GOOD PRACTICE CASE STUDY 398

Fuel champion saves equivalent of 50 trailer loads of carbon dioxide a year

BOC Ltd

* Driver training saved £240, 000 in one year

* Optimising bulk storage saved £110,000

* Potential fuel saving of up to 4% by fitting aerodynamic kits

BEST PRACTICE PROGRAMME

ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

HOST ORGANISATION

I have been delighted with the focused professionalism that Mark Badkin has brought as our 'fuel champion'. Key to success has been the development of the wider team and the growing ownership of the subject at branch level. The driver trainers, vehicle technicians and the transport managers have provided the enthusiasm and commitment to enable the fuel savings to be made but the real challenge lies in making these changes stick permanently.
This is being achieved through the involvement and commitment from the whole gas division drivers' group and the many ideas generated by the depot teams, managers, technicians and drivers alike. It has been a pleasure to see so much achieved by so many working together successfully.

Simon Coney,
General Manager, Process Gas Solutions,
BOC

BOC is a global company based in the UK but with many manufacturing facilities in 60 countries around the world where it employs 43, 000 people Its main business is the supply of gases to around 2 million customers in 15 major market sectors, many in the automotive, chemicals, petroleum, electronics and semiconductor fabrication sectors

BACKGROUND

BOC prides itself on innovation, which it sees as vital to its future growth Now, the Company has applied this philosophy to its UK-based, bulk gas road vehicle operation, with exciting results

In the UK the BOC Group operates some 2, 000 large delivery vehicles Its Bulk Gas Delivery Vehicle section alone operates over 200 vehicles with an annual fuel spend of £5 5 million A fleet ot over 700 vehicles, delivering gas cylinders, consumes fuel worth a similar annual sum

The bulk gas delivery vehicles are specialist tank vehicles distributing oxygen, nitrogen, carbon dioxide carbon monoxide, hydrogen and argon

The trailer vessels, complete with discharge pumps, cost around £170, 000 and have a life expectancy of between 25 and 30 years When purchasing new bulk gas delivery tractors, BOC specifies fuel-efficient engines

Vessel pressures are below 3 bar (44 psi), but discharge pressure can be as high as 40 bar (580 psi) liquid nitrogen product temperatures touch minus 196°C The vehicles are therefore fitted with a range of special safety features and BOC is careful to select highly professional drivers to operate them The drivers are restricted to 1, 800 working hours per year in preparation for the Working Time Directive The Company is able to pick and choose the most skilled driver applicants

On joining the Company, all drivers undertake a three-week induction course and attend two yearly refresher-training courses Drivers are also encouraged to seek additional training sessions if management feels this is desirable

With 'state-of-the-art' vehicles and expert drivers, BOC might have thought that its fleet's efficiency could not be improved However, with the rising price of DERV and its influence on the fleet total running costs, BOC Senior Managers decided to set fuel saving targets for the Bulk Gas Delivery Fleet The BOC Board set the fleet a target of fuel savings worth £340, 000, which represented about 3% of the previous year's fuel costs Group Fleet Engineer, Mr Jon Ostle, and Operations Support Manager, Mr Mark Badkin, considered the task to be very challenging

With pump delivery pressures as high as 40 bar (580 psi), and liquid nitrogen temperatures down to minus 196°C, regular refresher training for drivers is essential

B0C 's bulk gas delivery trailer vessel', cost around £ 70, 000 and the tank vessels have a life expectancy of 25 to 30 years

Triscan's Kiss Key 'easy to use but not to abuse' fuel management system played a major role in collecting accurate information on vehicle mileage and fuel consumption.

SETTING AN ACCURATE METHOD OF RECORDING FUEL CONSUMPTION

BOC initially planned to establish fuel consumption benchmarks for specific vehicles and routes. The Company calculated each individual vehicle's fuel consumption, using data taken from its Cummins Road Relay onboard engine management system, and compared it with data generated by the BOC Triscan fuel dispenser equipment. The Triscan data proved to be unreliable because the driver and mileage data being fed in were frequently incorrect.

