

# THE NEW MEANING OF RACING GREEN

Think that politics have nothing to do with F1? Think again. The future of motorsport depends on it waking up to energy efficiency. By GEMMA BRIGGS



It's 2010. The oil fields of the Middle East burn as the latest Gulf conflict escalates. In Britain, fuel is rationed for all but key workers and the public transport network halves its timetables. A court in Brussels decides that Formula 1 is banned from visiting any race tracks in Europe until the situation improves, and for the first time in its 60-year history, the F1 world championship grinds to a halt.

Before you start thinking that we've been reading too much George Orwell, this isn't a scenario born of pure imagination. When FIA president Max Mosley raises the possibility that one day the sport may be put on hold by global politics, then you know it's time to listen. And it isn't just barrels of crude oil we're talking about here. It's CO2 emissions. It's hybrid engines. It's fuel made from turnips. Reckon we've gone mad? Then read on...

#### WHY TALK ABOUT 'GREEN' ISSUES?

Motorsport doesn't 'do' politics. Governments may come and go and wars may erupt, but – unless you count the internal politicking around engine freezes and Concorde Agreements – the sport carries on in its own soundproof bubble. It's entertainment, after all, isn't it? Yet consider two of the greatest issues in world politics today: conflict in the Middle East and global warming. The former influences the supply of oil; the latter demonstrates that we must cut down our consumption of that oil. Motorsport isn't going anywhere without fuel – and that's not just the race cars, but the team trucks and spectators' cars, too – and so these issues could potentially affect the entire strata of motorsport.

As one of the most important figures in racing, Mosley is a man to be listened to, and he believes that it's prudent for the sport to become environmentally aware. Speaking exclusively to Autosport (the full text is on page 37), he said, "I don't think motorsport would ever be outlawed as such. Where motor racing could be vulnerable is if there's an oil crisis of some sort, then there could be a major problem because politicians like something symbolic, something like F1, to show they're serious about economising on fuel.

"They might try to stop F1 for six months, for example, which would be completely stupid, but if we are working absolutely on the cutting edge of fuel efficiency and economy, it gives the friends that we have among politicians a very strong argument to protect racing."

If you're unconvinced that such an extreme reaction as putting F1 on ice for six months would ever occur, then there's an even more compelling reason why motorsport has to go green. That reason is global warming. Now that the majority of the world's leaders have recognised that carbon emissions must be cut, the automotive industry is under pressure and its influence will be the deciding factor in motorsport's adoption of alternative fuels and energy efficient technologies.

#### WHY SHOULD MOTORSPORT CARE?

The car manufacturers are the crutch of motorsport. If they aren't involved then the sport as we know it will collapse. One of the biggest issues facing these automotive giants right now is the need to cut the CO2 emissions of their products. Just last week Ford announced it would be investing £1 billion in R&D of green cars in the UK over the next six years. It's recognised the fact that going green is not a choice but an inevitability.

Ford and its contemporaries face a stiff task: not only must they spend billions on R&D, but they must convince the public to buy them. Richard Parry Jones, chief technical officer at Ford, believes motorsport can play a role in increasing awareness of bio-fuels, of which there is little public knowledge.

"If you started using it in motorsport, particularly in the higher echelons, it would get a lot of coverage," he told Autosport. "That would give the energy industry, as well as the car industry, the chance to explain it."

This is where the big opportunity comes in for motorsport. What better way to prove to the general public that 'clean' diesels, bio-fuelled or hybrid cars are just as powerful and exciting to drive as petrol ones than by proving it on the race track? Alan Gow, chairman of the MSA and boss of the BTCC, is one of many in the sport who points out that motorsport's actual contribution to global warming is tiny. He's backed up by that famous statistic that an entire F1 season uses less petrol on track than a single flight from London to New York. However, Gow agrees that such a fact doesn't mean that racing should rest on its laurels. Motorsport should set the agenda and bring in the changes.



**"IF THERE'S AN OIL CRISIS... THEY MIGHT STOP F1 FOR SIX MONTHS"**

**MAX MOSLEY**

#### OIL BE DAMNED

#### FOSSIL FUELS: RUNNING LOW



**FOSSILS. THEY'VE** been dead for millions of years, but still they haunt us. Humans, you see, have developed a tendency to burn them up to make their cars trundle around.

