energy saving trust

Advising fuel efficient driving techniques for your fleet

Department for Transport

Introduction

Promoting an efficient driving style is often considered outside the traditional remit of the fleet manager, but the continued pressure on fleet budgets makes the case for this important area to be a priority.

Recent dramatic improvements in car and van official fuel consumption figures might suggest that vehicle technology is taking care of the issue. However, the data also shows an increasing divergence between the official figures and real world results. Efficient drivers can cut down or eliminate the disparity, which suggests that addressing driver behaviour is increasingly important.

Fuel efficient driving or ecodriving is about adopting driving techniques that maximise modern engines' efficiency. Using less fuel when driving also means that carbon emissions and air pollutants from vehicles are reduced. Ecodriving contributes to safety due to the strong focus on greater anticipation.

It is worth emphasising at the start of the journey that it is not about sacrificing performance and enjoyment for the sake of doing the right thing; it is about a more professional approach and becoming a better driver. Evidence shows that driving more efficiently does not necessarily increase journey times. Once drivers realise this, their conversations can turn from how quickly they completed a journey to what MPG they achieved, leading to financial and environmental benefits.

This guide aims to raise awareness about fuel efficient driving techniques and the benefits they can have for a fleet.

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Fuel efficient driving techniques

Core Tips The core tips **apply to most drivers most of time** and have a significant effect on fuel consumption.	
1. Drive smoothly	Anticipate situations and other road users as far ahead as possible to avoid unnecessary braking and acceleration. Maintain a greater distance from the vehicle in front so that you can regulate your speed when necessary without using the brakes.
2. Step off the accelerator	When slowing down or driving downhill, remain in gear but take your foot off the accelerator as early as possible. In most situations and for most vehicles this will activate the fuel cut-off switch, reducing fuel flow to virtually zero.
3. Shift up early	When accelerating shift to higher gear early, usually by around 2,000-2,500 revs per minute (RPM). Skip gears e.g. 3rd to 5th or 4th to 6th when appropriate.
4. Avoid excessive speed	High speeds greatly increase fuel consumption.

Other Tips	
5. Use air conditioning sparingly	All ancillary loads, but particularly air conditioning, add to fuel consumption.
6. Turn off/avoid idling	Turn off your engine if you expect to be stationary for more than a minute or so.
7. Reduce drag	Remove racks, roof boxes and bike carriers when not in use as they significantly increase air resistance and fuel consumption at higher speeds. Keep windows shut at high speed.
8. Avoid unnecessary weight	Avoid carrying dead weight as anything that adds to the weight of a vehicle will increase fuel consumption.
9. Maintenance	Service your vehicles regularly (according to manufacturers' advice) to maintain engine efficiency. Make sure you use the right specification of engine oil. Check tyre pressures regularly and before long journeys; under-inflated tyres create more rolling resistance and so use more fuel.

Principles and evidence behind the techniques

1. Drive smoothly
In urban driving, greater anticipation to avoid unnecessary acceleration and braking is probably the single most important technique. This is no surprise if you consider the basic physics behind the motion of a vehicle.

Energy is required for two main reasons: to accelerate the vehicle and to overcome air resistance. Much smaller amounts are also required to overcome friction, gain height when driving uphill and run the ancillary loads. Air resistance is fairly negligible at low speeds – see further discussion below under 'Avoid excessive speed' – which means in typical urban driving the vast majority of fuel is used for acceleration.

2. Step off the accelerator
When driving downhill or slowing down, a modern vehicle will usually use less fuel if you remain in gear but take your foot off the accelerator, than if you 'coast' in neutral. This is because it is intelligent enough to recognise that the momentum of the vehicle is driving the engine, rather than the normal situation when the reverse is true. The response is for the fuel cut-off switch to operate, stopping the flow of fuel to the injectors. In contrast the vehicle coasting in neutral would still be burning some fuel to keep the engine ticking over. This does not hold at low revs when the fuel cut-off switch no longer operates and most engines will instead inject enough fuel to prevent a stall even if the accelerator is not depressed.

Many European organisations[1] involved with fuel efficient driving advocate rolling or coasting in neutral at low speeds when the fuel cut-off would have ceased to operate, but this is contrary to the Highway Code in the UK.

