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CAR

MECHANICS

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Freelander Survival Guide



All About Gearboxes

ALTERNATIVE FUELS SPECIAL

SAVE MONEY - LPG, BIO-FUEL, ELECTRIC & HYDROGEN!

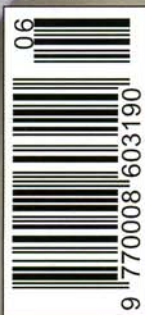


Honda CR-V Diagnostics

WIN see page 18
Clarke
2 AIR KITS
TO BE WON!



BMW 523i Project Car





Fuels of the Future!

LPG/CNG, bio, electric or hydrogen. Which will provide our transport-fuel in future? Iain Robertson investigates.

While CO₂ is essential for plants to create oxygen by means of photosynthesis, excess build-up can lead to a dilution of the ozone layer. Yet, CO₂ is not a pollutant, despite what today's politicians might argue.

According to Dr Bruno Pollet, a professor at Birmingham University, soon to be home to the greenest campus in the UK: "Many people confuse, understandably, carbon dioxide with carbon footprint. A lot of disinformation has emerged and, with the race to be eco-friendly, some important factors are being omitted from aspects of planning. What constitutes pollution is the amount of NO_x (oxides of Nitrogen) and SO_x (oxides of sulphur) emerging from vehicle exhaust pipes, which are lethal poisons and that rise disproportionately as CO₂ levels reduce, which is another issue altogether. However, nobody counted on the fact that we would reach a point at which natural resources would start to run out."

HYBRIDS

Both Toyota and Honda have committed substantially to developing hybrid transport; cars in which an electric 'assist' engine sits alongside an internal combustion (IC) unit and an on-board, self-charging battery pack acts as an additional fuel supply.

These sophisticated machines have led to developments by other major carmakers, such as Ford and GM, and the benefit of being able to run as a non-polluting electric vehicle, albeit for only short bursts, is outstanding. Increased mileage capability, enhanced performance relative to the cubic capacity of the engine and lower overall exhaust emissions are crucial factors in the hybrid success story. However, the uptake rate is slow and consumers feel confused, especially as the purveyors of the vehicles are sometimes unwilling to explain the technological issues coherently.

Yet, the missing component with hybrids is the use of non-fossil fuels. While it should be eminently possible to fire the internal combustion engine

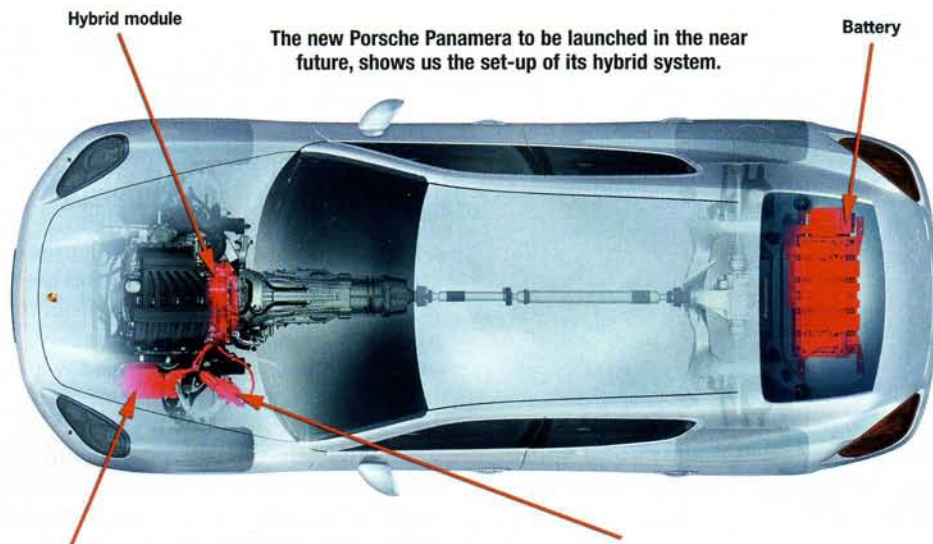
on crop-grown bio-fuels, either via bio-diesel or bio-ethanol/methanol, this class of hybrid is not yet available. Hybrids have also introduced another problem area, that of battery pack life-span and subsequent environmentally-friendly disposal.

The Nickel Metal Hydride (NiMH) type presently in production is not the easiest of packs to dispose of and recycling is very expensive, although the costs would reduce with broader applications and advancements in recycling technology.