We're not just talking about prehistoric bat skeletons faintly etched into cave walls. Of far more relevance are coal, oil and some gas – all classified as fossil fuels. And what makes a fossil fuel a fossil fuel? It's derived from something that was once alive – and that means it contains carbon.

The biggest problem with burning fossil fuels is that the carbon (among other toxic pollutants) is released into the atmosphere. Although our planet's ecosystem recycles atmospheric carbon, the amount we're producing outweighs that recycling capacity. So an increasing amount of carbon dioxide is hovering up there, permitting thermal radiation from the sun to pass through but then preventing a lot of radiant heat from the earth's surface to pass back out.

The other issue with fossil fuels is that they run out. Well, not quite, but as our consumption increases we use up the existing resources more quickly. New sources will become increasingly hard (and therefore more costly) to find. That was hardly believable until the industrial revolution, but since then we've been gorging ourselves on fossil fuels and the results have been catastrophic.

Stop anybody in the street and they'll tell you that a lot of the world's misery has been caused by squabbles over oil resources – and that it's going to get worse since there are more and more of us here to use it up. And if they're not a motorsport fan they'll probably be of the opinion that our sport is notably profligate in its use of fossil fuels.

The best way to counter that is to point out that motorsport is leading the way in developing cleaner and more efficient technologies. It certainly needs to be seen to be doing so.

*Richard Asher*

"Motorsport has to influence technology, regardless of the environment," he says. "I do not agree that it's part of the problem, but it should be seen as part of the education."

As an analogy, Gow refers to the safety revolution that occurred in motorsport and filtered down into road car technology. "Years ago you could never sell safety as far as road cars went, it was not an important part of the buyer's decision," he says. "Just as safety became a sellable item in road cars, so can fuel efficiency." He also recalls the introduction of catalytic converters and unleaded fuel into the BTCC 15 years ago when they weren't standard on road-going cars. Now, who drives without them?

There's another reason why manufacturers will eventually introduce their green technologies into motorsport. Many racing and/or marketing divisions already struggle to justify their involvement in the sport. In a recent article in Ricardo's RQ magazine, Herb Fishel, former motorsport boss at GM, argued that if racing is to remain in automotive manufacturers' plans, it will have to change to remain relevant.

"Previous game-changers in racing such as aerodynamics, electronics, TV and tobacco sponsorship led to big shifts in attitudes and approaches," he said. "Now, race cars that meet and exceed fuel efficiency and air quality regulations, which

have provisions for alternative fuels, new energy sources and hybrid technologies have the power to create change in motorsports that is seismic, refreshing and profitable."

From the manufacturers' point of view, if you flip over the coin that says 'you must support green technologies', how will it look if they support non-green technologies during an oil crisis, for example? By introducing their R&D into motorsport, the level of involvement should be maintained, if not increase. This could be the time when *more* car builders enter the sport.

So, why is Autosport convinced that motorsport has to go green? Because there will never be a cure for global warming, because manufacturers will have to change, so the sport will change too. The real question, then, is *how* is it going to do it?

#### WHAT IS THE WAY FORWARD?

There are two routes in the quest to make motorsport green: alternative fuels and energy storage devices. When it comes to alternative fuels, there is no better example than the IRL. It's currently racing with a mix of 10 per cent ethanol and 90 per cent methanol, but from next year is going 100 per cent ethanol. Of all the countries in the world, you would not expect America – which has refused to sign up to the Kyoto Protocol – to lead the way by racing on fuel made from corn.

And yet the attractiveness of using a fuel from its homeland, rather than the Middle East, is clear to see.

"With the current awareness about fuel cost and foreign dependency in the US, the exposure that the IRL and the ethanol industry will receive makes the relationship very beneficial to both parties," says Jeff Horton, the IRL's Director of Engineering. "There probably is no better advertising platform for an alternative fuel than powering the cars that run the Indy 500." According to Horton, because ethanol and methanol are very close in chemical make-up, the switch to 100 per cent ethanol for 2007 is proving very easy and judging by the introduction of the 10 per cent mix, they're confident that there will be no change in speeds, sound or reliability. Ensuring that the cars sound as good as ever is crucial to getting green conversions right – it's worked in the IRL and the BTCC. And although Audi's R10 practically whispered around Le Mans, its petrol predecessor was hardly rorty.