3. Shift up early
Driving with high or even medium engine RPM consumes more fuel then driving at low RPM at a given speed. Therefore, early shifting is recommended. Research into the effect of the use of gears on fuel consumption shows that both petrol and diesel cars shifting up at low RPM and 50% accelerator position result in the lowest fuel consumption[2].

4. Avoid excessive speed
Air resistance or drag increases by the square of a vehicle's speed. This means whenever speed is doubled air resistance increases by a factor of four, so relatively small increases in speed add significantly to fuel consumption[2].

Data on the effects of speed on fuel consumption for different vehicle types is available from the Department for Transport[3] (DfT) based on work carried out by the Transport Research Laboratory in 2009. The table on the next page gives extracts of the DfT data, also converted to miles per gallon (MPG), and shows that for a typical modern car fuel consumption increases by around 14.9% between 60 and 75mph. For a typical large van (>1,760kg) the increase in fuel consumption is even higher; 27% between 60 and 75mph. It is perhaps not surprising that an increasing number of vans are being fitted with speed limiters.

1 Including the German Road Safety Council (DVR), The Austrian Energy Agency (AEA) and SenterNovem in the Netherlands
2 "The effects of a range of measures to reduce the tailpipe emissions &/or the fuel consumption of modern passenger cars on petrol and diesel"; TNO 2006
3 http://webarchive.nationalarchives.gov.uk/20121107103953/http://www.dft.gov.uk/pgr/roads/environment/emissions/viewer.xls

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	60mph	75mph	Increase in fuel consumption (%)
Petrol car[4] fuel economy (mpg)	51.4	44.8	12.8%
Diesel car[5] fuel economy (mpg)	71.0	58.4	17.7%
Car[6] fuel economy (mpg)	59.6	50.7	14.9%
Large diesel van[7] fuel economy (mpg)	28.2	20.6	27.0%

Fuel consumption data from TRL 2009, downloaded from www.dft.gov.uk/pgr/roads/environment/emissions/viewer.xls

4 Petrol car, 1400-2000cc, Euro 5
5 Diesel car, 1400-2000cc, Euro 5
6 Simple un-weighted average of petrol & diesel car figures
7 Diesel Light Commercial Vehicle, Category N1 (III) i.e. >1760 tonnes, all emissions standards

5. Use air conditioning sparingly

Air conditioning (a/c) systems use heat pumps to pump a fluid around a circuit. The fluid is caused to evaporate in one part of the circuit (taking in heat) and condense in another part (losing heat). With vehicle a/c, the fluid evaporates at a point that removes heat from the vehicle and condenses at a point where the heat is released outside the vehicle. The compressor that drives the movement of this fluid is powered by the vehicle engine, increasing fuel consumption.

Research from ADEME[8], France found that over the standard European test cycle (NEDC) and with ambient temperature set at 30°C, cars with their a/c systems working at their maximum capacity consumed around 25% more fuel than when their a/c systems were turned off. Perhaps a more useful statistic from the same paper was that over the course of a year, cars with a/c typically use around 5% more fuel than the same models without a/c. The advice to 'use a/c sparingly' is a pragmatic recognition that most drivers would not be prepared to stop using their a/c completely, but many could reduce use with little or no sacrifice to comfort, for example by setting the climate control a degree or two higher.

6. Turn off/avoid idling

Research suggests that for both petrol and diesel cars the CO_2 emissions (and therefore fuel consumption) from idling "are substantial and so high compared to the restart emissions, that stopping the engine almost directly (after no more than 10-20 seconds) leads to a benefit". For diesel cars the same was true for nitrogen oxides (NOx) and particulate matter (PM), the air pollutants that are most damaging to human health in urban areas.

The advice to "turn off if you expect to be stationary for more than a minute or so" again seeks to take a pragmatic line by recognising that most drivers would find it impractical or irritating to turn their engines off every time they expected to be stationary for 10-20 seconds. Of course simplified advice like this is just a guideline and in one-to-one training a good ecodriving instructor will take account of many factors.

7. Reduce drag

At motorway speeds most of an engine's output is used to overcome air resistance. Given the lengths that manufacturers go to ensure that even details such as door handles and badges do not adversely affect a vehicle's aerodynamics, it is no surprise that a roof rack or box, set of ladders or even just roof bars will significantly increase air resistance and fuel consumption. Anything that affects a vehicle's aerodynamics, even just an open window, will significantly increase fuel consumption at higher speeds.