At this stage, you might fairly wonder how these aspects are going to



Lexus hybrid GS450h. The electric motor works in harmony with the 3.5-litre V6 engine to produce power normally associated with a V8 and the economy of a 2.0-litre 4-cylinder.



The new Porsche Panamera to be launched in the future, shows us the set-up of its hybrid system.

Power electronics controlling the flow of electric current between the battery and the electric motor

Spindle actuator operating the disengagement clutch between the combustion engine and the electric motor

affect you, the typical *CM* reader. As hybrids have been available in the UK for six years in any quantity, many of them are already hitting the secondhand scene and are surprisingly affordable (early Priuses now start at under £4k at auction. *Ed.*). As a means to save money in operational terms, they are viable and battery packs are warranted for up to eight years and 100,000 miles, although I feel sure that they will remain viable for considerably longer periods of usage.

IT'S A GAS!

Equally, a lot of LPG-fuelled vehicles created by companies as varied as Prins and Tinleytech, whose well-proven hardware and conversion packages have been fitted to vehicles as diverse as Ford Mondeos, Range Rovers and Jaguars, are also appearing on used car pitches. Some sectors of the motor trade seem typically suspicious of these conversions, a feeling that probably goes back to the period when a large number of 'back street' garages were employed in fitting the kits to customers' vehicles. Unreliability issues did result. These, though, were simply a consequence of poor-quality kits and, in many cases, even worse quality installation. We've direct experience of several cars on which the LPG conversion has been carried out correctly, and none had any reliability or driveability issues at all. It's vital that a good quality kit is used, it is fitted properly, and the installation comes with a certificate confirming it is safe.

Richard Tinley of Tinleytech, an early exponent of gas conversions, agrees that the shoddy workmanship of some opportunists around five years ago did lead to subsequent resistance from consumers. "Yet our business has continued to grow year-on-year and only a couple of years ago did it show

any signs of tailing off," he highlights. "However, recent increases in pump fuel prices have sent even more customers to our door. We supply and fit only the latest equipment, which is capable of working effectively with modern-day fuel injection systems. The biggest issue is a lack of faith. We still have people saying to us that the government will increase taxes, which in real terms it has not in the past decade (increases have been in-line with normal pump fuel), and the rolling programme of subsidies, by means of not applying the full taxation element, remains firmly in place."

Aside from that, while availability seemed to improve gradually, many



Fitting an LPG kit will save you money at the pumps and currently exempts you from the London Congestion Charge fee.



No loss of luggage space for this Shogun as the tank is mounted under the rear floor!

outlets were small garages, open for a limited number of hours. These days, however, LPG has become more mainstream, with many chain petrol retailers installing an LPG pump and open 24 hours a day in some cases. Thanks to a concerted awareness campaign in the LPG industry, its future is looking more assured.

It is far more environmentally friendly to ship stocks of LPG from the north of Scotland for UK distribution than it is to import petrol and diesel supplies from Qatar, although the role of this fuel, when considering the usage of non-renewable fossil fuels, does have a finite limit. A litre of LPG costs around half the price of a litre of petrol, though a vehicle will use slightly more (typically 12-15%) gas. CO₂ and particulate emissions, however, are markedly lower, meaning that LPG gets favorable tax treatment and thus provides real cost savings.



A few major manufacturers have been offering dual-fuel models in their range of vehicles sold in the UK. Government grants were set-up so the initial purchaser could claim back some of the higher purchase cost.

CNG (compressed natural gas) takes all this one stage further; emission levels are negligible. It does, however, present some storage issues, and at present it's best used with diesel engines in large commercial vehicles. The fact that 'home-fill' units could be created, which would tap into domestic gas supplies, is a benefit that is yet to be explored effectively, although the technology, which has been available for the best part of a decade, can adopt some more up-to-date technological developments in the near future.

'Home-fill' technology is also available for LPG clients and companies such as Green Fuels, one of Europe's largest sellers of equipment, have been satisfying that requirement.

As a convenient bridging fuel between petrol or diesel and hydrogen fuel cells, LPG/CNG has a viable future that will save money and reduce the end-users' carbon footprints. As suggested earlier, increased confidence should lead to more users. At present it's thought that around 138,000 motorists in Britain use it. There's certainly scope for increase – not least because there's a massive surplus of the gases stored and being burnt off in Scotland. Far better that it's burnt in a way that uses it!

