

# LPG'S KNIGHT IN

Alternate fuels have been talked about for years, but when Toll decided to adopt the technology, it was time to sit up and take notice.

So many uses of alternate fuels in recent years have been shrouded in the green cloak of environmentalism that it's been difficult to sort the genuine contenders from the Trading spin.

For all the protestations that road transport has an environmental conscience, the only uses of alternate fuels so far have been those enjoying an operational or efficiency edge.

So when an operation the size and stature of Toll subsidiary Refrigerated Roadways opted to use LPG in a linehaul operation, the ears naturally prick up. The company's healthy share price has been sustained by regular buyouts and lots of noises about its prowess in IT, certainly not its commitment to the environment.

And when there are reports from the equipment supplier of savings of up to eight cents per kilometre, one's left asking why the use of LPG in aiding the

combustion of diesel wasn't more widespread years ago.

Refrigerated Roadways has employed Truckgas to convert two Cummins N14 engines to operate on an LPG-diesel hybrid. The two prime movers do not operate solely on LPG but use the gas to aid in the more complete combustion of diesel.

The process, known as fumigation, is as old as the diesel itself - even the father of the engine, Rudolf Diesel, recognized that his compression-ignition design needed an aid to complete the combustion process. Because diesel is a relatively slow-burning fuel, considerable amounts of energy are lost in emissions as a result of the exhaust ports opening prior to the completion of the burn.

The process is worse under load, when more fuel is delivered to the chamber, and this is where fumigation by LPG accelerates combustion and reduces diesel consumption. Truckgas's locally built after-

market conversion works by injecting the international standard for LPG, HD5 propane, into the air inlet just prior to the turbo-charger. The propane enters the cylinder as an air and gas mixture after metering by a computer system employing a stepper motor to control the amount of gas entering the air inlet.

The ignition of the diesel under compression provides the spark for the propane which, having a higher flash point than diesel, speeds the burn rate of the diesel and provides more total combustion.

The proportion of propane to diesel varies from 18 to 23 per cent, depending on engine load. Sensors detecting throttle position and road speed dictate the timing and amount of substitution



# SHINING ARMOUR

## Computer regulated

The converted N14 engines use two computers - the Cummins CELECT original equipment, and a locally manufactured computer that regulates the timing and amount of gas. The trucks have had one of their diesel fuel tanks replaced with an LPG tank and, in one of the most surprising aspects of the conversion, have suffered no loss in range. There has been no change to the tare weights of either of the vehicles fully fuelled, because while the propane tank is heavy, propane is a lighter fuel.

Refrigerated Roadways operates both LPG-equipped prime movers out of its Arndell Park depot in outer Sydney. One is a K100G Kenworth pulling a B-double, while the other is a four-year old T601. At the time of *Truck Australia's* visit, Refrigerated Roadways' national linehaul manager, David Wright, explained that the bonneted Kenworth had clocked up just on 100,000km in six months with the Truckgas equipment fully operational. The K100G Aerodyne had done fewer kilometers in its two months of service.

"In fitting the equipment to a chassis, we chose one that had done a moderate mileage - 570,000km - rather than either a new truck or one which was getting older," he said.

"We've been running the bonneted truck between Sydney and Brisbane for five nights a week, 5000km, in that period."

He said the routine had been an excellent baseline on which to assess the truck's performance against that of a standard N14 Cummins.

In supporting the one-driver-per-truck principle for linehaul work, Mr. Wright said the regular driver initially voiced concern about the idea, "until he did a trip, and then he was convinced it was a goer".

Since then, no less than four drivers have tested the unit and all have agreed the system improves on-road performance. "We've received consistent feedback, stating they gain a half-gear on hills over the standard engine," he said.

"I drove the 42 tonne gross unit myself from Melbourne to Sydney during the initial setup trials and found the same thing. On that trip, a technician from Atlas rode in the cab and optimized the system's onboard computer as we traveled."

