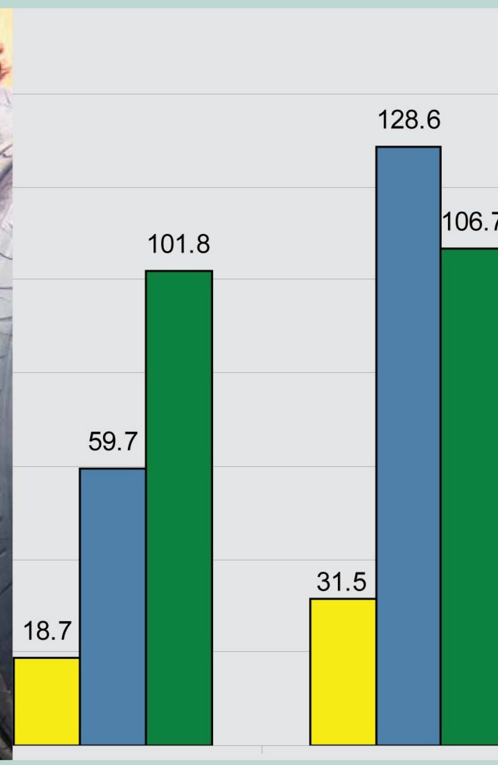
FreightBestPractice

Department for Transport

Fuel Efficiency Trials Research

Research Report



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Fuel Efficiency Trials Research Report

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1 Executive Summary

1 Executive Summary

The fuel efficiency trials research report provides a useful overview of current in-fleet trials of two widely available fuel efficiency interventions for the road freight industry; energy efficient tyres and telematics systems. The report provides transport operators and managers with details of the results of the in-fleet trials, confirming the efficiency savings available to the transport operators who implemented the trials.

The energy efficient tyre trial was conducted, from the beginning of October 2007 to the end of February 2008, on two heavy articulated tractor units which are part of the trunking fleet operated by a delivery network. The telematics system trial was conducted during an eight-week period from the beginning of January 2008 to the end of February 2008, where a fuel flowmeter, linked to a telematics system was fitted to articulated and rigid type vehicles,

On average the trials showed that energy efficient tyres improved vehicle MPG by 4.72%, whilst the telematics system improved vehicle MPG by 4.96%.

Specific conclusions and recommendations are summarised for each trial. An evaluation of the trial process for each in-fleet trial is also provided in order to determine generic recommendations that could be deemed to be applicable to transport operators currently conducting trials or to other proposed in-fleet fuel efficiency intervention trials.

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2 Research Aims

2 Research Aims

2.1 Research Aims and Background

Efficient fleet management is an important requirement for any freight transport business, particularly with increasing operating costs. Fuel costs are ever increasing, so priority must be given to understanding and implementing methods for improving the fuel efficiency of freight vehicles. Increases in fuel efficiency will not only save money, but also reduce harmful carbon dioxide emissions that pollute the environment.

The central aim of this research report is to demonstrate the implementation of trials, and draw conclusions for potential savings and highlight any pitfalls encountered. This will inform future research, help sell the benefits of fuel saving trials and provide practical information on different interventions and how they can be applied in different settings.

It is important for transport managers to be able to measure fuel efficiency in order to manage it effectively, and to implement appropriate actions to continuously improve. There are many fuel efficiency interventions available in the marketplace, for which manufacturers and suppliers portray their intervention as the 'best in the market', often with associated claimed fuel savings. However, it is important for transport managers to understand whether the claimed fuel savings can be realised in practice, and to consider a trial of selected fuel efficiency interventions on a suitable sample of their fleet before deciding on the most appropriate option to roll-out across their whole fleet.

The Freight Best Practice (FBP) Guide, 'In-fleet Trials of Fuel Saving Interventions for Trucks', outlines a methodology for operators to carry out their own in-use assessment of potential fuel saving measures. The guide includes illustrative examples of companies which have trialled certain fuel saving interventions and have based subsequent purchasing decisions on the results. This is an important publication as it is not only important for the programme to provide operators with fuel saving measures, but also just as important to show how they can go about evaluating and introducing them. Evaluating and testing fuel saving measures is often difficult to justify in a busy operational setting, but can result in major fuel savings if done appropriately.

Monitoring real-life trials on fuel efficiency interventions complements this other work and represents the logical next step from the 'In-fleet Trials of Fuel Saving Interventions for Trucks' Guide. The findings will provide information which can be used in current and future FBP projects, such as the Transport Operators' Pack (TOP) and future guides.

If the methodology of the fuel efficiency trials is found to offer positive outcomes for road freight operators through assisting accurate decision-making in order to achieve improved fuel efficiency, the methodology could be recommended to operators. Other positive outcomes might include:

- Reducing fuel costs;
- Reducing air pollution;
- Improving driver development; and
- Increasing the understanding of specific fuel efficiency interventions within the freight industry.

The starting point for this research was to understand which examples of fuel efficiency intervention trials might be most appropriate. The key was to identify trials that were currently being undertaken by transport operators which could be deemed to have further potential that would offer valuable conclusions with regards to the greater adoption of similar trials within the freight industry, for similar and alternative types of fuel efficiency interventions.

Energy efficient tyres and telematics systems were selected as being appropriate for this research.

2.2 Energy Efficient Tyres

2.2.1 What are Energy Efficient Tyres?

There are several different types of energy efficient tyres available, principally tyres that reduce rolling resistance through the design of the tyre itself. A reduction in rolling resistance means less fuel is used to overcome the resistance and move the vehicles.

2.2.2 What can Energy Efficient Tyres Do for your Operation?

Energy efficient tyres can reduce the amount of rolling resistance encountered by a vehicle and, as a consequence, reduce the amount of fuel consumed. The reduction in fuel consumption can lead to cost savings and improvements in your operation's efficiency and profit, together with reductions in CO_2 emissions.

2.3 Telematics Systems

2.3.1 What is a Telematics System?

The term 'telematics' covers many different systems but it generally refers to devices which help road freight operators by combining Information Technology (IT) and modern telecommunications to control or monitor vehicles, drivers, trailers and other mobile assets. Some of these systems can monitor the location of vehicles and their activity at any given time.

2.3.2 What can a Telematics System Do for your Operation?

The use of a telematics system can help operators manage assets more effectively and gain a greater understanding of the performance of their transport operation. Effective use of the right system can lead to significant improvements in fleet security, productivity and efficiency. This improved efficiency can lead to increased productivity, reduced costs and lower emissions.

2.4 Thanks to Contributors

Freight Best Practice would particularly like to thank the following companies for their help and assistance during the completion of this research:

- Michelin Tyre Plc;
- Home Delivery Network Ltd;
- B-Track Solutions Ltd; and
- Bandvulc Tyres Ltd.

3 Methodology

3 Methodology

3.1 Methodology

3.1.1 *Selection of Trials*

The identification of potential fuel saving interventions and the recruitment of operators willing to participate in 'In Fleet' trials formed the first steps of the work. The decision on which interventions to be trialled was informed by fuel efficiency research to date. The following criteria were considered and balanced when looking at the types of intervention which would be tested and analysed:

- Those with the largest expected savings;
- Those that are less widespread;
- Those which operators tend to resist applying; and
- Those which are quantifiable and achievable in the period of the project.

The operators chosen were aware of the programme and met the basic criterion of having a fuel management system in place to ensure accurate monitoring of the procedure and the results.

Extensive consultation was undertaken to determine the most appropriate trials. Although it may have been preferable to identify and monitor three trials, we were able to successfully identify two operators that met the standards that were required. Contact was made with various fuel efficiency intervention suppliers. Examples of fuel efficiency interventions considered were computerised vehicle routing and scheduling (CVRS) systems, double-deck trailers, energy efficient tyres, vehicle aerodynamic options, and telematics systems.

The advantages and disadvantages of each intervention were considered in order to determine the two most appropriate interventions to analyse in greater detail. The extensive consultation already completed with suppliers and operators determined two in-fleet trials that would offer the most benefit to this research in terms of validating the trial methodology adopted for each trial, and in terms of understanding the results of each trial to determine if proposed fuel savings were being realised in practice.

3.1.2 *Preparation and Monitoring*

The next step of the research involved preparation for the trials before the implementation of the interventions. Extensive discussion took place between the members of the research team and the volunteer companies in order to ensure the most accurate and productive approach was followed. Care was taken to inform suppliers that the programme could not specifically promote their product, although an acknowledgement would be made of their assistance and participation.

During the project there was close monitoring of the implementation of the fuel efficiency interventions and the resulting performance. The research team kept in contact with the selected operators during the period of the trial. This way the reliability of data collection and the integrity of the trial were ensured.

3.1.3 *Energy Efficient Tyres Trial*

A five-month trial of energy efficient tyres was undertaken from the beginning of October 2007 to the end of February 2008 on two heavy articulated tractor units, as part of the trunking fleet operated by a delivery network.

In parallel, two articulated tractor units within the same fleet were run on standard tyres, to enable a comparison to be drawn between the two sets of vehicles within the same fleet.

The fuel efficiency of vehicles can be affected by many variables. Some of the main variables to consider when measuring the fuel efficiency of vehicles are:

- Weather conditions (rain, cold, dry, warm);
- Time of year (seasonal effects);

- Type of operation the vehicle is being used for (long distance/medium distance);
- Driver characteristics and techniques; and
- Type of terrain the vehicle is used on (flat versus hilly).

Weather conditions such as rain, wind and cooler temperatures can influence fuel efficiency. Tyres need to work harder during periods of cold and wet weather. The cooler the air temperature, the denser the air and therefore the more resistance it creates. These conditions can generally be factored for according to the time of year and/or seasonal variation.

The type of operation can be significant, as longer distance journeys tend to achieve better fuel efficiency results because higher average speeds are attained. Shorter distances tend to attain lower average speeds and therefore lower fuel efficiency results.

Driver characteristics and techniques can prove to be an important determining factor on fuel efficiency as each driver will drive a vehicle in a unique way and demonstrate varying attributes relating to economical driving.

Different types of terrain will affect fuel consumption, for example, hilly terrain will often force a driver to select lower gears which will increase fuel consumption and therefore lower fuel efficiency results.

In order to minimise the variables during the energy efficient tyre test, the vehicles selected for the trial needed to meet as many of the following criteria as possible to achieve a fair test:

- Vehicles to have identical technical specification and performance, tyre sizes, makes and patterns, and aerodynamic equipment;
- Vehicles not to be involved in any other fuel comparison tests at the same time, to be on single man operation, and expected to have the same driver for the test period;
- Vehicles fitted with energy efficient tyres to be involved in the same type of operations as vehicles fitted with standard tyres;
- Tyres removed from the two sets of vehicles, prior to fitting the new trial tyres, to be at a similar tread depth. Worn tyres will have a lower rolling resistance, and therefore would achieve artificially higher fuel consumption before the comparison;
- Vehicles selected to be of the same age;
- Vehicles to have 12 months' fuel history before commencement of the trial; and
- All vehicles in the test to be fitted with new tyres at the same time before trial commencement, whether energy efficient or standard type.

Data were recorded during the trial at regular intervals in terms of litres of fuel consumed and distance travelled. For each calendar month of the trial, the data obtained were converted into miles per gallon (MPG) to be able to directly compare against the MPG of the vehicles in the 12-month period before the trial.

