INFORMATION GUIDE NO. 3

# FUEL EFFICIENCY TECHNOLOGIES

## 1 INTRODUCTION

EcoStation is a joint initiative of the Victorian Environment Protection Authority (EPA) and the Victorian Transport Association (VTA) designed to reduce greenhouse emissions and air pollution from the road freight sector.

A key aim of EcoStation is to promote a sharing of information about the practical actions that can be taken by industry stakeholders to improve the fuel efficiency of road freight operation and to reduce the emissions associated with these vehicles.

With this aim in mind, EcoStation is producing information sheets that will provide commercial vehicle operators with guidance on a number of potential improvement actions with a view to encouraging increased adoption of these programs by industry. This information guide discusses fuel efficiency technologies.

Fuel efficiency technologies are designed to reduce the power needed to run a vehicle and thus achieve optimum fuel efficiency for operation. The available fuel efficiency technologies are described below.

## 2 AERODYNAMICS

Aerodynamic drag can be reduced in heavy vehicles by fitting kits or devices that target areas where drag is most prevalent, such as the gap between cab and trailer, the gap between trailer and road, and the rear of the trailer at which parasitic drag occurs. These devices are commonly referred to as 'fairings'.

The higher the drag coefficient of a vehicle, the higher the energy losses, resulting in greater fuel consumption. Studies have indicated that over half of the energy consumption by a heavy vehicle at high speed is used to overcome aerodynamic drag. Therefore a reduction in aerodynamic drag will lead to significant fuel savings.

Aerodynamic additions to the cab are estimated to achieve a fuel economy benefit of 10–15%. Additionally, trailer modifications such as side skirtings can achieve fuel savings of over 6%.

Aerodynamic fairings are available on most new vehicles or they can be retrofitted to existing vehicles. The technology is most applicable to heavy vehicles, particularly in linehaul applications with a greater proportion of high speeds. The drag coefficient tends to increase from light commercial vehicles to buses, followed by rigid trucks and then articulated trucks.

Some truck operators have shown a resistance to fitting fairings on the basis that they are prone to damage and extend the size of an already large trailer. Skirtings aimed at reducing cab/trailer gaps may not be as relevant in the Australian road freight context, as the gap is traditionally far less here than overseas. Rear of trailer drag reduction add-ons would not be legal in Australia due to rear overhang limits and overall length limits.

Linfox, together with MaxiTRANS and Monash University, has investigated the benefits of aerodynamic truck and trailer technology. It was found that implementing aerodynamic technology in vehicles can reduce fuel consumption by 15%.

Linfox have produced an energy efficiency report which discusses the range of measures taken to improve fuel efficiency, and the results achieved.

http://www.lin\fox.com/~/media/Documents/PDF/2009%20Linfox%20Energy%20Efficiency%20Opportunities%20Reporting%20Public%20Report.ashx

## 3 AUTOMATED MANUAL TRANSMISSION

Automated manual transmission (AMT) is a system designed to ensure optimum gear shifting regimes during operational periods. The result is that the vehicle operates within the engine's peak torque area at all times.

Automated transmission systems offer potential fuel consumption and greenhouse gas emissions benefits by ensuring optimum gear shifting regimes during operational periods.

Improved transmissions can result in a reduction of fuel consumption in a range of 1–5%. Maintenance costs are also reduced via lessened clutch wear. Driveline shunt from poor clutch use can also be lessened, resulting in lower risk of component failures.

Conditions for AMT are optimal for vehicles which are subject to frequent gear changing, such as in urban operations.

The premium is likely to increase vehicle cost by anywhere from $2000–$8500, depending on truck and gearbox specification. Experience in the US has shown that the fuel savings can deliver an eighteen-month payback on the incremental cost of the AMT (Kilcarr 2008). However, the duty cycle of the vehicle should be considered, as regional linehaul applications (with reduced gear shifting) are not likely to experience such a payback period.