He said that to test the system's effectiveness during the trip, he switched the gas in and out when climbing some of the well-known gradients.

"It soon became clear that the difference could be felt. The boost was effective down as low as 1150 revs and up to 1400rpm," he said.

## Automatic shutoff

The computer is set up to shut off the gas supply to the intake when revs drop below 700rpm and when maximum revs are reached. Likewise, there's no point in feeding gas to the engine when the driver applies the brakes.

"It's a driver-friendly system - there's nothing in the cab he need be aware of other than a simple LPG fuel gauge and a system on-off switch on the dash - one of Kenworth's normal dash-panels switches," he said.



Above: Gas converter mounts on nearside of Cummins N14  
Left: Gas is injected (small hoses) into intake pipe before the turbocharger

**REFRIGERATED ROADWAYS AS AT FEB 2001**

**TRIAL RESULT SYDNEY TO MELBOURNE RETURN**

**KLMS PER TRIP RETURN 1780 KLM'S**

**NORMAL DIESEL USAGE 900 LTRS**

**KLM RATE FOR DIESEL PER LTR 64.2 CENTS**

**TOTAL DIESEL COST PER TRIP \$ 577.80**

**TEST RESULTS WITH CONVERSION SYSTEM IN OPERATION**

**KLM'S PER RRETURN TRIP 1780 KLM'S**

**AMOUNT OF DIESEL USED 572 LTRS**

**AMOUNT OF LPG USED 147 LTRS**

**TOTAL AMOUNT OF FUEL USED 719 LTRS**

**COST OF DIESEL AFTER REBATE 64.2 C/P/Lts**

**COST OF LPG HD5 AFTER REBATE 37 C/P/L**

**TOTAL COST OF DIESEL PER TRIP \$ 367.22**

**TOTAL COST OF LPG TRIP PER TRIP \$ 54.40**

**TOTAL COST OF COMBINED FUELS \$ 421.62**

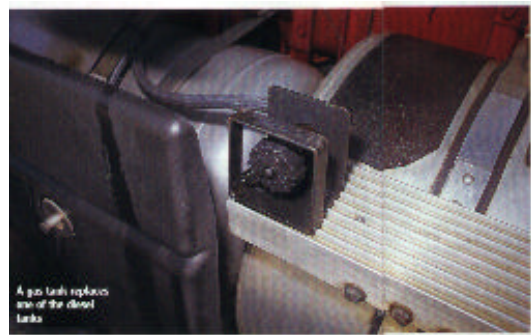
**TOTAL SAVINGS PER TRIP \$ 156.18**

**KLMS PER LITRECOMBINED FUELS 2.476**

**COST PER KLM OF DIESEL 32.46 CENTS**

**COST PER OF COMBINED FUELS 23.69 CENTS**

**SAVINGS PER KLM 8.77 CENTS**



“One thing our drivers have noted though, is that exhaust gas pyrometer readings are lower than on a conventional N14 engine running the same routes.”

The gas system is entirely failsafe - if there's a malfunction or the gas runs out - unlikely given Refrigerated Roadways' refueling schedule - the engine continues running in its diesel-only form. The driver doesn't have to do anything.

Mr. Wright said that prior to installation, the N14 was re-rated at 460hp to allow for the LPG-supplement to lift the power to around 495hp.

“The output is a good match to the driveline in this truck, which has a 13-speed Fuller and 4.1:1 diffs,” he said.

The initial installation comprised a single tank for the propane, replacing one of the four standard diesel tanks, but this will soon be replaced by a tank with a diameter similar to the diesel tanks. The gas tank on the Kenworth is refilled in the yard by a mobile delivery tanker from Elgas every second day, either in Sydney or Brisbane.

“You can see that one tank-load gets us up and back on this route,” he said.

“As well, we now refuel only two of the diesel tanks every second day.”

He said that Cummins engineers in Australia were positive about the conversion.