Picture 2.1 Energy Efficient Tyres

Picture 2.1 shows different examples of energy efficient tyres. The reason that they differ in tread and shape is because they are for different axles. In order from left to right, the energy efficient tyres are meant to be fitted to the steer axle, drive axle and trailer axle. Tyres all perform a specific function in the movement of a vehicle so fitting the correct tyre to the correct axle is vital to achieve maximum efficiency.

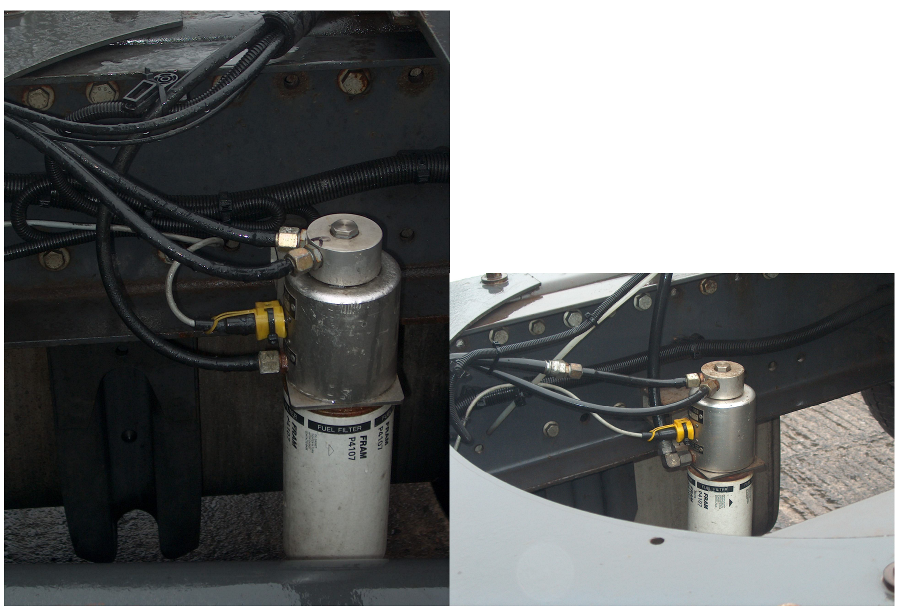
3.1.4 *Telematics System Trial*

An eight-week trial of a fuel flowmeter linked to a telematics system was undertaken from the beginning of January 2008 to the end of February 2008. Different types of vehicle were chosen in this test, in order to compare the fuel performance of articulated tractors and rigid vehicles. Two articulated tractor units and one rigid vehicle were chosen as part of the trunking fleet operated by a national tyre company from its South West depot.

The telematics system would measure the fuel consumption of the tractor units through the fuel filter, and would also measure uneconomical driving such as harsh braking, speeding and over-revving. The final result would produce a points grading for the driver. The points grading is derived from a weighted system, whereby a factor is given a number of points which are added to the driver's score each time an infringement occurs. For example, when the driver over-revved for more than 15 seconds, this would add ten points to the score. The initial grading was determined by fitting the system covertly to each vehicle for an initial three-week period. This allowed average benchmark vehicle performance to be obtained to compare against vehicle performance after the telematics system was revealed to each of the drivers as being fitted to the vehicles.

After the initial three-week period a driver consultation meeting was held to reveal the fact that the telematics systems had been fitted to the vehicles in the fleet. Initial driver discontent at the disclosure that the telematics system had been fitted without their knowledge was soon overcome through the understanding of what the system was able to offer in terms of information to target improved vehicle performance to ultimately reduce costs in the business. Vehicle data were recorded for a further five-week period, to illustrate the comparison between the vehicle data before and after driver awareness of the telematics system being fitted.

The telematics system used in this trial allowed for real-time upload of information onto an internet platform that could be accessed at any time, with performance criteria being monitored across any variable date range. Its main advantage is that it can be fitted on vehicles of any specification being used on any type of operation.



Picture 2.2 Fuel Flowmeter Linked to Telematics System

Picture 2.2 shows the fuel flowmeter attached to the trial vehicles. The cables run to the on-board telematics system.

4 Summary of Findings: Energy Efficient Tyres

4 Summary of Findings: Energy Efficient Tyres

4.1 Energy Efficient Tyres

The data provided by the energy efficient tyre trial have been analysed to better understand any benefits. The data have been summarised according to the key criteria of:

- Mileage;
- Fuel consumption; and
- Fuel savings.

For all graphs shown below, the vehicles shown in green depict the two vehicles that were equipped with the energy efficient tyres and the vehicles shown in black determine the two vehicles that were fitted with standard tyres.

4.1.1 Mileage

The graph below highlights the distances travelled by the four vehicles over the trial period.

Figure 3.1 Mileage

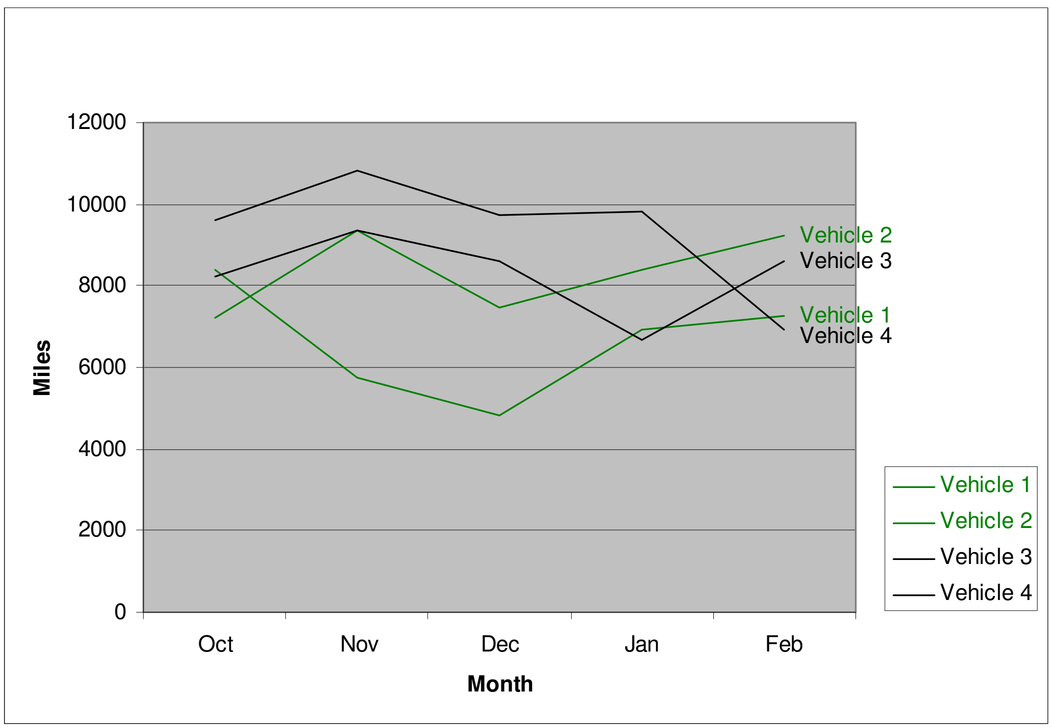


Figure 3.1 illustrates that the vehicles equipped with energy efficient tyres typically travelled shorter distances.

It is important to note that each of the vehicles involved in the trial will not have travelled the same route. This explains why the distances travelled by the vehicles are different.

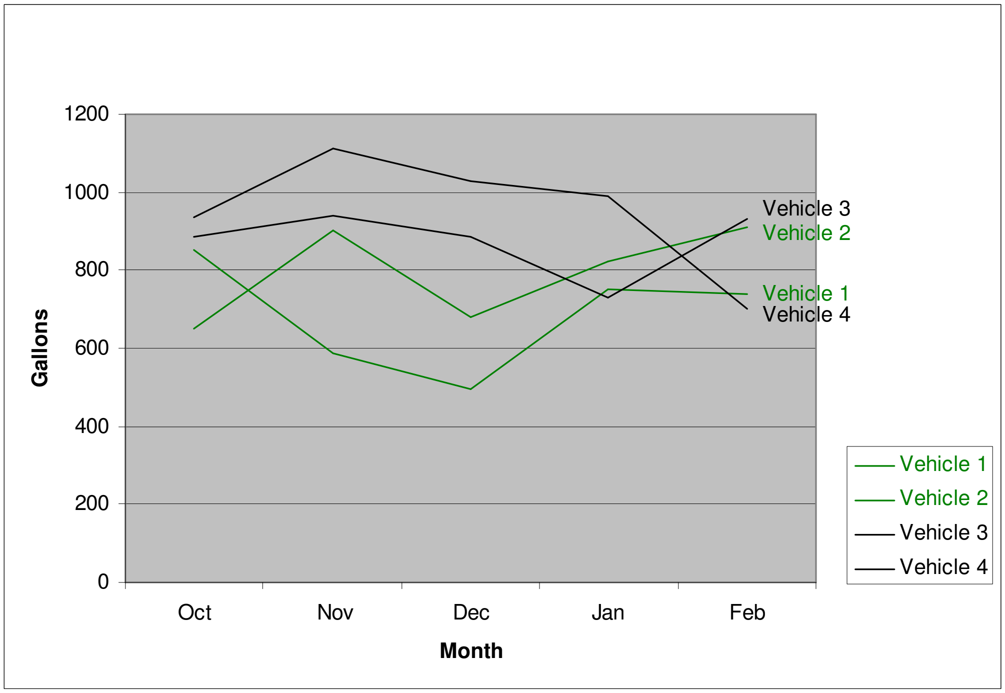
The total difference in distance travelled between the two sets of vehicles was 13,602 miles between the period from October 2007 to February 2008. This is significant and could affect the fuel savings results.

4.1.2 Fuel Consumption

Figure 3.2 provides details of the number of gallons of fuel consumed over the trial period from October 2007 to February 2008. The vehicles with energy efficient tyres consumed fewer gallons than the vehicles fitted with standard tyres.

This can be explained because the vehicles fitted with energy efficient tyres have travelled shorter distances.

Figure 3.2 Fuel Consumption



In order to provide a better understanding of whether the energy efficient tyres have had a positive effect on the fuel consumption of the vehicles fitted with them, a ratio between the distance travelled and the fuel consumed has been calculated as MPG for each vehicle. By calculating the distance travelled while using 1 gallon of fuel, a fairer and better understanding of whether the energy efficient tyres have had an effect can be realised.

