due to the driving improvement seen in Figure 1).

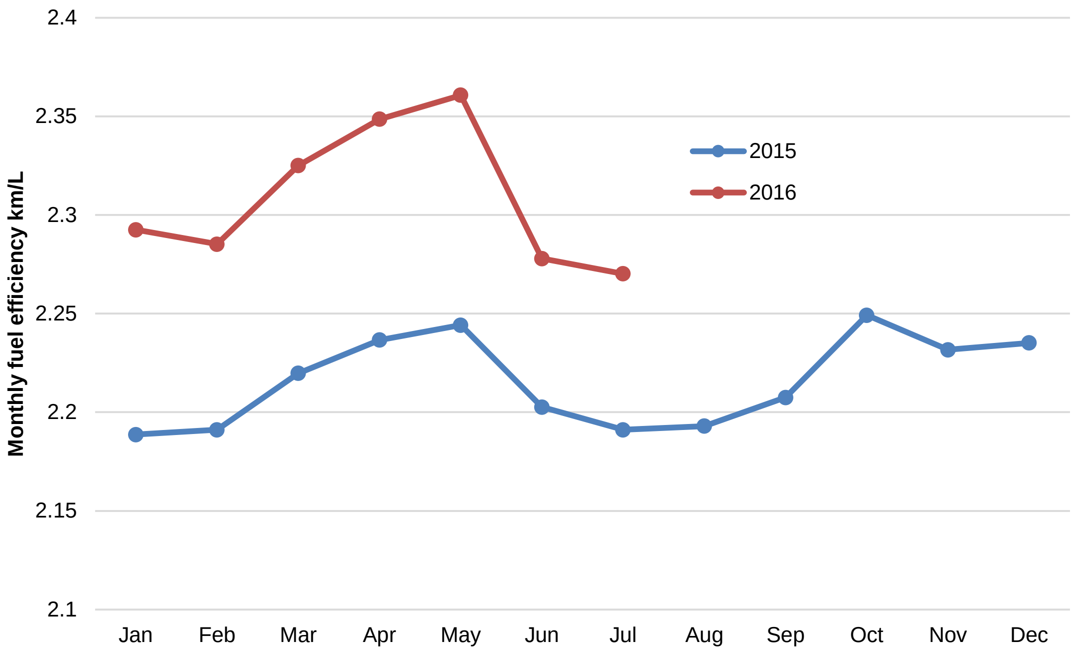
However, to eliminate the effect of mileage or milk production a third analysis was applied, correlating milk production and fuel efficiency. Figure 4 shows that the average fuel efficiency drops as milk production increases. Separating the pre-incentive and post-incentive periods (2015, 2016) shows a similar correlation with production, but significantly improved fuel efficiency after the introduction of incentives.

*Figure 4: Fuel efficiency vs milk production (fleet monthly average)*



This was then validated against the fuel efficiency data in the telemetry. Figure 5 shows 2015's seasonal fuel efficiency trend compared with that of 2016.

*Figure 5: Fleet monthly average fuel efficiency from vehicle telemetry (higher is better)*




**Question 3: Was the bonus system financially viable, ie were the bonus payouts less than the fuel saved?**

Did the bonuses paid to staff overshadow the reduction in fuel costs? To answer this, a simple benefit cost analysis was performed.

The amount of bonuses paid was consolidated and totalled with the "driver performance dataset".

The value of fuel savings was estimated from the difference between actual 2016 fuel use and what the fuel consumption may have been without driver incentives (so-called business as usual, or BAU).

The BAU was based on the minimum (conservative) difference between 2015 and 2016 production-based efficiency curves in Figure 4, with the difference then applied to total 2016 fuel use. The financial saving was calculated based on an assumed retail diesel price of $1.20 per litre.

# 4 Results

**Question 1: Did the driver incentives program have an impact on driving behaviour as logged by the telemetry systems metrics?**

The driver incentives program had a measurable, positive effect on driver behaviour, as measured by the anticipation and braking metric. The rapid initial improvement in score may be at least partially attributed to drivers having daily feedback on their score. The improvements did not lag after the monthly bonuses were announced, they led.

For the rest of the program, the scores clearly trended upwards, as well as becoming more consistent. As can be seen in Figure 1, the driver scores at the start of the incentives program were around 60/100. At the end of the period analysed, the scores were averaging close to 90/100.

**Question 2: If a change in behaviour was noted by the metrics, how does this translate to actual fuel efficiency improvement?**

The change in driver behaviour translated to a measurable change in fuel efficiency in the fleet. Analysing and accounting for the effect of production variables (litre of milk and distance travelled) showed a clear efficiency improvement of at least 4.5 per cent.

The telemetry data validated this fuel efficiency improvement. When viewed on a seasonal basis, fuel efficiency in the January to July period showed an average 4.4 per cent improvement on the year prior. Although the telemetry data did not account for changes in the freight task, it was surprisingly close in magnitude to the change seen in production-adjusted efficiency.

Carbon emissions in this case are directly proportional to the amount of fuel consumed, as no change in fuel type has taken place. As such, the carbon benefit of the program is also considered at least a 4.5 per cent improvement.

**Question 3: Was the bonus system financially viable, ie were the bonus payouts less than the fuel saved?**

The fuel savings were larger than the costs associated with bonus payouts. A simple benefit cost ratio was calculated with the fuel saved (in dollars), and the bonus payouts (in dollars), using the conservative calculation factors described above. With this method, the benefit cost ratio was found to be 4.1.

In other words, for every dollar paid in bonuses, the company saved at least $4.10 in fuel.

It should be noted that the opportunity costs of administering the program were not considered in this analysis. Conversely, the benefit of reduced maintenance costs associated with improved driver behaviour is also not considered.

# 5 Conclusion

This case study showed a clear benefit of instituting the driver incentives program. Both the drivers and the company were able to capture the value of economical driving.

What makes the result even more dramatic is that this improvement was over and above an existing in-house driver training program.

Ongoing driver training programs generally represent the bulk of efficiency gains, with previously *Green Truck Partnership* studies showing an 18 per cent saving. It is reasonable to assume that a large saving of this scale could be achieved on its own, with incentives providing a further 4.5 per cent by providing a reason for drivers to implement their newfound knowledge.

# 6 References


1. Green Truck Partnership, *Ongoing Environmental Driver Training – Prime Mover,* Roads and Maritime Services 2014, *http://www.rms.nsw.gov.au/documents/about/environment/air/140717-final-ongoing-environmental-driver-training-case-study-prime-mover.pdf*


# 7 Document control

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