“We haven't changed the engine oil spec because of the LPG, and oil samples analyzed in conjunction with Truckgas have not indicated anything out of the ordinary,” he said.

**Electronic engine**

If these initial trials have been so positive, the question could be asked, why hasn't the system been applied sooner? And why haven't we heard about it being used overseas?

The key to the success of the current fumigation technology is the electronic engine.





Previous attempts at fumigation using mechanical engines foundered on the inability to measure and regulate the gas flow, resulting in overfuelling and poor performance, especially at idle. The advent of the electronic engine has allowed the gas to be injected at the optimum quantity at the optimum time, predominantly when the engine is under load.

As a result, the Truckgas conversion is intended for linehaul-applications, when the engine spends a considerable amount of its time under load. It is not especially suited to metropolitan applications, and in any event, the absence of electronic engines on a big slice of the metropolitan truck fleet nullifies many of the benefits of the conversion.

Mr. Wright understands that Australia is the first country to trial it in high horse power on-road running in order to save diesel fuel. Like many initiatives in road transport, perhaps it's another Australian first. If the conversion continues to recoup its costs through fuel savings, Refrigerated Roadways will consider trialling it on Detroit Diesel Series 60 engines.

"While the performance gains are good for the driver, this is not a speed-related issue," Mr. Wright concluded.

"We're mainly onto economy - while doing something to help the greenhouse problem," he said.

Truckgas Managing Director, Jim O'Pray, said the conversions, while relatively new to road transport, have been successful in the past in stationary engines, including big-bore Cummins KTA series engines in remote Australia. He said the cleaner combustion and reduced levels of soot in the oil had allowed oil change intervals in those engines to be extended from 250 hours to 400.

"The oil companies found, and their laboratories found, that they weren't contaminated. You could actually pull out the dipstick and read it, because it wasn't covered in black oil."

The only serious downsides to the use of LPG are the availability of the fuel and the breadth of the service backup. The truck will only operate on HD5, which must comprise at least 90 per cent propane. The conversion will not operate on the troublesome Automix, the erratic cocktail of propane and butane sold to the Australian motorist as LPG.

## Refueling obstacle

While the wider availability of propane through Elgas is underway, for the moment, roadside refueling is an obstacle.

The upside is that when the truck runs out of LPG, it can operate quite happily solely on diesel.

The conversion cost is about \$10,000 per truck, however under the Federal Government's program to encourage alternate fuel use, half the cost of conversion is subsidized. With savings of eight cents per kilometre, the initial outlay is recouped after about 65,000km.

Service-wise, while Truckgas has 105 gas fitters Australia-wide, only a dozen are trained in the maintenance of the computer. Mr. O'Pray assured *Truck Australia* that this number was on the increase.

Compressed natural gas, which could also be used in this type of technology, is a far cheaper fuel and is not linked to the price of crude oil like LPG. However, natural gas occupies five times as much space as LPG and must be stored at far higher pressures.

Mr. O'Pray said it was unlikely that sufficient natural gas could be stored on a linehaul prime mover to provide sufficient range.

"We can go 2000km on LPG without refueling - natural gas can't do that.

"The other advantage is that we don't need the compressor stations to get the gas to the right pressure to refuel," he said.

In addition, the higher pressure under which compressed natural gas operates requires the installation of more expensive stainless steel fittings, rather than the flexible lines used on the Truckgas conversion.

Mr. O'Pray said he was confident of attaining Euro 3 emissions standards prior to the end of the year.

Beyond that, however, the installation of a preheated catalytic converter would be required, because the exhaust gases from the fumigated engine were insufficient to activate the converter.

Any enquiries can be directed to Truckgas at Unit 4, 1440 New Cleveland Road, Capalaba in Brisbane. The telephone number is (07) 3245 4046, fax (07) 3245 4246 or on the toll free number 1800 999 937. E-mail sales@atlasgas.com

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