At low speeds, however, aerodynamics has little effect. For most urban driving, perhaps up to around 30mph, it is usually more efficient to open the windows than use the a/c but at higher speeds the reverse is true.

8 "Automobile Air-Conditioning, its Energy & Environmental Impact", S Barbusse and L Gagnepain, ADEME, 2003

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8. Lose weight

Carrying unnecessary weight in a vehicle increases the power and therefore fuel required for acceleration. However this point can be overstated. In May 2010 a consortium led by AEA Technologies including Ricardo published a report into research[9] that had measured fuel consumption over the NEDC test cycle for a series of vans at their Gross Vehicle Weight (i.e. fully laden) and their Reference Weight (i.e. unladen). The average increase in fuel consumption when fully laden was only 7.8% even though the load typically added around 50% to the total mass.

It therefore seems reasonable to conclude that the amount of weight most vehicles might realistically carry unnecessarily would usually have only a small effect on fuel consumption. One caveat is that the NEDC cycle contains only gentle acceleration and in duty cycles with more stop-start and faster acceleration we would expect weight to have more effect on fuel consumption.

Nevertheless, compared to the previous point about aerodynamics, the fuel consumption penalty for driving with unnecessary weight is likely to be much smaller than the penalty for driving at medium to high speeds with a rack, ladder or box attached.

9. Maintenance

Tyres are flexible and flatten at the bottom where they are in contact with the road. This means the shape of a tyre is constantly changing as it rotates and a different section comes into contact with the road. This process, which is exacerbated in an underinflated tyre, creates friction and heat and increases rolling resistance.

According to Michelin research from 2015, 62% of cars on the road ran on underinflated tyres and 37% had at least one tyre classed as either ''dangerously" or "very dangerously" (more than 14psi - 0.97 bar) underinflated. The company also calculated that UK motorists could be wasting £246 million a year running cars with underinflated tyres[10]. Establishing processes and checks to ensure tyres are correctly maintained is an important efficiency and safety issue.

9 Light Goods Vehicles – CO2 Emissions Study: Final Report, AEA Technology, February 2010
10 Michelin 2011 "UK motorists put lives at risk and waste £246 million on fuel" press release

Case Study: Carlsberg

Background
Carlsberg UK runs a fleet of 296 vehicles, covering over 8.5 million miles every year and delivering to around 13,000 accounts every week. Carlsberg's environmental policy underlines the importance of sustainability and continuous improvement in every aspect of business operation. Logistics contributes significantly to Carlsberg's emissions therefore the company wanted to reduce the fuel cost and emissions generated by their vehicles, all of which are 7.5 tonnes or above, mostly 26 tonne rigid trucks.

Measures implemented
Energy Saving Trust conducted a Green Fleet Review for Carlsberg in 2007 which identified a number of areas for improvement in Carlsberg's fleet including, vehicle choice, mileage management and driver performance. To bring about a more sustainable fleet, Carlsberg ultimately implemented the following initiatives:

- Microlise, a telematics system which monitors and ranks drivers' performance on a daily basis providing an overall efficiency rating for to each driver and detailed feedback on how to improve performance
- Prioritising driver engagement and empowering drivers to improve their performance. Telematics reports, used in conjunction with driver de-briefing, education and training, encourage drivers to reduce over-revving, harsh braking and speeding violations and eliminate unnecessary idling
- Carlsberg are an accredited supplier of driver Certificate of Professional Competence (CPC) courses employing logistic support trainers to provide this training, which includes ecodriving courses. Carlsberg drivers average five days of this training every year: far more than both the legal requirement and the industry average.

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The results
Carlsberg has made incredible progress in promoting ecodriving since Energy Saving Trust first conducted their Green Fleet Review back in 2007. Carlsberg has saved 502,549 litres of fuel, £568,687 and 1,346 tonnes of CO2 since 2011.

Carlsberg are also at the forefront of accident reduction. The company has reduced and held their insurance premiums for the last three years, reducing their loss ratio (a measure of the average cost of accidents per vehicle) from 68% to 51%.

Carlsberg's efforts were recognised by Energy Saving Trust in 2015 when they won the Ecodriving category of the Energy Saving Trust Fleet Hero Awards.