This is Tesla Motors' amazing all-electric sports car with a 0-60 time of 3.9 seconds, 13,000rpm redline, equivalent of 135mpg, 220 miles between charges and 3.5 hour charge time of its lithium-ion batteries. www.teslamotors.com



SHOCKING TALE

Of course, the use of electricity to power motor vehicles has been around almost since the dawn of the motorcar. However, unless it can be harnessed as it is in the self-charging system used by hybrids, too great a reliance on a supply from the National Grid, which is not nuclear-powered and relies too heavily on the relative inefficiencies of either gas or coal-firing, the electric vehicle (EV) becomes unviable.

While Scottish Power also hooks into the National Grid, its greater dependence on hydro-electric generation, by which stored water spins a large dynamo, can make electricity a



Modec produce electric vehicles of this size with over 100 mile range carrying 2 tonne payload from a single overnight charge. www.modec.co.uk

future proposition. The City of London, along with many world capitals, is committed to zero active pollution, and some forward-thinking councils have been installing roadside and car park plug-in facilities for recharging of G-Whiz, smart ed and the latest Think EV models. However, the battery hardware is heavy and only promises a finite life at this stage. Its ability to produce torque on demand is of vital importance to researchers in this field, but a lot of work needs to be carried out to increase both range and performance expectations.

Steam generation to power a series of electric motors is a distinct possibility, but the issues related to obtaining steam by non-fossil means are as consuming as those related to producing hydrogen for fuel cell vehicles. The Steamcar

Challenge is back on track for late-2008 and it is intended that its Land Speed Record attempts will place some focus in that direction.

BIO-DIVERSITY

Growing crops of future fuels is a possibility, but even the highest yield of around one tonne of bio-diesel requires a hectare of annually renewable crops, a factor that James Hygate of Green Fuels states "...is highly efficient, compared with the extraction of some other resources. However, our research has demonstrated that other methods of 'farming', such as with algae plants, will add to the diversity of available future technology". However, time must be allocated, even with nutrients being placed into the soil and genetically modified seeds being sown, for the earth to recover, which will demand one or more seasons of fallow farming and therefore non-productivity.

The farming of sugar beet in the UK may seem sensible, but the costs related to establishing a high-tech plant and the relatively inefficient yield, plus the corrosive qualities of the alcohol fuel that results make the future of bio-ethanol and bio-methanol seem fairly unrealistic. It is little wonder that the carmakers have to factor in an additional charge over the cost of their standard offerings, when they are line-converted to run on these fuels. New tanks, fuel lines and even an IC engine's

inner workings have to be considered, when bio-fuels are being injected.

The most logical route is to use waste vegetable oils, which may be sunflower, olive or soya bean based and, as long as they have been cleaned properly, they will operate quite satisfactorily in a conventional diesel engine. Scientist John Nicholson of Bio Power has been at the forefront of developments in this area, and feels strongly that the antipathy that has been shown towards him and his company's developments has been somewhat misdirected.

Having retrieved waste oils from their former applications in restaurants and fast food outlets, they pass through a cleansing and filtration process that removes any particulates, which can be burned in a closed-loop system to maximise their efficiency. John is vehemently opposed to current governmental thinking, which is biased towards a system that can be monitored, thus making it easier to prioritise revenue generation by means of taxation levies.

He states: "We are not against taxation but we have been proposing the use of waste oils to re-fuel motor vehicles that does not warrant the inclusion of fatty acid methyl ester (FAME), which is a transesterification process that is not only wasteful but highly inefficient. The 'preferred' process adds to Europe's growing glycerol lake, because it is a by-product of the chemical reaction. However, working with methanol as a catalyst has innumerable dangers attached, but its consideration means that it cannot be recovered or re-used, thereby negating its role.

"The government's insistence of all mineral diesel fuel containing a minimum proportion of FAME," he continues, "also increases the amounts of NOx emitted, which cannot be overcome by engine technology and adds to the environmental issue. Of course, the proposed method of using methanol as a methyl ester means that it has come from methane extracted from gas and oil wells, which means that the transesterification process takes a perfectly good non-fossil feedstock (vegetable oil) and

Last year Ford unveiled a green Focus Coupe-Cabriolet Concept.

continued on page 8 ▶





Supermarkets are now offering 'crop-grown' fuels, like BioEthanol and BioDiesel.

transforms it into a partly fossil fuel material, which contributes to the climate change issue!"

As a scientist, John knows what he is talking about and the proof lies in the vast numbers of diesel vehicles presently operating on old chip oil. As long as it has been properly prepared, no further modifications are required on an engine, although kits are available, complete with in-line filters, for the home-based fuel converter.