Triscan overcame the problem by providing dedicated driver and vehicle 'kiss keys'. The kiss key automatically identifies the driver and vehicle and downloads the vehicle mileage, removing the need for drivers to input data manually.

With the kiss keys in use, the data from the fuel dispensers matched that from the onboard engine management systems with a variation of just 0.1 mpg. Thus by continuously cross-checking Triscan and Cummins Road Relay data, BOC management had confidence in the fuel usage and mileage input data.

Once BOC was satisfied that it could monitor fuel consumption accurately, it turned its attention to setting achievable benchmarks for each vehicle and route.

Benchmarking fuel consumption

At the start of the project, the only information on fuel consumption that was readily available was that provided by the accounts department based on the fuel suppliers' invoices.

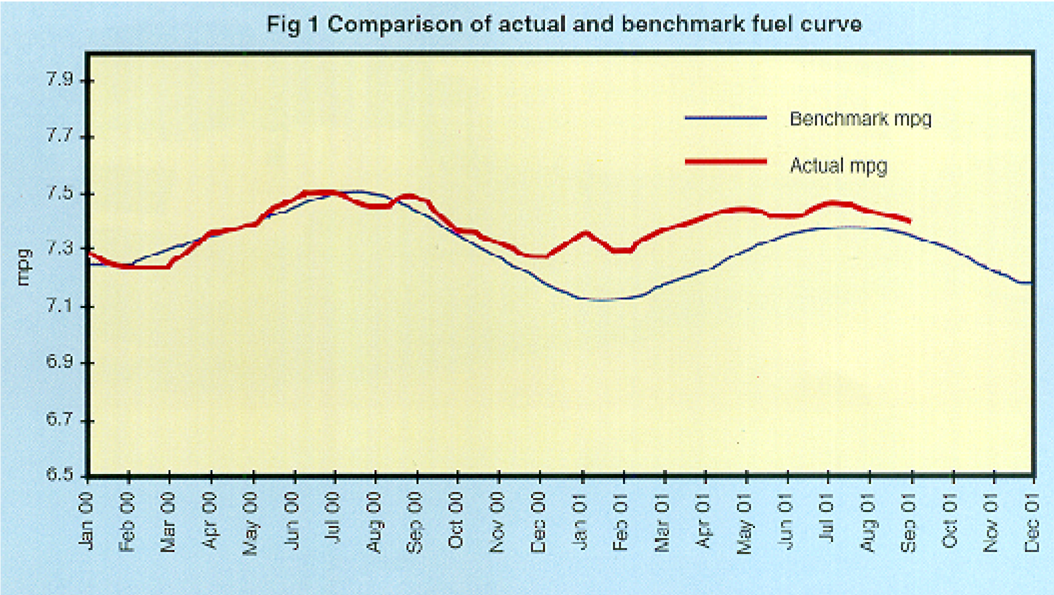
Even this basic information highlighted a seasonal effect on fuel consumption, ranging from 7.5 mpg during the summer months to almost 7 mpg in the winter.

This variation is illustrated below in Fig 1 against the actual 'average' fuel consumptions recorded at the time.

The reasons for the seasonal effect on fuel consumption are not always immediately obvious nor within the control of the driver or management; however, seasonal changes in the fuel specification appear to be a significant factor.

Petroleum companies tend to commence the delivery of 'winter grade' DERV in late September and to switch to the 'summer grade' in late March. The winter grade fuel has a cold filter plugging performance of -15°C, as opposed to the summer grade's -12°C, and this increases the fuel consumption.

Today, as a result of reliable and real time fuel consumption measurements becoming available, it is possible to produce a benchmark for specific routes by BOC branch/depot and by time of year.