Figure 3.3 Monthly MPG

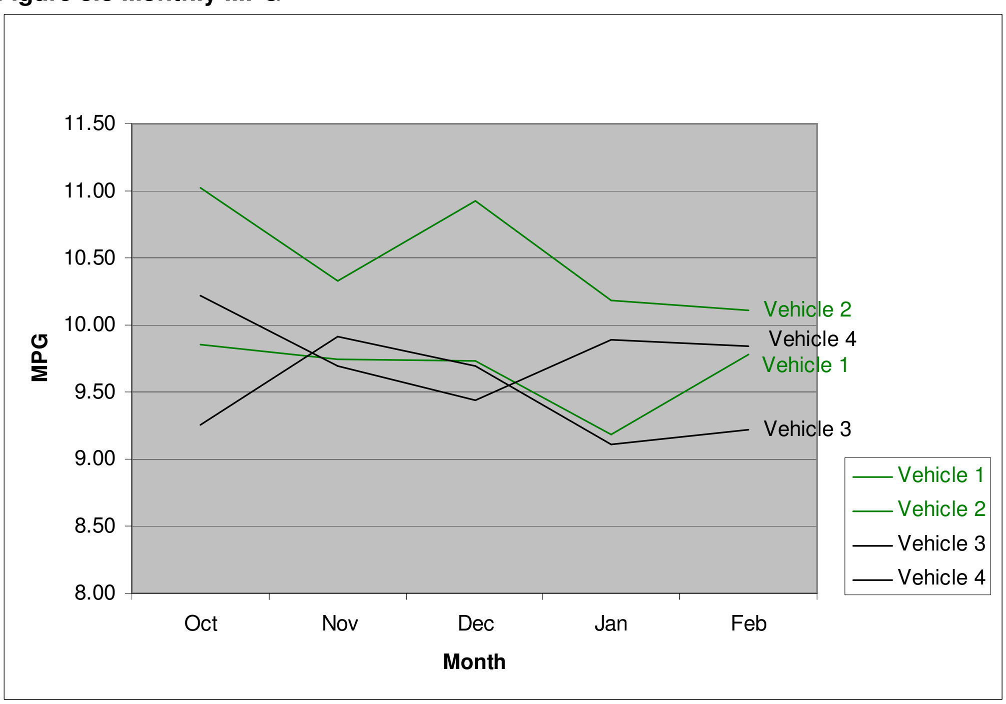


Figure 3.3 illustrates that typically (though somewhat inconsistently) the two vehicles fitted with energy efficient tyres have a better MPG result than the vehicles fitted with standard tyres.

However, it is worth noting that an MPG figure measures fuel consumption, but is affected by a variety of external factors as previously described in the Methodology section.

To gain a consolidated view of fuel consumption, the distances and fuel consumption of the two sets of vehicles was combined to calculate a group MPG. This shows a more indicative picture of the effect that energy efficient tyres have on fuel consumption.

Figure 3.4 Group Monthly MPG

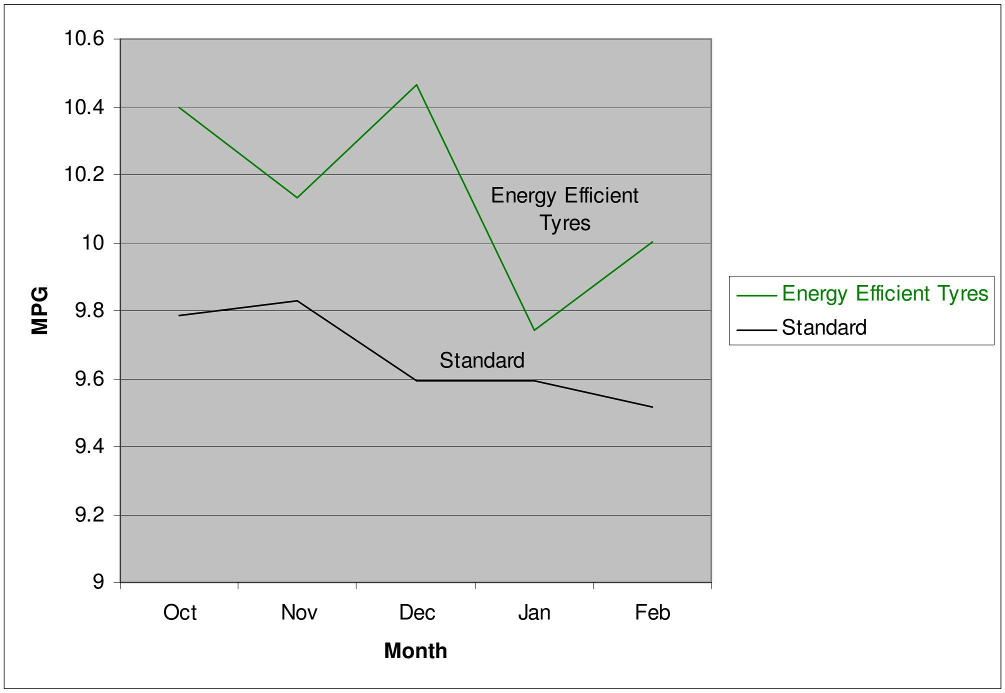


Figure 3.4 illustrates that the vehicles equipped with energy efficient tyres consistently have a better MPG figure than the vehicles equipped with standard tyres.

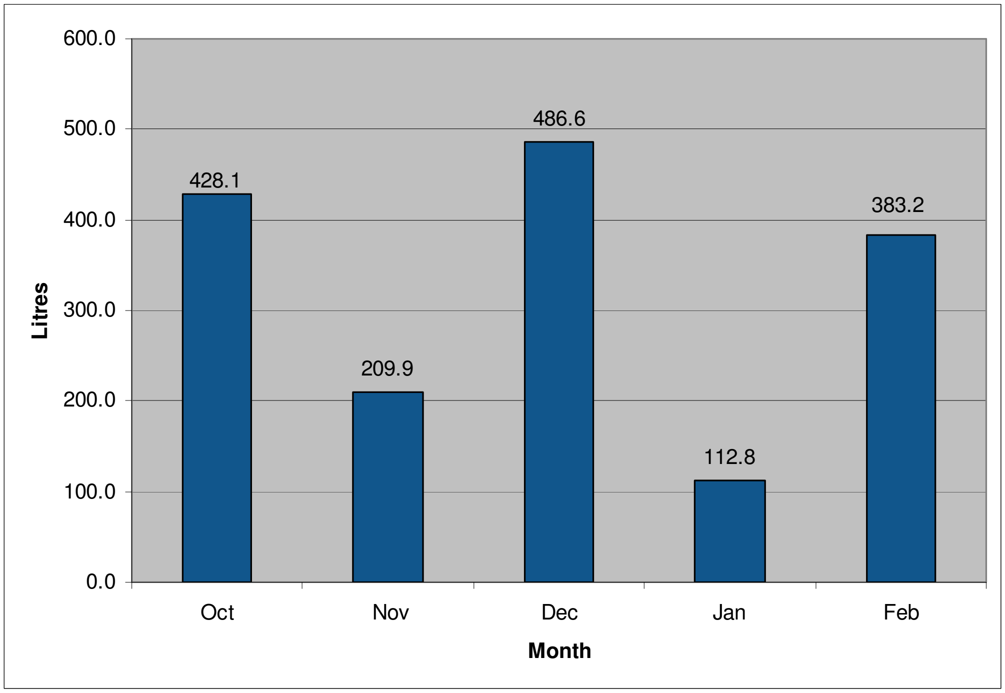
The improvement in fuel consumption is between 0.15 MPG and 0.87 MPG, which equates to 1.57% and 9.07%; the average fuel consumption improvement being 0.47 MPG (4.72%).

4.1.3 *Fuel Savings*

It is possible to quantify how much fuel was actually saved by using the energy efficient tyres and therefore the reduction in the amount of carbon dioxide (CO_2) that was emitted by the vehicles fitted with the energy efficient tyres. Figure 3.5 on the following page illustrates how much fuel has been saved.

This was calculated by understanding the quantity of fuel to be consumed if the vehicles that were fitted with energy efficient tyres had been using standard tyres. The total quantity of fuel saved was calculated in terms of both litres and CO_2, using an industry standard figure of 1 litre of fuel saved equating to 2.63 kilograms of CO_2 emissions prevented.

Figure 3.5 Fuel Saving



The total actual fuel saving in this trial over five months was 1,620 litres of diesel, over the two vehicles.

This equates to an average of 162 litres of fuel per vehicle per month. Therefore, over 12 months a saving of 1,944 litres of fuel per vehicle could be made by using energy efficient tyres.

Figure 3.6 Comparison of Fuel Saving

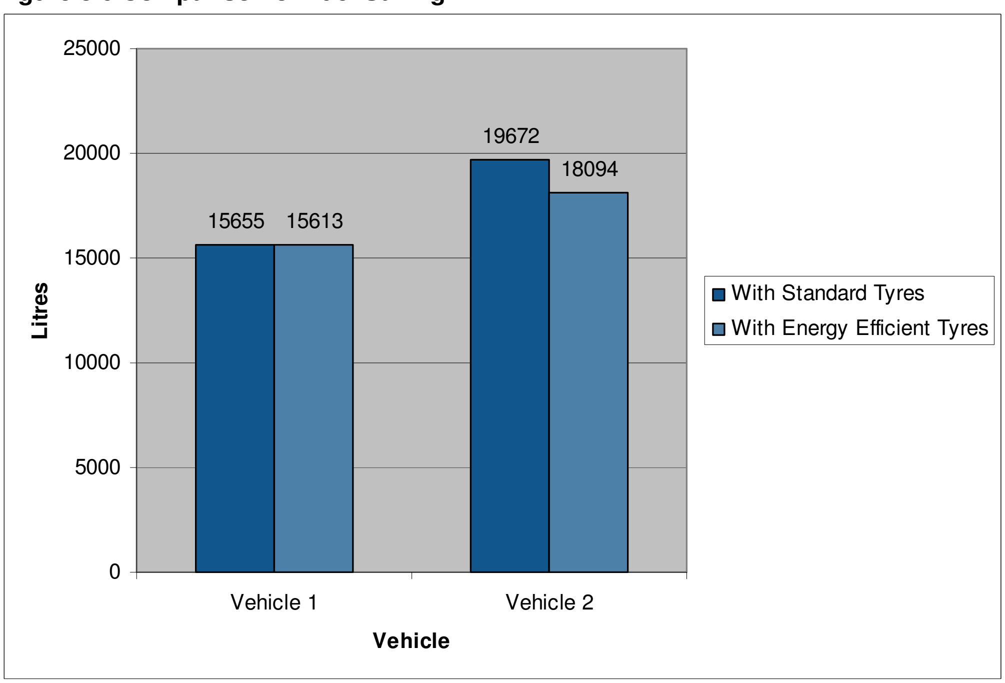


Figure 3.6 illustrates the comparison between fuel consumption for the two articulated tractor units fitted with energy efficient tyres in this trial. This shows the difference in fuel consumption with the vehicles being fitted with energy efficient tyres, when compared to the vehicles if they had still been fitted with standard tyres. Each vehicle shows a fuel consumption saving, with a total saving of 1,620 litres of fuel across the two vehicles. It is interesting to note that Vehicle 1 shows a saving of only 42 litres. This is very low and contrasts against the more noticeable saving made by Vehicle 2 (1,578 litres).

Following the fuel saving analysis, it has been possible to calculate the reduction in the amount of CO_2 emissions and money that has been saved.