The benefits of fuel efficient driving

Lower Fuel Consumption and CO_2 emissions
By reducing fuel consumption, fuel efficient driving saves money and reduces CO_2 emissions. The scale of savings depends on details such as the vehicles you operate, the duties they perform, and most importantly how your drivers currently drive. As a rule of thumb the techniques outlined in this guide, if applied thoroughly and consistently, might save an average of around 15% and a realistic long term goal for a fleet might be between 3 - 6%. These long term savings will depend on fleet policies and management and are discussed further under "Ensuring the Benefits Stick".

Energy Saving Trust has subsidised training for nearly 50,000 drivers in England and Scotland. On the day of training, drivers see an average of around 14% reduction in fuel consumption, though over time those benefits reduce.

For a given fuel, CO_2 emissions are proportional to fuel consumption, so any reduction in fuel consumption will give the same percentage reduction in CO_2. Whilst most organisations' involvement with fuel efficient driving stems primarily from a desire to reduce costs, many forward-thinking organisations are also interested in the environmental, corporate social responsibility (CSR) and PR benefits of shrinking their corporate carbon footprint.

Financial Benefits
For fleets using fuel cards or bunkered fuel, the financial benefits from lower fuel consumption are clear. However, fleets that pay Advisory Fuel Rates (AFRs) or other fixed mileage rates can also benefit if ecodriving is promoted in conjunction with lower mileage rates – or at least used to help resist calls for higher rates.

Safety
Fuel efficient driving brings safety benefits due to the focus on greater anticipation and avoidance of excessive speed. The link between the two is widely acknowledged throughout the driver training industry.

A documented example of fuel efficient driving training leading to lower accident rates is Carlsberg UK which managed to reduce and hold their insurance premiums for the last three years, reducing their loss ratio from 68% to 51%. This improvement was attributed to a combination of the introduction of a telematics system and of a system of driver profiling, education and training.

Service, Maintenance and Repair
Fuel efficient driving's smooth driving style, with less acceleration and braking, reduces vehicle maintenance costs through less wear and tear on components including brakes, clutches and tyres. Vehicles with variable service intervals are likely to be able to travel greater distances between services.

Vehicles with diesel particulate filters (DPFs) that perform predominantly low speed light duties are sometimes reported to suffer from problems regenerating their DPFs. This can be exacerbated by ecodriving due to the emphasis on gear changes at low revs.

However, it only takes an occasional short run at higher engine speeds (not necessarily higher vehicle speeds) to generate the heat required for the regeneration. Where these vehicles are fitted with a warning light that DPF generation is taking place, drivers should comply with the instructions provided in the vehicle's handbook to minimise the possibility of damage resulting from blocked DPF filters.

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Options for promoting fuel efficient driving

On-the road training with a suitably qualified and experienced trainer is an effective way to promote fuel efficient driving. Training can be carried out as a stand-alone short-duration session, or fuel efficient driving messages can be incorporated into longer training that perhaps focuses primarily on safety.

In-car technologies especially those giving drivers instant feedback on their driving are also effective and are available from telematics companies, sat nav providers and in some cases from vehicle manufacturers themselves.

Telematics provide accurate mileage management and can report on the fuel economy of specific vehicles which can help fleets to achieve significant reductions in fuel use and emissions. By having more accurate, vehicle-specific data, a company can quickly identify where action needs to be taken, such as providing driver training.

Driver training and in-car technologies naturally complement each other since the training provides drivers with a good understanding of fuel efficient driving techniques, while the technologies provide ongoing reminders and feedback encouraging drivers to use and further develop their fuel efficient driving skills.

Online fuel efficient driving courses are often used to show both new and experienced drivers how to safely save on fuel and vehicle maintenance costs. The advantage of this learning method is that it can be less time consuming and well-suited to organisations' needs. However, the efficiency of this method and the extent to which benefits are realised are not well documented.

Ecodriving information, whether it is printed, electronic, or delivered verbally, is a useful way to remind drivers of what they have already learned and might work as a stand-alone means of communicating information such as the effects of tyre pressures or speed. However, it is no substitute for training when it comes to the key skills of anticipation and using gears efficiently.