Bio-fuels are now being considered for both F1 and WRC. Parry Jones believes that manufacturers will be supportive of the introduction, but a proper period of consultation is needed. He also suggests allowing fuel companies to showcase the diverse range of bio-fuels available. "Rather than restricting technical choice on bio-fuels, they could

encourage them to compete," he says. The other approach is for championships to allow alternative-fuelled cars to compete directly alongside conventional ones, exactly as the ACO has done (see page 40).

Diesels certainly don't have the reputation of being clean fuels. But Shell's V-Power Diesel, which Audi competed with at Le Mans and a version of which can be bought at the pumps, contains GTL, a synthetic 'gas to liquids' fuel that burns more cleanly than refinery oil.

"I think it's going to be one of the alternatives for the future," says Jack Jacometti, vice-president of GTL development at Shell. "If you look at conventional fuels, they will remain the mainstream for a very long time to come. But the synthetic fuels will play a very important part, alongside bio-fuels." By winning with a diesel car, Audi could help change the perception that diesels are slow, noisy and dirty.

Shell is active in linking R&D on alternative fuels and energy efficiency with the race track. "There are many solutions out there," says Mike Copson, technical motorsport manager at Shell. "With the ACO we are working with them on a proving ground for diesel fuel technology and development. In F1 we are talking about, with the FIA, the introduction of bio-fuels into F1 in 2008. For MotoGP there's discussion



or whatever. It would certainly be of interest technically."

Take-up of alternative fuels in racing is low, even when the regulations allow it. For example, there are no diesels competing in the WTCC although the rule book permits them. On a national scale, the MSA's blue book currently only allows competitors to run leaded, lead replacement (unleaded) and diesel, with a special dispensation needed for alternative fuels. From next year, however, it will recognise that bio-fuels exist and on application competitors will be able to use them. The main hurdle is that there is no government standard for new fuels and without this it is extremely difficult for the MSA to ensure a level playing field. Furthermore, it will take time to understand the performance advantages that alternative fuels may bring with their differing octane levels. This means that the introduction of alternative fuels is likely to be an evolution, rather than a revolution.

The same can be said of the technological advances that form the other path of introducing energy efficiency into motorsport. Engine technology, currently the subject of vigorous debate within F1, will have to change. The basic idea is to get maximum power from minimum fuel and the FIA wants manufacturers to find a way to do this with their F1 engines, without losing the sound and feel.

Automotive manufacturers are already researching how to use energy lost through heat, for example under braking and

from exhaust gases, and Mosley wants to see that technology in F1 too. He has discussed hybrid systems and raised the idea of a 'push to pass' button (see page 37).

**WILL ANY OF THIS EVER HAPPEN?**

There is clearly a need for a culture change within the industry. No-one is going to go on record saying that global warming isn't an issue or that petrol cars don't give out carbon dioxide. But at the same time, very few are willing to take the risk and mandate bio-fuels in their championship or introduce a hybrid racer into a field of conventional petrol-engined cars. Mosley wants change to come quickly – yet we found a cool response to his suggestions in the paddock at Magny-Cours. There may be some serious forward-thinking going on at board level, but it hasn't yet hit the ground.

"The basic idea of F1 becoming a vehicle for new ideas is a good one, but we have to be careful," says Norbert Haug, Mercedes-Benz motorsport boss. "The idea of energy recovery is a good one but I don't know yet if it's going to be workable. I have spoken to the people in our factories who are specialists on this and they say 'we'll think about it'. And these are the R&D guys who normally leap at any chance to try something new and spend some cash!"

This is a long-term issue, but the sooner that motorsport starts thinking about it, the better. There are some lobbying

bodies, such as Energy Efficient Motorsport (EEMS) and Green Motorsport, which has plans for an electric-powered kart series using renewable resources.

"Motorsport can be seen to be part of the environmental problem or seen to be part of the solution. We want it to be the latter," says Steve Bunkhull, project director of EEMS. "If we want a future for motorsport, we have to influence and lead the way on the development and use of alternative-fuelled engines and technologies."