GPCS 398 First published 01/02

FUEL SAVING STRATEGY

TRAINING

BOC invited driver trainers from vehicle manufacturer ERF and engine supplier Cummins to help establish benchmark fuel consumption figures and to demonstrate to the drivers what they could achieve without adversely affecting journey times.

This trial proved a very positive and successful exercise, particularly as these very professional trainers could, and did, demonstrate their lessons in practice on the road, allaying any scepticism the Company's drivers may have felt.

The next step was to select and train driver-trainers at each of BOC's depots, so that all drivers could be trained in the skills of fuel-efficient driving in addition to their normal schedule of safety training.

In the meantime Mark Badkin had been collecting and analysing data downloaded from the Cummins Road Relay onboard management system. He found that these data held the key to identifying the reasons why some drivers were far more efficient than others.

For example, a driver holding top gear for 87% of the distance and using cruise control for 89% of the journey would use 21% less fuel than a driver who was in top gear for 71% and in cruise control for 25% of the same route and driving the same vehicle. This is illustrated in Table 1.

Table 2 illustrates the fuel consumption benefits through the reduction of over-revving the engine.

Mark Badkin concluded that the best driving practice for fuel efficiency is to keep the Cummins engines' rpm below the 1, 700 'sweetspot' limit. Above this sweetspot, which was at the top of the green band, 'was like turning up the fuel tap', he said. The sweetspot is the optimal (minimum) Specific Fuel Consumption for a given engine power and speed.

Table 1 Fuel efficiency improvement of 21.4% through maximising use of top gear and cruise control

Fleet No.	Miles	Gallons	mpg	% distance in top gear	% distance using cruise control
4505	9560	1201	7.96	71	25
4505	9996	1035	9.66	87	89
Difference			1.7 (21%)	16	64

Source: Huddersfield University

Table 2 Fuel efficiencies through the reduction of over-reving

Fleet No	Engine Revs	Miles	Gallons	mpg
4547	Allowed to go above 1, 700rpm	12687	1515	8.4
4547	Kept below 1, 700 rpm	12942	1484	8.7
Difference				0.3 (3.5%)

Source: BOC

By managing the fuel consumption data effectively, BOC recognised that there was a tendency for some drivers' fuel efficiency performance to improve after training but then gradually drift back to their former driving pattern. This trend highlighted the potential benefits of regular on-the-job refresher training.

Downloaded daily, weekly and monthly reports were a positive aid to the depot managers in identifying which drivers would benefit from training. By publishing a weekly depot league table, BOC introduced an element of friendly competition among depots and a means for depot managers to gauge their team's performance against others.

The overall saving for the whole fleet as a result of driver training at the end of the first year was 4.3%, or 334, 000 litres of DERV worth £240, 000 during the period covered.

Operations Support Manager Mark Badkin has found it profitable to continue gathering and analysing fuel consumption data as a tool for continuous improvement.

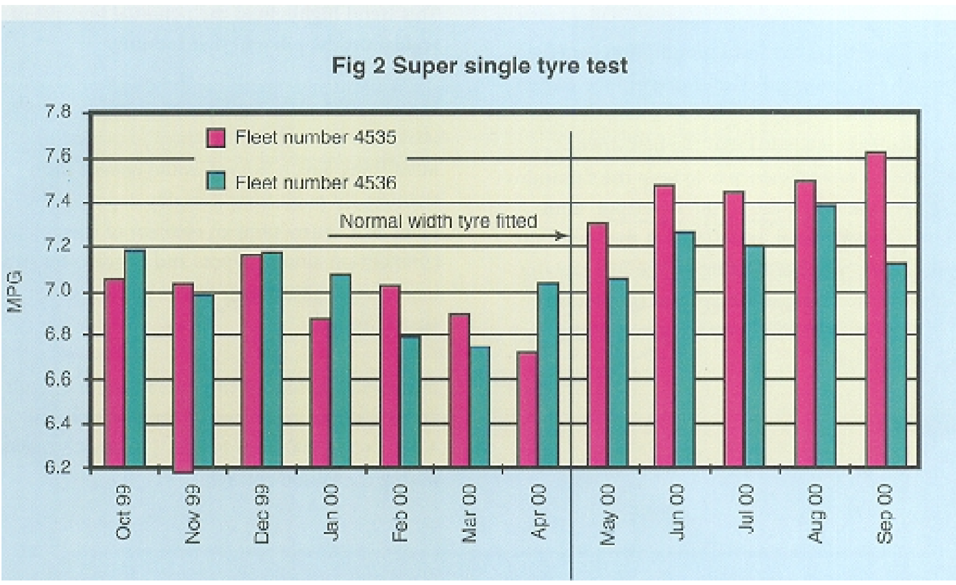
VALUE AND POWER OF ACCURATE REAL-TIME DATA