Figure 3.7 Carbon Dioxide Prevention

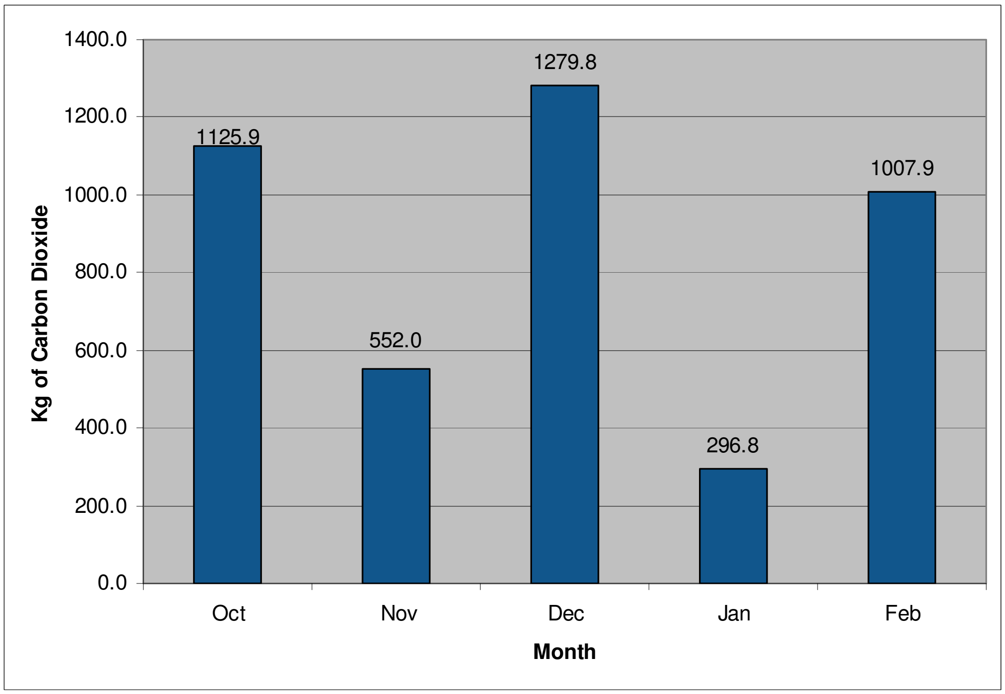


Figure 3.7 shows how many kilograms of CO_2 have been prevented by the vehicles using energy efficient tyres.

A total reduction of 4,262 kg of CO_2 has been made. This equates to 426 kg of CO_2 per vehicle per month.

Over the course of a year, a reduction of 5,112 kg of CO_2 emissions could be made by one vehicle using energy efficient tyres, in comparison with standard tyres on this trunking operation.

Figure 3.8 Cost Saving (at 95p per Litre)

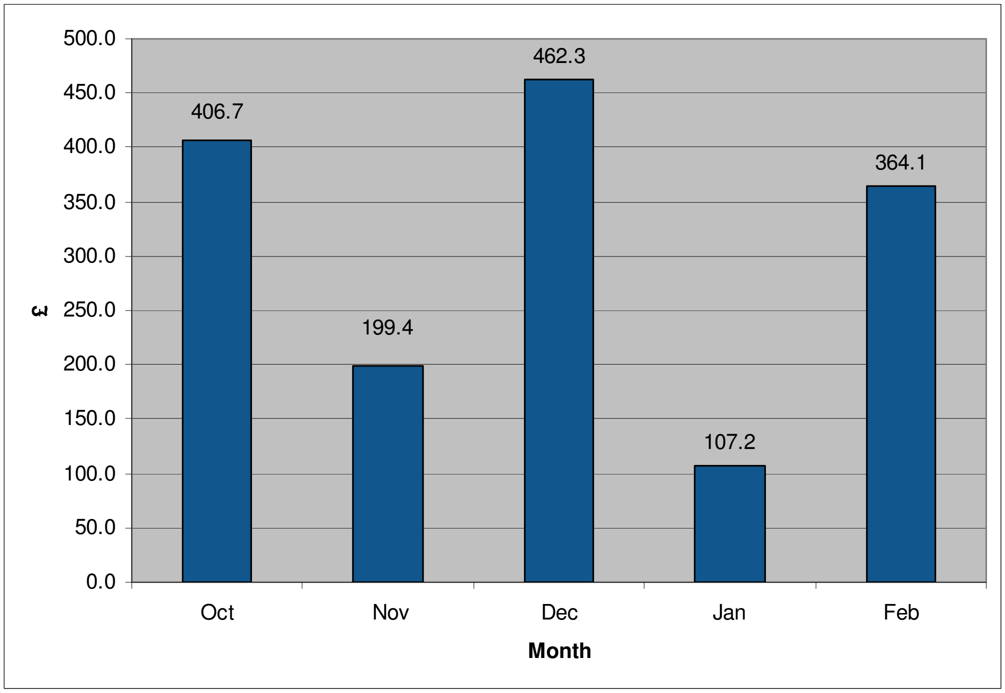


Figure 3.8 demonstrates the amount of fuel cost saved.

In total, the energy efficient tyres saved £1,539 in fuel during the period from October 2007 to February 2008. This equates to £153 per vehicle per month.

Over the course of a year, one vehicle could save £1,836 by adopting energy efficient tyres.

From the distance travelled and fuel consumption data provided by this trial, the energy efficient tyre vehicle was calculated as consuming 0.28 litres of fuel for each kilometre travelled, compared to a standard tyre vehicle consuming 0.29 litres of fuel for each kilometre travelled. Applying a fuel price per litre of 95 pence, the amount of money spent on fuel with energy efficient tyres is 26.6 pence per kilometre, and with standard tyres it is 27.6 pence. Energy efficient tyres therefore saved on average 1 pence for each kilometre travelled in this trial.

4.1.4 *Payback Period*

Based upon consultation with users of energy efficient tyres, the lifespan of an energy efficient tyre can be typically 20% shorter than that of a standard tyre. This is explained by the fact that energy efficient tyres have a lower tread depth when new, compared to standard tyres, and therefore wear more quickly.

The tyre manufacturer involved in this trial confirmed that there was no difference in cost between energy efficient and standard tyres.

Using indicative market figures, a standard tyre costs £300 and has a lifespan of 120,000 kilometres. A similar energy efficient tyre also costs £300 and has a lifespan of 100,000 kilometres. Based on these indicative figures, a ratio of pence per kilometre can be calculated. For the standard tyre, this ratio is 0.25 pence per kilometre and for the energy efficient tyre the ratio is 0.30 pence per kilometre. If they are fitted on the type of vehicle (4x2 axle tractor unit) as described in this trial, then six of each tyre would need to be used. Therefore, for every kilometre travelled by the vehicle, the standard tyres would cost 1.50 pence per kilometre and the energy efficient tyres would cost 1.80 pence per kilometre. This is a 0.30 pence per kilometre difference.

Since energy efficient tyres save 1 pence per kilometre in fuel over standard tyres and energy efficient tyres cost 0.30 pence per kilometre more than standard tyres, the net saving by fitting energy efficient tyres is 0.70 pence per kilometre. This translates to a saving of £700 over the six tyres' typical lifespan (100,000 km), as fitted to a tractor unit in this trial.

These indicative figures do not take into account the cost of fitting the tyres or the cost of the time that the vehicle is off the road during tyre replacement (although it could be possible to negotiate the cost of fitting the tyres into the price of a new tyre and the tyres should be fitted when the vehicle is not scheduled to be utilised, i.e. at weekends).

The figures also do not take into account that tyres can be re-grooved and in some cases can be remoulded, thus extending the lifespan of the tyres, which in turn makes the cost in pence per kilometre significantly less, and the saving considerably more.

These figures do not consider any improved performance of the tyre as the life of the tyre increases and the rolling resistance reduces. However, this should have the same effect on both types of tyre.

Additionally, the figures do not take into consideration the casing, or scrap, value of the tyre when worn, which will be the same for both types of tyres, and which can be offset against the initial cost of the tyre when new, but is a variable value dependent on current market conditions.

It is important to note that although energy efficient tyres do typically have a 20% shorter lifespan compared to a standard tyre, early indications from this particular trial suggest that the energy efficient tyres will out-perform the standard tyres on a km per tyre mm worn basis. This can be attributed to the articulated tractor units being used on ideally suited long-distance routes.

4.2 Summary of Key Findings from the Energy Efficient Tyre Trial

In consideration that this particular trial was related to the specific conditions of a national trunking operation, the following findings can be summarised.

Positive Findings:

- ***The MPG of vehicles fitted with energy efficient tyres was better than that of vehicles fitted with standard tyres by, on average, 0.47 MPG (4.72%); and***
- ***Trial data suggest that annualised savings of £1,836 and 5,112 kg of CO_2 emissions per vehicle are possible.***

The cost of energy efficient tyres is the same as standard tyres, suggesting that transport operators would benefit by switching to energy efficient tyres for vehicles within the fleet that are consistent with high mileage type operations,

Negative Findings:

- ***In this trial, energy efficient tyre vehicles covered fewer miles than the standard tyre vehicles, therefore accurate comparisons based on similar mileages was not possible to attain.***

Inconclusive Findings:

- ***The trial period was conducted over winter months and therefore no results are available for summer months when the fuel efficiency of vehicles is generally better owing to improved weather conditions, however, the seasonal effect would be the same for both sets of vehicles;***
- ***The trial period analysed in this research is a snap-shot of the total trial undertaken, therefore this does not allow for determining with confidence the expected lifespan of energy efficient tyres versus standard tyres, and therefore calculating an overall lifespan cost comparison between energy efficient and standard tyres was not possible;***
- ***The trial was conducted using only one manufacturer of energy efficient tyres, therefore comparisons between other manufacturers of similar tyres was not possible;***
- ***The trial did not consider any positive effect of using energy efficient tyres on the transport operator's customer base, i.e. did this help to gain additional business as environmental criteria are being better met for the customer?***

- ***The trial did not consider any variation in the fit of energy efficient tyres to an articulated vehicle, and therefore cannot conclude with confidence that to fit energy efficient tyres to all axles on an articulated tractor and trailer unit maximises fuel efficiency savings over standard tyres. This trial only considered the benefits of energy efficient tyres as fitted to all axles of the tractor units.***

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5 Summary of Findings: Telematics System

5 Summary of Findings: Telematics System

5.1 Telematics System

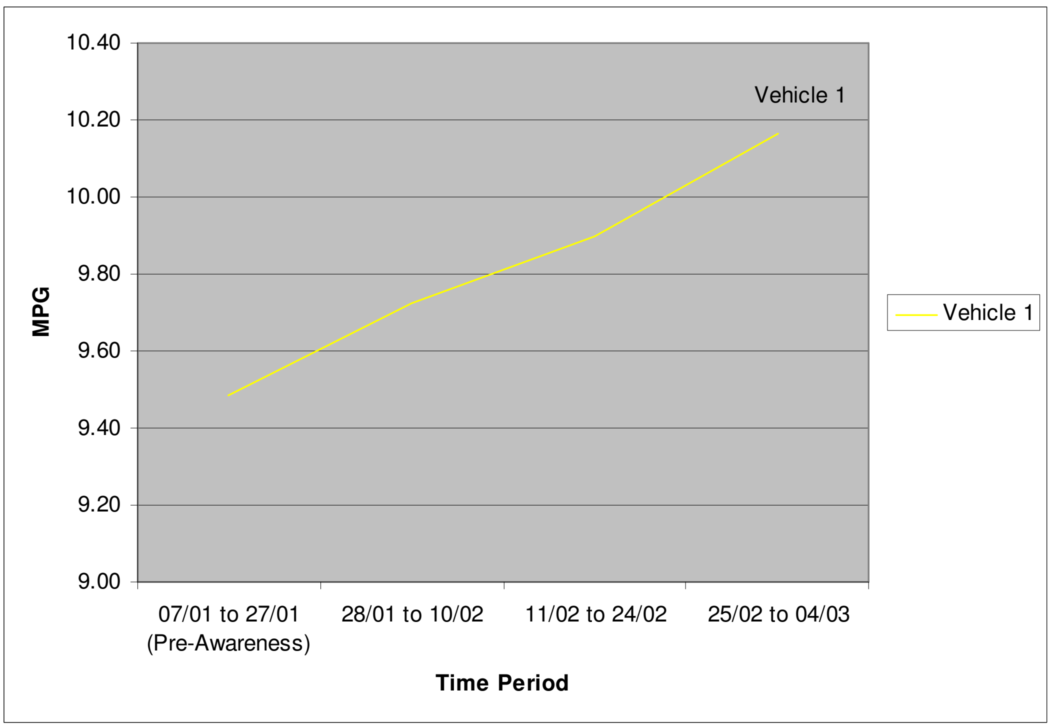
The data provided by the telematics system trial have been analysed and categorised according to the following elements:

- Fuel consumption;
- Average drive time;
- Over-speeding;
- Over-revving; and
- Idling time.