The question is, who will decide to lead the way? Will it be teams, manufacturers or championships? Some people believe the ball is in the car companies' court. "The world's largest companies – automotive and fuel – will drive the market at the speed they want it to be driven at," says Chris Aylett, CEO of the UK's Motorsport Industry Association. "They'll either get their cars out quickly or slowly, get the gas stations to sell hydrogen quickly or slowly. If no-one makes a car... then nothing will happen."

It is true that the manufacturers have the power, and the need, to turn motorsport green. Yet there is also a responsibility for championship organisers to be open to change, to find a way of creating an equivalency for different fuels, and to encourage and allow the introduction of energy efficient technologies. And the teams? Well, motorsport engineers are the masters of efficiency, aren't they? ❑

**Q&A**  
**MAX MOSLEY**

**How important are green issues to Formula 1 and motorsport?**

Well, rather than talking about green technology, we should be talking about modern technology. That's fundamental to all our thinking on this issue. You can't have a full-on green formula where you say, for example: "Here's 50 litres of petrol and you have to do 180 miles with it. Go and do the best you can." That wouldn't be the sort of racing people want to see.

Focusing on engines, at the moment you are allowed 2.4 litres, and the more power you get out of that the better off you are. There's an enormous amount of money being spent trying to get more and more power. It can be done in many ways, but by far the fastest way is to increase the revs.

In terms of anything to do with the big wide world, that's completely pointless. Whereas if you had a formula in which the more power you could get from a given quantity of fuel, the better off you would be – or, put another way, you limit the power of the cars by fuel, or by energy, rather than by capacity – that would be rational, because that's what all manufacturers are trying to do with their road cars.

We're talking about fuel flow at the moment, but there are some very clever people out there working on fascinating things to do with heat recovery, using exhaust gases, etc, so we reckon it's up to them. At a rough schedule I would, say, introduce this in 2011, having stopped development on the existing engines. That gives us plenty of time.

**What would be the cost implications of energy-efficient technology?**

If the money spent in F1 is spent on basic research that's relevant it's less likely to be a problem. At the moment there are six manufacturers in F1 and the ones that are finishing sixth best are going to need a good reason to stay in. Developing energy-efficient technology helps justify their involvement.

If you went to any of the people outside the motor industry and offered them even a fraction of the money that's currently spent on F1 engine development, they would be able to up their rate of progress enormously. At the moment they are working in the hundreds-of-thousands-of-Euros-type budget, rather than the millions. With bigger budgets we could get the most spectacular leaps. And if we do, in the amount of energy that can be stored in a 20kg device and recovered, even if it's from only 10 per cent of what they are spending on engines, it would be massively worthwhile. It would come into road cars and have a huge effect.

**What would be the focus of the technological development?**

At the moment hybrid technology is relatively primitive. Most energy is lost to heat, and they can't charge the battery quickly.

The problem with current hybrids is that the batteries are very heavy, they take up a lot of room and they can only store energy at a very limited rate. In a conventional car, when you lift off you are still driving the engine and all the energy is going in heat.

Hybrids disconnect the engine and charge the battery, but still an enormous amount of energy is wasted. Even so, a hybrid road car like a Toyota Prius does 60mpg. It's nothing special on the open road, because it has to schlep around batteries and extra weight. That's where F1 comes in, because it will help drive development of making something very efficient and very light.

The more energy you can store, the greater the advantage for the teams that work out how to do it best. And of course, that's exactly what you want for a road car. Avoiding wasting energy is fundamental to all modern research by the big car companies.

Manufacturers are trying to develop super-capacitors and flywheel technology, too. There's a very good reason to believe that before long you'll be able to store all the energy from a two-ton car at 100 km/h [62 mph] as it stops at the traffic lights. Almost all of that energy can be stored and re-used for acceleration, or, in a high performance car, to add to the performance.

That's what we're talking about in F1: having energy stored in a 20kg device and giving the drivers a push-to-pass button that will use the stored energy for an overtaking boost.

All the research will go into storing max energy in minimum weight plus being able to absorb it and store and re-use it as quickly as possible – perhaps for a burst of energy down the straight.