Mark Badkin has adopted the mantle of 'Fuel Champion' at BOC. He believes that optimum performance should be an upward moving target and individual vehicles and drivers' performance trends are as important as achieving set levels of performance.

With the benchmarks in place, and driver training and feedback under way, he found that by presenting the key fuel consumption monitoring data in the form of graphs, he could quickly identify exceptions or changes that could lead to further fuel savings. For example, one particular vehicle was identified as having a worse fuel consumption than comparable vehicles. Subsequent investigations revealed a faulty cut-out in the fan drive. This meant that the fan was continually drawing energy and fuel from the engine and it was increasing the time for the engine to reach its most fuel-efficient operating temperature.

Having high-quality data also meant that other fuel saving initiatives could be evaluated accurately.

Another good example of Mark Badkin's attention to detail was when he noticed that two new vehicles were struggling to meet their fuel consumption targets. He discovered that they were fitted with wide single tyres on the steer axle. By reverting to standard width tyres, fuel consumption was improved by an average of 0.51 mpg or 3.6%. Both vehicles have now bettered their route targets, and are providing an annual fuel saving of £1, 900 per year. The bar chart (Fig 2) not only shows the immediate improvement in fuel consumption after the standard width tyres were fitted; it also illustrates the power of a bar chart to demonstrate trends.



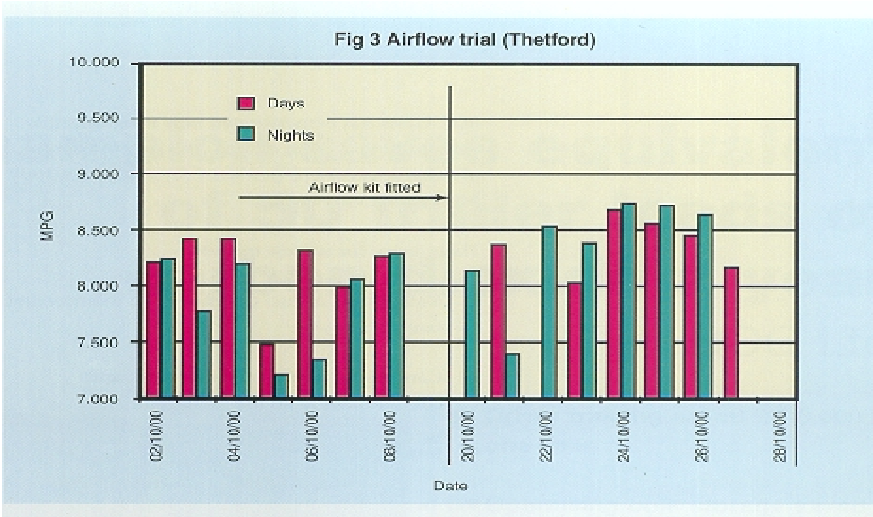
ECONOMICS AND OVERALL ASSESSMENT

AERODYNAMIC PROJECT

Having accurate, real-time data that could be used to spot trends quickly encouraged BOC to carry out an experiment to determine whether improving the aerodynamic efficiency of the ERF cab would prove cost-effective