This trucking news article discusses the benefits, including fuel efficiency, of Volvo's automated transmission. Volvo claims its I-Shift transmission, the first to be equipped with this EcoRoll feature, saves 36 horsepower (27 kilowatts), providing a measurable fuel saving.

http://www.volvotrucks.com/SiteCollectionDocuments/VTNA_Tree/ILF/News%20and%20Events/PDF/volvoishiftTruckNews.pdf

While the test driver experienced an approximate 5% increase in fuel efficiency, the big advantage of AMT for heavy vehicles is consistency of fuel usage across different drivers in the fleet.

## 4 ENGINE EFFICIENCY MANAGEMENT SYSTEMS

Through the use of an intelligent controller that monitors an engine continuously, engine efficiency management systems tune the engine to specific parameters, adjusting performance to match the engine's work state. Some systems can be controlled remotely to ensure constant operational efficiency.

The system adjusts performance to match the engine's work state, resulting in optimum fuel efficiency. Currently this technology is under trial, but anecdotal evidence suggests vehicles will run smoother, using less fuel, demonstrating greater power when most needed, and showing less evidence of emissions in the exhaust.

The technology applies to a wide range of diesel systems and is well suited to Australia's existing heavy vehicle fleet. Some systems can also be controlled remotely if necessary to ensure constant operational efficiency.

These systems can be retrofitted to existing vehicles without affecting engine or vehicle warranties. Some manufacturers offer a free assessment to determine the likely benefits. Following the assessment, benefits will be backed up by a guarantee, reducing the uncertainty surrounding payback periods and performance.

Logan City Council is working with clean technology company, Peak 3, to measure and reduce its diesel emissions. The Fleet Services Manager has reported a smoother running vehicle that uses less fuel and demonstrates more power when needed. Full results of the trial have not yet been published.

## 5 LIGHTWEIGHT MATERIALS

Many truck components are typically made of heavy steel; however, the use of aluminium, metal alloys, metal matrix composites and other lightweight components can reduce tare weight. When manufactured with lightweight materials, prime mover weight can be reduced by over 500 kilograms, and trailers by over one tonne. This is an important consideration given that fuel consumption increases with vehicle weight.

Results have shown that with every 10% drop in truck weight, fuel use reduces between 5% and 10%. Total trips required can also be reduced by allowing for an increase in payload.

Lightweight materials benefit both light commercial and heavy vehicle operations, with modifications to trailers and trucks applicable to both. Lighter materials typically come at a cost premium to the operator, and payback is dependent on vehicle usage over the lifetime of ownership.

The following case study discuses the impressive fuel savings realised by a UK company with the use of lightweight materials in rigid truck design. The delivery fleet of MEMS UK realised a 22% increase in fuel efficiency through the use of lightweight rigid trucks. At a price premium of 1.5% over the standard model, the company experienced a two-year payback period for the technology.

www.freightbestpractice.org.uk/lightweight-truck-specification-generates-saings-for-mems -

## 6 REFRIGERATION

Small truck units are powered directly from the vehicle engine, while large truck and trailer units are powered by a stand-alone independent diesel generator. Stand-alone units can be replaced with newer, more efficient models, and there are alternative options for engine powered refrigeration such as grid charged hybrid electric and liquid nitrogen cooling technology.

The design, application and efficiency of the refrigeration unit has a significant impact on fuel consumption. Greater fuel efficiency and lower emissions are achieved simply by replacing old units with new, more efficient models. Alternative cooling systems claim to be less noisy, have lower maintenance costs (owing to fewer moving parts) and in some cases are emissions free.

This is a long-term and ongoing opportunity as and when stand-alone diesel generators and/or trailers are due to be replaced. Alternative cooling technologies are reaching commercialisation stage in Australia, but depend on the price of diesel generation relative to alternative technology.

The purchase of newer units and retrofitting can be expensive. However, the capital cost of refrigerated transport equipment may account for less than 50% of its whole-of-life cost when maintenance and other operating expenses are taken into account.