James Hygate of Green Fuels pinpointed the greater efficacy of alternative fuels. The core of the business is still commercial scale plants; however, since the government's allowance of 2,500 litres of bio-diesel duty-free, the company have seen a massive increase in sales of their domestic processors such as the FuelPod2, which can produce around 50 litres daily of bio-diesel from a cocktail of waste oil, new cooking oil and methanol. Green Fuels can also supply compact hydrogen units that work in tandem with normal IC engines and require only the addition of 2.5-litres of distilled water every 100 operating hours to work. Both items are priced at around the £2,500-2,600 level.

Another recent addition to this burgeoning market are Gemini Bio Fuels who have unveiled their Bio+ fuel. Claimed to be a pure bio-fuel, with no fossil blend, it's produced to EN14214 standard, thus making it recognised by car makers and can be used in any 1994-on diesel-engined car with no modification required.

Bio+ is also claimed to be able to clean and lubricate your engine better than conventional diesel, while your car is also said to deliver better fuel economy. These claims are actually related and true to some extent of all bio-diesels. They all clean carbon and other mineral-related debris from the system, resulting in better engine efficiency which in turn improves performance and economy and reduces emissions resulting from incomplete combustion. You'll probably need to renew the fuel filter shortly after switching an engine that's hitherto run on mineral diesel on to bio – all the gunge from the fuel system will be trapped there.

THE HYDROGEN ISSUE

Finally, the fuel type generating the most headlines over the past five to eight years has been hydrogen and the much-vaunted fuel cell vehicle. As mentioned earlier, Birmingham University intends to be the first all-green campus in the UK, having embarked on a process of research and development into hydrogen technology, among other processes that include algae, beet, cane and corn farming.

Dr Pollet continues: "We are starting to take the necessary steps to gear up towards a hydrogen and fuel cell infrastructure, so it is essential now that we begin to develop a supply chain of businesses, which can generate jobs and growth in these new technologies. Hydrogen-powered vehicles will help to create new working partnerships and to bring about a sense of cohesion among those already working in the industry."

British-based Microcab has produced a bespoke experimental vehicle for the university to use in its developments, and Air Products has installed a new hydrogen filling station on



The type of Hydrogen tank found in the back of a Microcab at Birmingham University.

the campus. Birmingham engineers will be comparing five hydrogen-powered vehicles with the University's own fleet of petrol, diesel and pure electric vehicles so that they can learn more about their efficiency and performance (which can be enhanced by the use of the latest super-capacitors). The researchers will determine how these vehicles need to be adapted in order to make hydrogen an attractive and cost-effective option as a future fuel.

Dr Waldemar Bujalski of the University's Fuel Cell Group states: "We fully appreciate the initial capital investment from Advantage West Midlands, which has enabled us to expand the scope of our long-standing activities in the hydrogen and fuel cell research areas. This investment was crucial for securing further funds from a variety of sources for establishing and maintaining the necessary manpower and resources to carry out this exciting research."

The research is part of the hydrogen energy project which has received funding from Regional Development

Agency Advantage West Midlands to develop the use of hydrogen energy as a green fuel in collaboration with the University of Warwick. The project has been approved as part of the Science City Initiative.

Naturally, the UK is still 10-15 years away from being able to consider hydrogen seriously as a fuel source, despite some exponents of the trade suggesting that it may happen sooner. The problem lies in a lack of refuelling infrastructure, an issue that will take years to resolve. However, you can rest assured that propulsion from 'cracking' water, the ultimate money-saver, is no longer a pipe-dream, even if water costs are sure to spiral upwards as a result.



The 2004 Audi A2-H2 concept car emits nothing but pure water vapour, yet offers performance similar to a petrol-powered A2.

CONCLUSIONS

While there are many billions of gallons of natural resources still to be extracted from inhospitable places such as the Russian Steppes and Afghanistan, using this finite resource as we are now is not the most sensible way forwards. As an interim fuel supply, LPG and CNG both have significant benefits and local stocks are readily available, while ready-converted and inexpensive kits are available from several trusted key suppliers.

Using old cooking oil is a tremendous method of bio-fuelling vehicles that involves both recycling and consuming a product that might otherwise be wasted. Incidentally, the much-publicised potential use of palm oil is largely politically-biased and not as viable as some sources might suggest. Electricity has its place, albeit limited and linked to tidal and wind power developments. That leaves hydrogen, which might just be a long-term future...

SOURCES:

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