An AB Air Flow Deflector kit was fitted to an ERF equipped with a sleeper cab which ran day and night on long distance, motorway trunking runs The vehicle was driven by the same four drivers and based at BOC's Thetford branch

The bar chart (Fig 3) illustrates not only a 4% improvement in fuel consumption of an already efficient 41 tonne vehicle, but also how the benefits are usually greater when the vehicle is running at night This is because of the longer period that the vehicle can run at the maximum regulated speed of 56 mph



All the data from the trial were carefully monitored by the Logistics Research Unit at Huddersfield University and indicate a 4% improvement in fuel consumption and a financial payback of five months

FUEL STOCK MANAGEMENT

Having exhausted all apparent ways of improving fuel consumption costs by improving driver training, BOC also turned its attention to optimising bulk fuel storage at its depots in order to achieve further financial savings

Working with its fuel supplier, BOC reduced or removed small fuel deliveries and load premiums This, combined with a programme of resizing their bulk storage tanks, yielded a one-off annual saving of £110, 000

EXHAUST EMMISSION REDUCTION

Based on just the 4 3% reduction in fuel consumed as the result of driver training, the following annual reductions in exhaust emissions have been calculated

Emmission	Annual Reduction
Nitrogen oxide	8,762 kilograms
Particulates	77 3 kilograms
Hydrocarbons	419 kilograms
Carbon monoxide	1,143 kilograms
Carbon dioxide	990 4 tonnes

The reduction in carbon dioxide can be best described in BOC Gases' terms as the equivalent of nearly 50 trailer vessels of gas payload The 4 3% reduction in fuel equates in BOC terms to 334, 000 litres of DERV saved, or the equivalent of 14 full fuel tankers.

Fitting the AB Air Flow Deflector kit to this already fuel-efficient vehicle demonstrated a 4% improvement in fuel consumption and a five-month financial payback

GPCS 398 First published 01/02

CONCLUSIONS

BOC Gases has demonstrated how it significantly reduced both its fleet energy costs produced, and the amount of exhaust emissions by applying a truly professional approach

Their recipe for success included

- Nominating a 'Fuel Champion' to monitor and target fuel usage
- Continuous support, involvement and commitment from top management
- Introduction of in-house driver trainers
- An accurate method of collecting real-time vehicle mileage and fuel data
- Setting up fuel consumption benchmarks for specific routes and vehicles
- On-board vehicle and driver performance monitoring
- Trip feedback to the driver and branch manager
- Publication of a weekly branch performance league table

Savings achieved through driver training amounted to £ 240, 000 or 4 3'%) of the annual fue bill with a three to six month payback Another £110, 000 was saved by optimising the bulk storage of fuel

Aerodynamic kits demonstrated a potential fuel saving of 4% on the selected routes with a five-month payback

Government's Energy Efficiency Best Practice Programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry, transport and buildings The information is disseminated through publications, videos and software, together with seminars, workshops and other events Publications within the Best Practice Programme are shown opposite

For further information visit our web site at www.energy-efficiency.gov.uk or

for buildings-related topics please
BRECSU
Building Research Establishment
Garston, Watford, WD2 7JR
Tel 01923664258
Fax 01923664787
E-mail brecsuenq@bre co uk

for industrial and transport topics please contact
ETSU
Harwell, Didcot, Oxfordshire,
0X11 OQJ
Fax 01235433066
Helpline Tel 0800585794
Helpline E-mail helpline@eebpp org

Energy Consumption Guides* compare energy use in specific processes operations plant and building types

Good Practice* promotes proven energy efficient techniques through Guides and Case Studies

New Practice: monitors first commercial applications of new energy efficiency measures

Future Practice, reports on joint R & D ventures into new energy efficiency measures

General Information* describes concepts and approaches yet to be fully established as good practice

Fuel Efficiency Booklets give detailed information on specific technologies and techniques

Energy Efficiency in Buildings: helps new energy managers understand the use and costs of heating lighting etc