The following news release details the presentation of a nitrogen-powered refrigerated trailer by MaxiTRANS, and the potential economic carbon, and operational benefits that it brings. EcoFridge is a liquid nitrogen-powered refrigerated trailer, and is claimed to be the most advanced, silent running and emission-free unit for cost-effective temperature-controlled transport.

http://www.tandlnews.com.au/2010/04/08/article/MaxiTRANS-launches-ecoFridge-wins-award/ETRISRJNUN

## 7 TYRE TECHNOLOGY

The rolling resistance of a tyre is the amount of energy that is required to get a tyre moving, and to keep it moving. Low rolling resistance tyres are designed to minimise the amount of energy needed to move a tyre. The replacement of traditional dual tyres with one single wide tyre can reduce the rolling resistance and weight of the tyres and wheels, thereby reducing engine load.

An automated tyre inflation system installed on a truck trailer maintains optimum tyre pressure without the need to rely on driver maintenance practices.

If the amount of rolling resistance can be reduced, the amount of fuel required to move a vehicle will also be reduced. Incorrectly inflated tyres on truck trailers increase drag and increase fuel consumption.

Information from a range of real-world trials and manufacturers indicate a likely range of fuel savings from low rolling resistance tyres of 4–13% for heavy vehicles. The US EPA SmartWay program suggests a fuel saving of 4% with the implementation of single wide tyres. When using automatic tyre inflation systems, overseas manufacturers claim a fuel reduction of 2% and an increase in tyre life of 10%.

Low rolling resistance and single wide tyres are particularly suited to long-haul applications allowing for minimum resistance when driving at open throttle. The same applies for automatic tyre inflation systems. Single wide tyres can be applied to all tractor and trailer tyre positions except the steer tires.

There is a cost premium involved in low rolling resistance tyres. In the US, where the technology has been in the marketplace longer, the premium is estimated to be just 2%. Although fuel savings are immediately apparent, payback is dependent on initial fuel expenditure.

Alterations made in order to reduce the rolling resistance of a tyre will result in a reduced lifespan, and increase maintenance time and costs to the fleet. Although these costs are typically outweighed by the fuel savings, maintenance cycles and lifespan should be considered prior to adoption.

Savings on single wide tyres are expected to be achieved universally. However, since tyres are not paired some concern is expressed that the vehicle would be immobilised with the failure of one tyre.

If tyre inflation maintenance practices are presently optimal, it is unlikely that the automated system would realise a significant benefit, if at all.

### 7.1 REDUCED ROLLING RESISTANCE TYRES

This case study illustrates the fuel savings achieved with the use of reduced rolling resistance tyres in a heavy vehicle freight application. The UK haulier undertook a tyre trial assessing fuel consumption over 140,000 kilometres with two identical truck units, one with low rolling resistance tyres. Fuel savings of 13% were achieved over the course of the trial. The trial assumed that the energy efficient tyres would have a shorter life by one-third; however, even taking this into account, fuel cost savings outweighed the replacement tyre costs by over $4000 over a year.

www.freightbestpractice.org.uk/save-fuel-with-lower-rolling-resistance-tyres -

### 7.2 SINGLE WIDE TYRES

The following case study details the fuel savings achieved by a freight company installing super single tyres on its truck fleet. Roadmaster first trialled the replacement of dual tyres with super singles over twenty years ago. The haulier has found that the use of super single tyres reduces the rolling resistance and provides a tare weight benefit, which gives Roadmaster a fuel saving of approximately 8%.

http://sites.google.com/site/truckenvironmentalcentre/case-studies-roadmaster-and-simon

### 7.3 AUTOMATIC TYRE INFLATION SYSTEM

This website provides comments from fleets that have implemented one particular brand of an automatic tyre inflation system. Testimonials indicate that the majority of savings relate to lower maintenance costs; however, many operators do cite an increase in fuel economy and miles per gallon.

http://www.psi-atis.com/testimonials.htm

## 8 FURTHER INFORMATION

Further information about EcoStation, including program participation, can be obtained by contacting the EcoStation Project Manager on:

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