5.1.1 Fuel Consumption

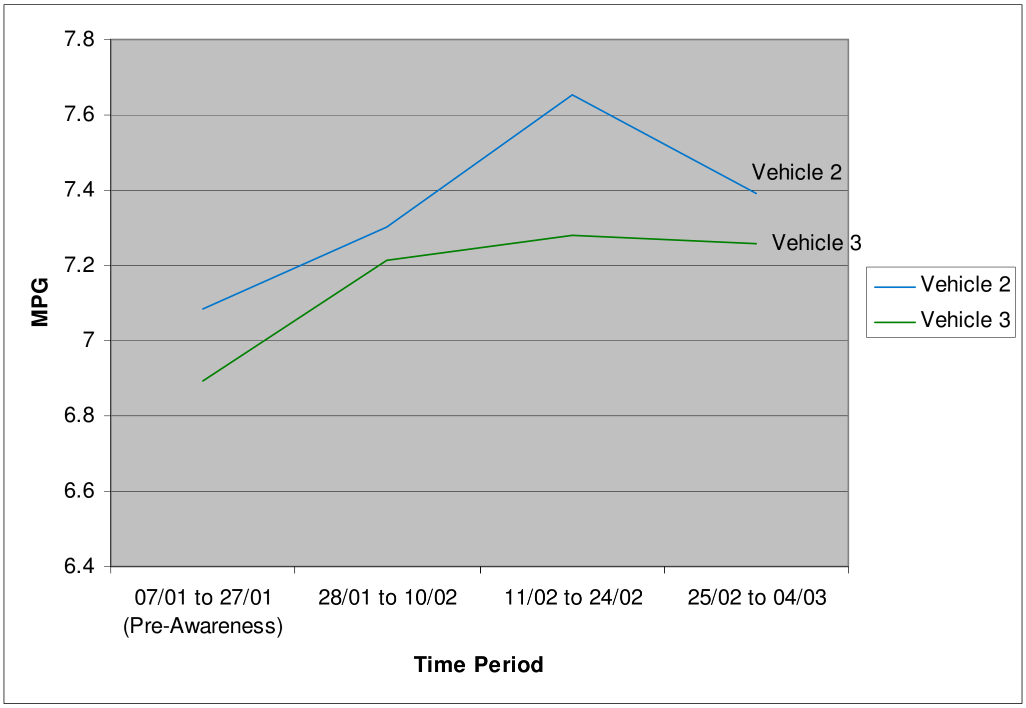
Of the three vehicles fitted with the telematics system, one was a rigid vehicle and two were articulated tractor units. Since fuel performance was expected to be significantly different for both vehicle types, owing to the types of operation undertaken, the rigid vehicle and articulated tractor units results were analysed separately and, where possible, results were combined.

Figure 4.1 Rigid MPG Figure



The rigid vehicle MPG figure shows marked improvement post-awareness, as shown in Figure 4.1. Unlike the articulated tractor unit figures seen in Figure 4.2, this MPG figure continues to rise after the two-week period from 28/01 to 10/02, following the driver awareness session. As the graph indicates, the rigid vehicle MPG is considerably higher than the articulated tractor unit MPG. This can be explained by the fact that the rigid vehicle is smaller and has a lower gross vehicle weight than the articulated tractor units. The overall increase in MPG during the eight-week trial period for the rigid vehicle was 0.68 MPG (7.2%), with the average increase in MPG being 0.42 MPG (4.41%)

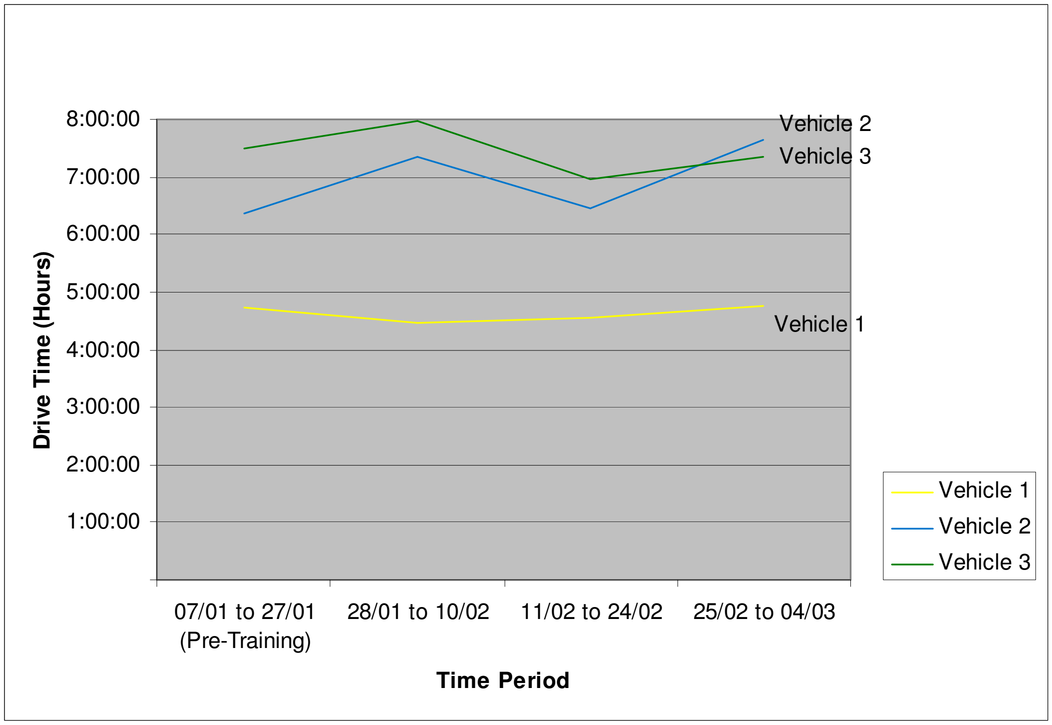
Figure 4.2 Artic MPG Figure



The MPG of the articulated tractor units noticeably increased after the drivers became aware that the system was fitted to their vehicle. The driver awareness session consisted of an explanation of the driver performance over the period from 07/01 to 27/01, when the telematics system was fitted covertly to the vehicles. The driver awareness session had a significant positive effect on fuel consumption. The best MPG figure was achieved in the third two-week period from 11/02 to 24/02, after which there is a subsequent drop in the MPG figure. While the MPG for the time period from 25/02 to 04/03 is not as good as the MPG for the time period from 11/02 to 24/02, it is still a marked improvement on the pre-awareness MPG figure. The MPG figure improves by a total of 0.66 MPG (9.5%) across the two articulated tractor units, with an average improvement of 0.36 MPG (5.15%).

5.1.2 Average Drive Time

Figure 4.3 Average Drive Time



The average daily drive time was calculated to understand how many hours each vehicle spent on the road, and is illustrated in Figure 4.3. This was calculated assuming that the vehicles were used on a typical five-day working week (i.e. not working at weekends). As could be expected, the articulated vehicles spent the most time driving as these vehicles would typically be doing trunking runs, consisting of medium-distance, high-mileage work. The yellow line depicts the rigid vehicle and this vehicle was driven for a shorter time than the articulated vehicles. The rigid vehicle would typically stop to make several deliveries throughout the day and this is why the rigid vehicle's average drive time is lower than that of the articulated vehicles.

5.1.3 Over-speeding

Figure 4.4 Over-speeding

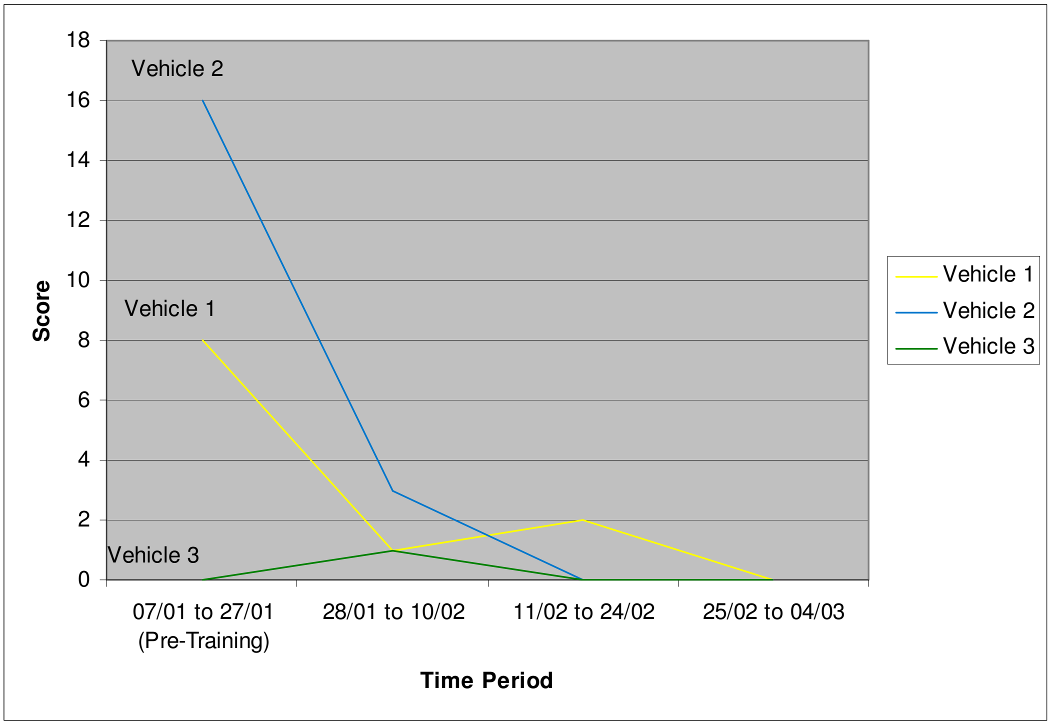


Figure 4.4 demonstrates the effect that the driver awareness session had on the number of incidents of over-speeding. As illustrated, the system score attributed to the number of cases of over-speeding dropped significantly and by the end of the third time period from 11/02 to 24/02, over-speeding had been eradicated completely.