Case Study: Drive DeVilbiss Healthcare

Background
Drive DeVilbiss Healthcare Ltd is a market leading supplier of medical products, medical equipment, hospital beds and moving and handling solutions to the NHS, community and nursing home sectors. Drive DeVilbiss Healthcare runs a fleet of over 100 vehicles based out of service centres across the country and the company fleet recently doubled in size.

Measures implemented
Drive DeVilbiss Healthcare identified that transport and logistics represented a major area for improvement and the Energy Saving Trust was engaged to undertake a fleet review to identify how to reduce both carbon footprint and costs, while improving safety.

- The company fleet manager now trains all new company vehicle drivers in environmental driving techniques during their induction and over 100 company and private vehicle drivers have been trained by the Energy Saving Trust's Ecodriving Scheme. A driver handbook has also been introduced, and is regularly assessed and updated
- Vehicle monitoring systems and speed limiting devices have been installed in all vehicles, collecting data on mileage and individual driver performance. The lowest performing 10% of drivers are identified each month and provided with training and guidance to help improve their performance
- Service Centres are strategically located around the UK and the Operations Team plan delivery routes to ensure that delivery vehicles are economically loaded and routed to minimise mileage. Fuel card usage and vehicle maintenance and also repair costs are closely monitored to help further reduce costs
- Vehicle maintenance and also repair costs are now more closely renewed to ensure efficiency and identify areas for improvement.

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The results

Energy Saving Trust's fleet review and Drive DeVilbiss Healthcare's commitment to improved transport and logistics management have brought about a number of impressive results including:

- Average MPG increasing from 23.43 to 33.77 per vehicle since 2012, through better driving practises and the use of more efficient vehicles
- Fuel use reduction from 3,960 litres/vehicle to 3,145 litres/vehicle in 2015
- A CO2e per vehicle reduction, from 10.66 in 2011 to 8.40 tonnes per vehicle in 2015
- Vehicles progressively replaced with more efficient Euro 6 compliant vehicles.

Drive DeVilbiss Healthcare's efforts were recognised at the Energy Saving Trust's Fleet Hero Awards 2014 where they won the Eco-driving category.

Ensuring the benefits stick

However fuel efficient driving is promoted, what matters is ensuring the benefits last. 15% is the typical reduction in fuel consumption that most fleet drivers could achieve immediately after training, but what they actually achieve will depend largely on the following key factors:

1. How drivers pay for their private fuel use
If company car drivers with fuel cards pay the cost of their private mileage as the appropriate proportion of their actual fuel costs, then they will have a personal financial incentive to drive efficiently for all their mileage, business and private. In contrast, the more common system in which private mileage is repaid as a fixed 'pence per mile' provides no such incentive.

2. Effective fleet management
A well-managed fleet might also implement a range of other measures such as periodically providing drivers with reminder information, producing fuel consumption league tables to encourage competition between drivers, offering incentives for the most efficient drivers and additional help and advice for the least efficient.

3. Incentive schemes
Incentive schemes to identify and reward the most efficient drivers can be an inexpensive and effective way to promote fuel efficient driving. Examples include awarding cash or vouchers to the most efficient drivers and funding monthly social events for the most efficient team.

4. Engagement with drivers
Fleet managers should engage with the worst drivers and find out why they are using more fuel than their peers. It might be due to mechanical problems or due to different duty cycles such as more stopping and starting or heavier loads. Help, advice, information and appealing to a driver's pride in his or her work are often more effective than disciplinary action.

Onroad training and in-car technologies complement each other well. Training can be very effective but suffers from fade, and the on-going presence and feedback from technology can help ensure the benefits stick.

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Driving an electric vehicle – conquering range anxiety

Anticipation and maintaining momentum are driving skills transferrable to ultra low emission vehicles (ULEVs), such as electric vehicles, helping to conserve energy and therefore range. The driving experience of the latest generation of electric cars and vans is very similar to that of an automatic conventional vehicle. However, there are important differences which once understood and practised can increase range by around 20%. For more information on how to extend range for ULEVs see the Energy Saving Trust's best practice guide for ULEV Driving.

Next steps

This guide offered an overview of fuel efficient driving techniques fleets should adopt to ensure fuel consumption and therefore fuel cost is reduced.

To discuss your driver training visit the Energy Saving Trust website to find out more information or contact us at ecodriving@est.org.uk

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