5.1.4 Over-revving

Figure 4.5 Over-revving

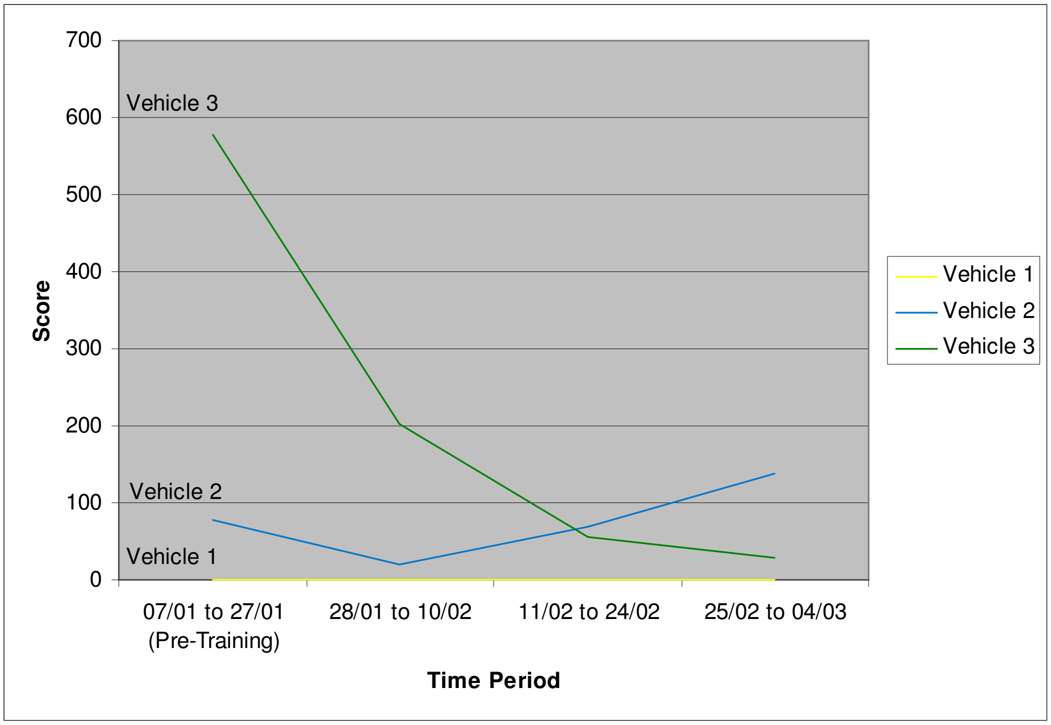


Figure 4.5 demonstrates the system score attributed to the number of cases of over-revving before and after driver awareness. The rigid vehicle had no cases of over-revving before or after the driver being made aware of the telematics system, which would suggest that the driver is already accomplished at minimising over-revving. The results for one of the articulated tractor units dropped dramatically whereas those for the other articulated tractor unit increased slightly, though this was not significant. It was not immediately evident why this occurred, as the trial did not allow for individual consultation with each driver involved. This increase in over-revving is in direct contrast to the other measures which showed a reduction in frequency after the driver awareness session. Longer monitoring would have allowed the opportunity to determine if this increase in over-revving could be reversed following the next planned company/driver consultation briefing, as part of the driver development programme, to support the results being provided by the telematics system.

5.1.5 Idling Time

Figure 4.6 Average Idling Time per Day

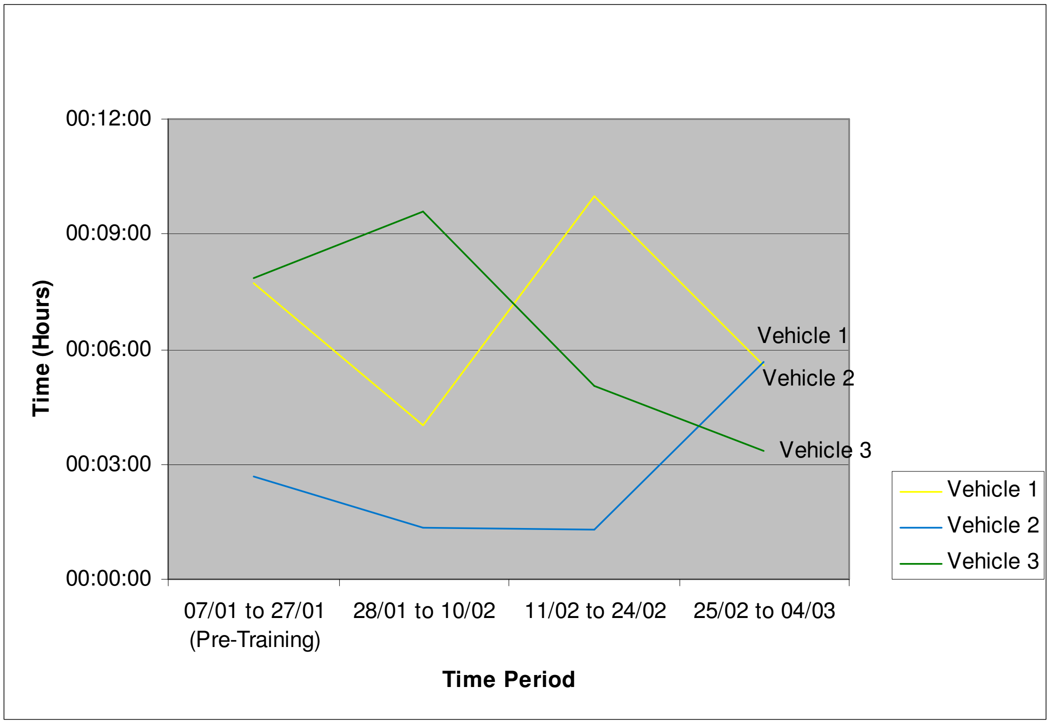


Figure 4.6 demonstrates the average amount of idling in a day. This was relatively low and includes time spent waiting at traffic lights or due to traffic congestion. This appeared to indicate that there was not an idling issue involving the test vehicles.

5.1.6 *Fuel and CO_2 Saving Summary*

By using the MPG figure from 07/01 to 27/01 for each vehicle, before driver awareness of the telematics system, and comparing it to the MPG of the vehicles during the subsequent five weeks of the trial, it is possible to calculate the amount of fuel that was saved as an effect of driver awareness of the telematics system. Consequently, the CO_2 emissions that were avoided and the amount of money that was saved could be calculated.

Figure 4.7 Fuel Saved

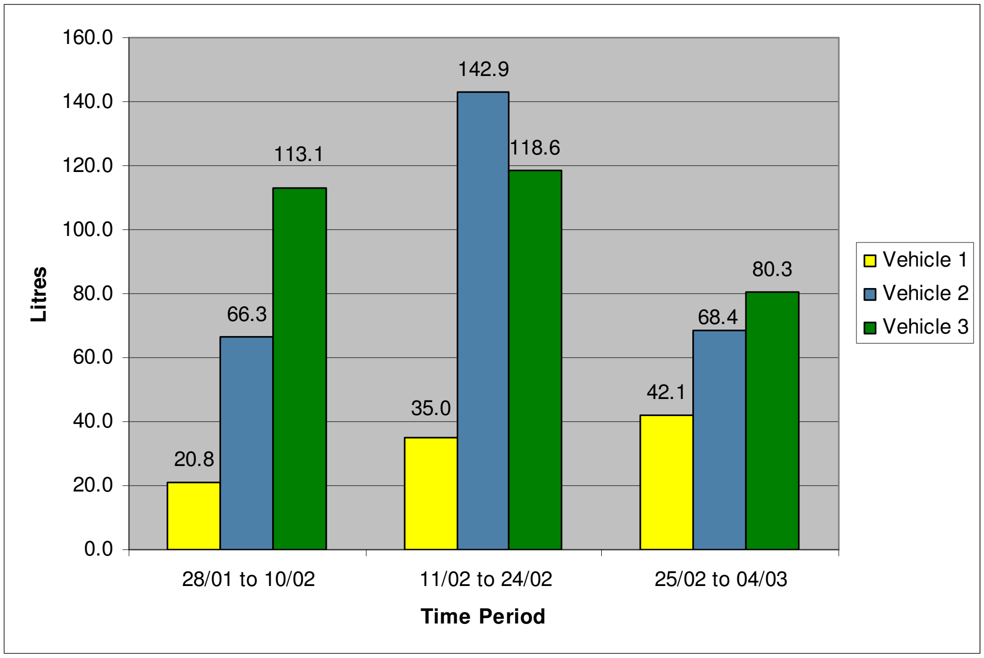


Figure 4.7 demonstrates the fuel savings that were made as a result of driver awareness of the telematics system. A total of 687 litres of fuel were saved. Interestingly, the highest volume of fuel saving was in the period from 11/02 to 24/02, with the fuel saving in the following period from 25/02 to 04/03 not as high. This would support the theory that a driver development programme in support of results made available from a telematics system needs to be structured accordingly at regular intervals, to ensure that drivers are constantly reminded of their economical driving performance, and continuously focused on the areas of uneconomical driving that need further improvement.

Of the total saving, the articulated tractor units accounted for 85% of the fuel saved. The rigid vehicle had different methods of operation, for example, multi-drop, and this explains why there was a less significant improvement in the fuel performance of this vehicle.

Figure 4.8 Comparison of Fuel Consumption

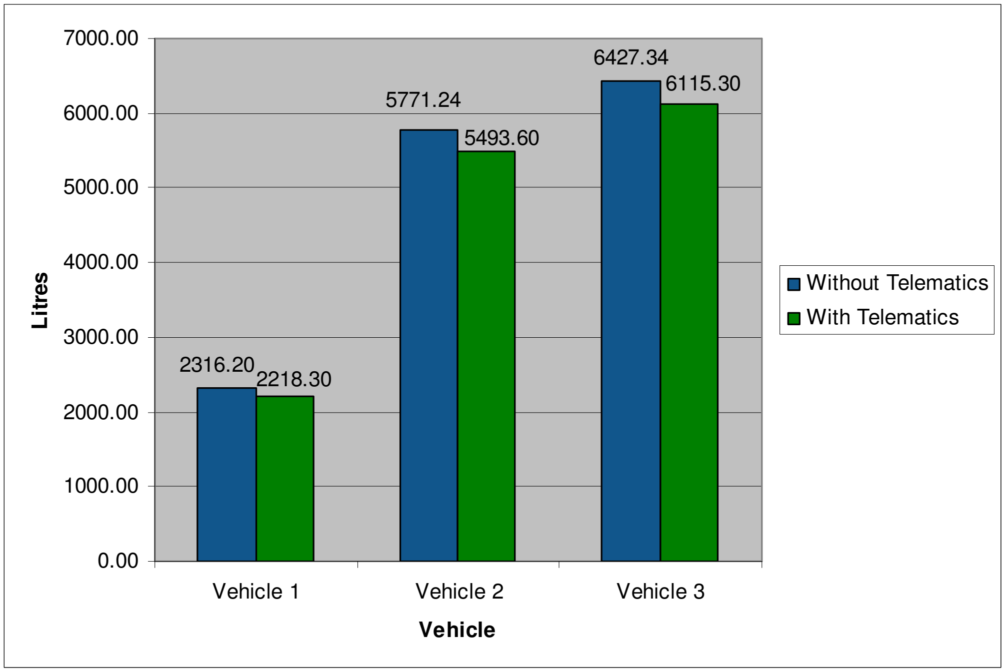
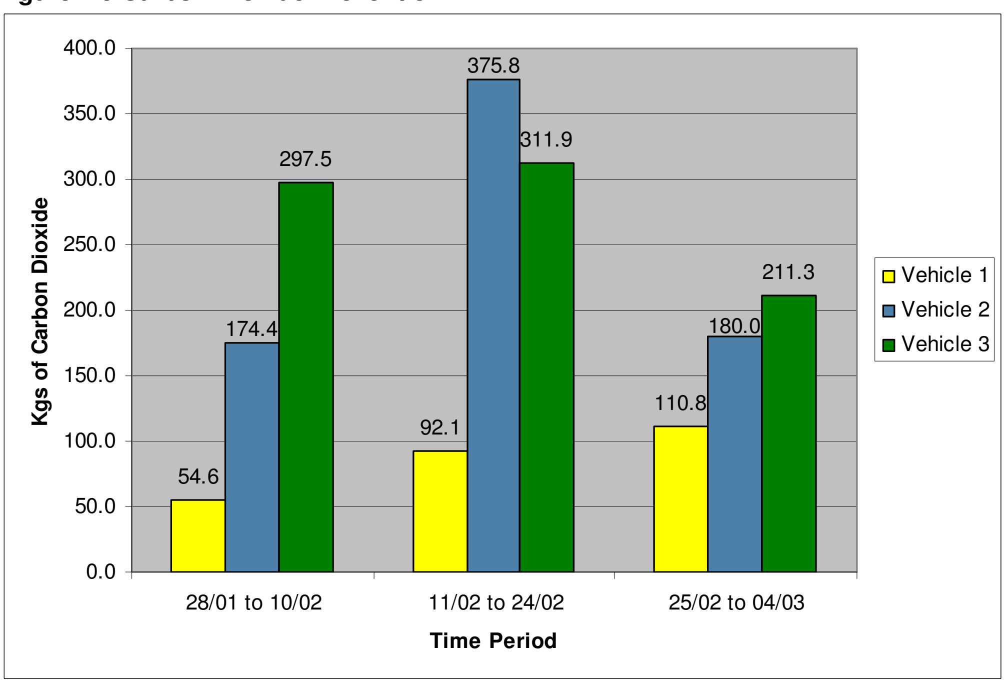


Figure 4.8 illustrates the comparison of fuel consumption for the three vehicles fitted with the telematics system in this trial. This shows the difference in fuel consumption, comparing the pre-awareness and post-awareness results of the trial. Each vehicle shows a fuel consumption saving of between 98 litres and 312 litres, with a total saving of 687 litres of fuel.

Figure 4.9 Carbon Dioxide Prevention



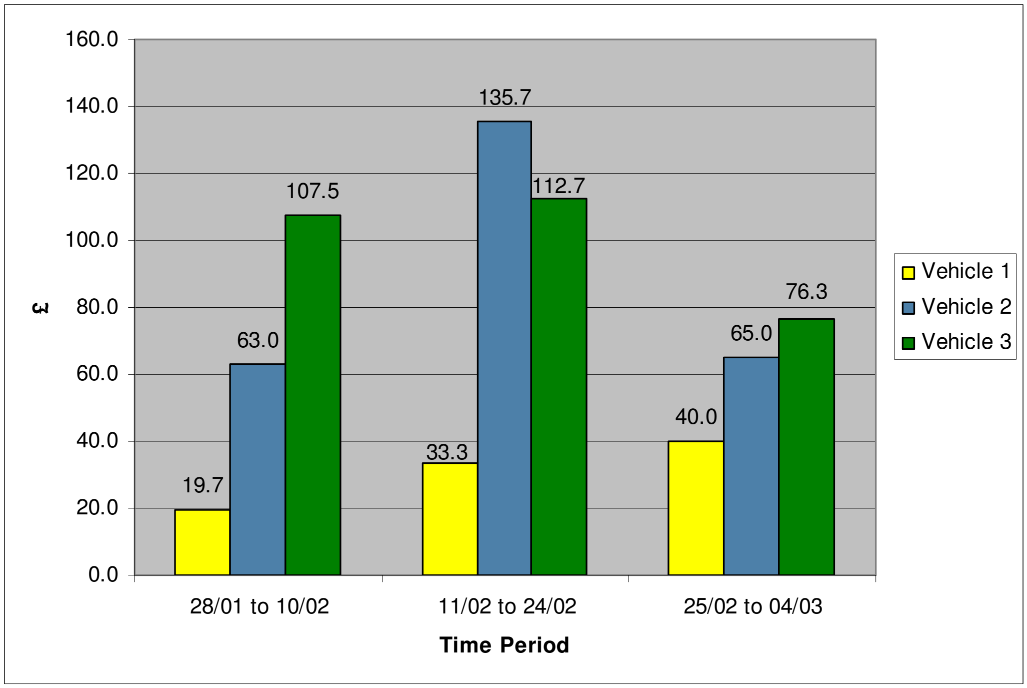
Following the fuel saving analysis, it is possible to calculate the reduction in the volume of CO_2 emissions and cost saved.

Figure 4.9 above demonstrates the volume of CO_2 emission reductions made from saving fuel.

In total, 1,806 kg of CO_2 was saved during the 5 week trial period. This is based on the industry standard calculation of saving 2.63 kg of CO_2 for each litre of fuel saved.

During the course of a 50 week typical operational year, 18,060 kg of CO_2 emissions can be expected to be prevented by the intervention analysed in this trial.

Figure 4.10 Cost Saving (at 95p per Litre)



The cost savings made as a result of the fuel savings have been calculated and the results are shown above in Figure 4.10.

In total, £653.20 was saved in this trial period.

If only the articulated tractor units are analysed, then these two vehicles save a total of £560.20 (85% of the total) between them, which can be further explained as £65 per articulated tractor per week.

One articulated tractor unit, operating in accordance with the conditions in this trial, can therefore expect to save approximately £3,250 per year, over a 50-week year, by using a telematics system. However, it is important to note that the use of a telematics system alone is not sufficient to achieve these fuel savings. A structured driver development programme also needs to be adopted by the transport operator to run in parallel, to ensure that such fuel savings are realised, by focusing regularly on the areas of poor driving performance as illustrated by the telematics system.

5.1.7 *Payback Period*

Taking into consideration the cost of the telematics system, together with the cost of installation and operating costs, the payback period would be approximately nine months using today's (March 2008) industry fuel cost figure of 95 pence per litre, assuming that the frequency of the associated driver development is maintained.

5.2 Summary of Key Findings from the Telematics System Trial

Positive Findings:

- ***The use of a telematics system can assist with improving the fuel efficiency of vehicles, once the drivers are aware that the telematics system is fitted to the vehicle, and the installation of such a system is supported with an appropriate driver development programme.***

- ***Trial data suggest that £3,250 can be saved and a reduction of 7,440 kg of CO_2 emissions can be made per year for a typical articulated trailer/tractor unit on trunking operations.***
- ***Based upon the cost of purchase, installation and operation of a telematics system, the payback period is approximately nine months, and the system can therefore be viewed as a useful medium-term, cost-effective tool for improving fuel efficiency.***
- ***Telematics systems can be fitted to any vehicle of any age and of any specification, therefore fuel efficiency savings can be realised across any transport fleet. However, they appear to be most suited to higher mileage, higher fuel consuming vehicles.***
- ***The telematics system analysed in this trial did not have to be fitted to dedicated driver vehicles, as individual coded keys could be issued to drivers to monitor individual driver performance on shared vehicles within a fleet.***

Negative Findings:

- ***The benefits of a telematics system are limited if the system is used alone. The use of such a system needs to be supported with a carefully structured driver development programme that caters for each driver's individual responses to training, and focuses on the areas of individual training required to obtain the most beneficial savings. This will incur additional cost for transport operators as drivers and trainers need to have time set aside for the completion of training on a regular basis.***

Inconclusive Findings:

- ***Elements measured by the telematics system are weighted according to a unique grading matrix as developed by the transport operator and are therefore subjective. The trial did not consider the effects of altering the grading system on the fuel efficiency of vehicles, i.e. is the transport operator confident that the optimum grading matrix has been implemented for the fleet?***
- ***The trial period was conducted over winter months and therefore no results are available for summer months when the fuel efficiency of vehicles is generally better owing to improved weather conditions.***
- ***The trial was completed using only one manufacturer of a telematics system and therefore a comparison between other manufacturers of similar telematics systems was not possible.***
- ***The trial did not consider any positive effect of using telematics systems on the transport operator's customer base, i.e. did this help to gain additional business as environmental criteria are being better met for the customer?***
- ***It is difficult to establish what fuel savings can be attributed to the telematics system itself and what can be attributed to the driver development programme. It is the interface between the system, the driver and the driver's awareness that produces the savings.***
- ***The most appropriate frequency of structured driver development to support the use of telematics systems could not be identified owing to the short timescale considered in this trial.***

6 Summary of Findings: Trial Process

6 Summary of Findings: Trial Process

An important aspect of this research study was to investigate the trial methodologies followed for the two in-fleet fuel efficiency trials covered, and to offer findings for each trial in order to develop guidance on good practice for transport managers to adopt, when considering the implementation of fuel efficiency intervention trials.

6.1 Energy Efficient Tyre Trial

Investigation into the energy efficient tyre trial was summarised according to the following findings.

6.1.1 Positive findings:

- Detailed criteria were considered for implementing the trial in order to ascertain the most appropriate sample of the transport operator's fleet to fit with energy efficient tyres, as detailed in the methodology section of the energy efficient tyre trial.
- The vehicles selected were matched to the type of operation most suited to the use of the tyre in order to compare actual fuel efficiency savings against claimed manufacturer savings.
- The trial considered like-for-like comparisons with vehicles fitted with standard tyres, with both sets of vehicles being fitted with new tyres at the same time, to prevent any vehicle advantage in running on part-worn tyres with a naturally lower rolling resistance than new tyres.
- The in-fleet trial was scheduled to last for a 12-month period in order to offset any effects of seasonality. The findings included in this research paper are based on a snapshot of only five months out of the proposed 12-month period.

6.1.2 Negative findings:

- The process of feedback of data from the trial was from the transport operator to the tyre manufacturer, with frequency of data feedback being set at monthly intervals. However, the transport operator did not always feed back data when required and had to be chased for progress update. This called into question the correct timings attributed to the data, and therefore the accuracy of mileage travelled and fuel consumed at the correct set monthly interval dates to allow for a structured comparison trial.
- The sample size of the fleet was small, in terms of measuring only two articulated tractor units from one national trunking depot. It could be argued that a larger sample size would have been beneficial in providing more reliable results, particularly if spread across multiple depots within a large national trunking fleet.

6.1.3 Recommendations:

- The transport operator to ensure that the sample size of the fleet is appropriate in terms of both size and geographical spread, and in terms of type of operation to best meet the characteristics of utilising energy efficient tyres.
- The transport operator to ensure a close match to generic fuel efficiency trial criteria.
- The transport operator to own a trial data calculation tool during the period of the trial and to be responsible for inputting data on mileage travelled and fuel consumed, to assist in meeting data entry deadlines and ensuring accuracy of data. The transport operator could also have the option of inputting data at more regular intervals than the monthly prescription, to build a more regular picture of fuel efficiency comparisons, i.e. weekly over the 12-month proposed trial period.

6.2 Telematics System Trial

Investigation into the telematics system trial was summarised according to the following findings.

6.2.1 Positive findings:

- The transport operator was empowered with having direct access to the trial measurement platform via the Internet, in order to obtain real-time latest information on the fuel efficiency of each vehicle within the trial, to assist in the integrated driver development programme.
- The transport operator was aware from the outset that driver development would be necessary as part of the use of the equipment, and therefore pre-planned this as part of the overall trial timing plan.

6.2.2 Negative findings:

- The fleet sample size was small, and did not offer multiple vehicles of the rigid type. Direct comparison between more than one rigid vehicle fitted with the telematics system was not possible. Therefore, the research was unable to conclude with confidence that the rigid vehicle performance was as expected, based on industry knowledge and expected performance of this type of vehicle. The fact that the two articulated vehicles were analysed with a telematics system fitted during the trial ensured that each set of results for each articulated vehicle could be compared directly with each other, to ensure that the results provided by the system were comparable and consistent.
- In contrast to the energy efficient tyre trial, the telematics system trial was conducted over a short time period of only eight weeks that was phased during the winter months. This timing could have impacted on the fuel efficiency results owing to the seasonal effect on fuel efficiency performance.

6.2.3 Recommendations:

- Sample size of fleet for fitting of trial fuel efficiency interventions to ensure that alternative vehicle types are trialled where possible in multiples of more than one, to offer a direct comparison within the same fleet of vehicle performance for similar vehicle types.
- Sample size of fleet to include vehicles that are not fitted with telematics systems to enable direct in-fleet comparisons between vehicles of similar type during the proposed trial period. This will help to avoid the covert fitting of the system to trial vehicles, which is not always practicable and from an impartial perspective should be avoided to ensure full driver involvement and participation in the trial from the outset.
- A longer trial period would have proved to be of more benefit by ensuring that seasonal and operational effects on the vehicles could be minimised to offer a more accurate set of results.

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7 Conclusions

7 Conclusions

7.1 Trial Process

The main conclusion to be derived from the fuel efficiency trials as detailed in this research paper is that fuel efficiency is improved following the adoption of either intervention. The two trials adopted differing methodologies, but both resulted in realised improvements to the fuel efficiency of the vehicles selected for trial within each fleet. Actual fuel efficiency savings can be deemed to be equivalent to savings promoted by each fuel efficiency intervention manufacturer. The analysis of each trial methodology allows for key trial criteria and elements of good practice to be understood to formulate into generic trial recommendations as detailed in the following Recommendations chapter. Furthermore, in addition to the findings already detailed in this research paper for each in-fleet trial, specific conclusions from each trial are detailed below.

7.2 Energy Efficient Tyre Trial

The trial confirms that energy efficient tyres do reduce fuel consumption. The trial suggests that fuel consumption is improved by 4.72% during the five-month time period analysed, which supports information obtained from the Freight Best Practice Fuel Ready Reckoner tool that suggests that the fuel saving from the use of energy efficient tyres would be between 1.53% and 4.58%, depending upon practical factors and the type of vehicle, with a typical average being approximately 3.05%.

It is also important to note that energy efficient tyres vary in design according to where they are be fitted to a vehicle, for example, steer tyres are designed differently to drive-axle tyres and these are designed differently to trailer tyres. A transport operator would need to determine if all or only some of the axles on a tractor and trailer vehicle unit need to be fitted with energy efficient tyres.

Energy efficient tyres are best suited to operations that travel at constant speeds such as trunking. This maximises the fuel efficiency savings that are available through the use of this type of tyre. Constant acceleration and deceleration reduce the energy efficient tyres' potential.

Although energy efficient tyres typically have a reduced lifespan versus standard tyres, the early indications from this trial suggest that the energy efficient tyres will out-perform the standard tyres. The overall cost/benefit analysis suggests that a transport operator can reduce costs by using energy efficient tyres.

7.3 Telematics System Trial

The most important conclusion from the telematics system trial is that such a system will not result in long-term fuel efficiency savings as a stand-alone system. The telematics system is merely a method of recording and monitoring how a vehicle is driven. The information derived from the system needs to be analysed to structure an associated driver development programme, to communicate the results to drivers and to implement initiatives to allow for driver improvements to support fuel efficiency savings, in particular, over-revving, over-speeding and idling. The driver becomes the key to fuel savings but this can only be achieved through appropriate driving techniques.

Undoubtedly, there was a significant fuel efficiency improvement during this trial, after driver awareness, particularly for the articulated tractor units. This improvement has been made through the utilisation of improved driving techniques, resulting in higher MPG through reductions in harsh braking, over-revving, over-speeding and idling time.

As described in the methodology for this trial, the articulated tractor units and rigid vehicles were analysed separately as they were different types of vehicle. The articulated tractor unit MPG figure improved by a total of 9.5%, whilst the rigid vehicle made a 7.2% increase on its pre-awareness MPG figure. Fitting of the telematics system will have contributed to the overall improvement, but it is more likely that the stimulus of the reduced fuel consumption is the inception of the driver awareness and development process. The reduction in idling, speeding and over-revving could be contributed to the telematics system, and whilst training can address these problems, the telematics system can be used as a continuous method of recording driver behaviour and ensuring that any anti-fuel efficient driver techniques are quickly identified and overcome through continuous development.

Although this trial was completed over an eight-week period, clear trends were apparent in the identification that initial driver awareness resulted in an improvement in fuel efficient performance for a period of approximately four weeks, before less fuel efficient techniques started to be re-employed by the drivers. This trend supports the conclusion that a regular driver development programme at intervals of approximately four weeks would assist in maintaining a consistent level of fuel efficient driving. If this trial had been conducted over a longer period of time, it may have been possible to determine an ideal frequency of driver development to support the use of telematics systems on improving fuel efficiency.

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8 Recommendations

8 Recommendations

8.1 Trial Process

As part of analysing the in-fleet trial processes adopted by the two transport operators within this research paper, good practice elements can be extracted by transport managers that have a general benefit to any fuel efficiency intervention trials or possible implementation. The following points are useful for transport operators to use as a reference point when considering the implementation of an in-fleet trial of fuel efficiency interventions. These points have been summarised from the positive findings and specific trial recommendations detailed in the Summary of Findings: Trial Process chapter.

- Ensure that the sample size of fleet is appropriate in terms of both size and type of operation to best meet the characteristics of the proposed fuel efficiency intervention;
- Own any trial fuel efficiency calculation tool and to be responsible for the inputting of any data into the tool to assist in ensuring accuracy of data, and to be empowered during the trial process;
- More than one of each alternative vehicle type to be included in the sample size of fleet for fitting of trial fuel efficiency interventions;
- Include vehicles that are not fitted with fuel efficiency interventions in the sample size of fleet; and
- Trial periods to be measured for at least six months to consider seasonal variation effects on the fuel efficiency of vehicles.

8.2 Energy Efficient Tyre Trial

Following the completion of the energy efficient tyre trial from October 2007 to the end of February 2008, the following recommendations can be made for the trial of energy efficient tyres:

- To be used only for medium to long distance trunking operations to maximise fuel efficiency savings and better utilise design functionality of the tyre type.
- To be trialled on a carefully selected sample of a fleet to ensure that fuel efficiency savings can be realised.
- Tyre trial programmes to support, as far as possible, the criteria identified in the methodology, for example, similar operations and vehicles of same specification.

Energy efficient tyres do save energy by having a lower rolling resistance than standard tyres. Whilst this research report does not specify the make of tyres or the manufacturer, it is recommended that an operator explore the various types on the market. Every tyre on the market performs a different specific function for the type of operation on which it is intended to be used and will therefore perform at its optimum in the desired conditions. For this reason, an energy efficient tyre will realise its optimum potential by being used on straight, level road surfaces, such as a motorway or dual carriageway. An energy efficient tyre will fare poorly if it is used on an ill-suited surface such as off-road. It is likely that the tyres will not generate a fuel saving, will lose grip and stability, and run the risk of being damaged by coarse surfaces, reducing their expected lifespan significantly.

Energy efficient tyres will not necessarily offer instant improvements. Tyres take time to be worn in and older tyres will have a lower rolling resistance than new tyres because they have a lower tread depth. Wearing reduces rolling resistance and thus improves MPG. Once the energy efficient tyres have been worn in, a larger improvement on the new tyre MPG should be realised.

All tyres can be re-grooved when they near the end of their life and energy efficient tyres are no exception. Tyres that are re-grooved have new tread pattern cut into them and so extend the tyres' useful life. As the tyre will already be worn in (see above), the rolling resistance of a re-grooved tyre will be significantly less than a new tyre, with industry manufacturer figures quoting between 30 to 40% less. Re-grooving a tyre does not compromise the safety standards of the tyre and is perfectly legal. Some manufacturers also offer a remoulding and retreading facility whereby an old tyre that has been worn down to its minimum tread depth is inspected and remoulded. New rubber is added to the casing of the tyre and, once completed the tyre is very similar to a new tyre. This remoulding and retreading procedure uses around 20 to 30% of the rubber that is required to make a new tyre. Remoulding and retreading is also typically cheaper than purchasing a new tyre as it does not involve buying a new tyre casing and uses less rubber. Retreaded tyres are also available in an energy efficient format. It is also more environmentally friendly as the casing is utilised for a longer period before being discarded.

8.3 Telematics System Trial

Following the completion of the telematics system trial from the end of January 2008 to the beginning of March 2008, the following recommendations can be made for the trial of telematics systems:

- Owing to the relative high cost of such systems, telematics systems should be targeted at vehicles with high fuel consumption in order to maximise savings and minimise the payback period.
- Telematics systems should be trialled as a fuel efficiency intervention, to ensure that any claimed savings by suppliers can be replicated in normal operating conditions.
- Telematics systems should be considered only in conjunction with a structured driver development programme. Fitting of the system alone will not result in fuel efficiency savings.
- Telematics systems should be fitted by supplier engineering teams when the vehicle is scheduled to be off the road, to ensure correct fit and coverage of the system under the supplier warranty terms.

8.4 Further Recommendations

- Follow-up research - further research should be carried out on the fleets examined in this trial, or alternative fleets conducting similar trials, over a longer timescale, to enable greater knowledge of how seasonal variations in fuel efficiency performance with and without the interventions can be counteracted by robust trial methodology.
- The Freight Best Practice Good Practice Guide, 'In-fleet Trials of Fuel Saving Interventions for Trucks', could usefully be completely revised to include additional detail on good practice for transport managers to adopt if considering an in-fleet trial of the broadest spectrum of fuel saving interventions. This will enable a standardised structured process to be followed to allow the most benefit to be realised from undertaking such a trial. This updated guide could highlight the advantages and disadvantages of different trial methods and be supported by case study material from this research and further research. This to be further supported with additional case study material on other latest fuel efficiency intervention in-fleet trials, for example, on double-deck trailer types or CVRS systems. Transport managers will then be able to use the guide to support the consideration and evaluation of the latest options that are available to improve the fuel efficiency of their fleets.