With present technology we can probably store enough energy for 60bhp over nine seconds and it would take all lap to store that much. An F1 car, when it's braking on the limit, dissipates 2500bhp through the brakes. You can claim back only a small proportion of that, but if you say that now we could take 100bhp to use for six seconds, we'd soon get more than that.

If Toyota and BMW and Mercedes dedicate more research to it, then the effort and momentum would be completely different. The motivation of all the engineers would be different. At the moment we're struggling to get 200 extra rpm out of engines and instead they will be working on a new area of research.

Flywheel technology is another area that could produce great dividends for energy re-use. Benetton, McLaren and Williams were all looking at these systems about 10 years ago, but we brought in a rule to stop it, because of the cost and because we were alarmed about the possibility of having 4-500kj of energy suddenly let loose. Since then there has been an enormous amount of work on containment systems and that problem no longer exists.

As long as it doesn't dissipate its energy explosively, it's okay. If you let it go all at once it's like dynamite, but there are systems now to stop this happening.

For me this area doesn't even warrant discussion. It's so obviously good for F1: it's exactly what the road cars need and it would give us a push-to-pass button.

**Must F1 and motorsport become more environmentally aware to avoid being outlawed by governments?**

I think it would be prudent, although I don't think motorsport would ever be outlawed as such, because it's just another way of entertaining using fuel. So before outlawing motorsport you would have to stop people using yachts and running private planes for pleasure. There's no end to it. Where motor racing could be vulnerable is if there's an oil crisis of some sort, then there could be a major problem because politicians like something symbolic, particularly something like F1, to show that they are serious about economising on fuel.

They might try to stop F1 for six months, for example, which would be completely stupid, but if



An F1 car dissipates a huge amount of energy under braking – could that energy be reclaimed?

we are working absolutely on the cutting edge of fuel efficiency and economy, it gives the friends that we have among politicians a very strong argument to protect racing.

It's a bit like the way we used motorsport effectively to subsidise Euro NCAP, which we did before it became fashionable. The idea was that if we had a serious accident, Euro NCAP would give us a lot of friends politically, because we could demonstrate that we were doing far more good than harm even if we had a really bad accident. In order to get politicians on your side you've got to give them an argument. That was the idea.

**Is there time pressure for motorsport to become greener?**

I think we should be doing it now. If the teams and the GPMA do not agree, we'll go ahead anyway. We'll draw up our own rules for the box for 2009, unless someone produces an overwhelming reason not to. We would prefer to do it in discussion with the manufacturers, but we don't have to. Provided we give two years notice we can bring in any technical regulation for 2009 we like, under the Concorde Agreement. And after '09, that becomes 18 months notice. Unless and until we sign up to another Concorde Agreement, we are free to do what we like and of course teams and manufacturers are free to enter or not enter.

But it would be difficult for manufacturers to go off and insist on running to the existing type of regulations if there's an F1 world championship with modern technology available.

**What has been the teams' response to these ideas?**

Some of them are talking to the experts on these storage devices. All the big car companies have

people working on these systems. They're already on buses and trains, so it's a coming technology.

**Could more manufacturers be encouraged to enter a more environmentally aware motorsport world?**

Yes. The fact that we are putting a stop to €200m F1 engine budgets makes it more likely that we will gain a manufacturer or two, than to lose one.

Max Mosley was talking to Anthony Rowlinson

**FUEL IF YOU THINK IT'S OVER**

**WHAT ARE THE ALTERNATIVES?**

**THE EASY** part of this debate is establishing that fossil fuels are not the way forward. Far more tricky is figuring out the most efficient alternative. It's a time of small-scale experimentation on the roads, and it's much the same on the race tracks.

Diesel is fast losing any claim to being innovative, though its renewable version, bio-diesel, can still get away with it. Audi's win at Le Mans this year with its R10 has done much for diesel's reputation, but diesel is still a fossil fuel (albeit with economy benefits) and there's nothing new about it in motorsport—a diesel ran at Indy half a century ago. The R10 wasn't the first diesel to race at Le Mans, and it wasn't the first major diesel endurance victory either. BMW's

**“DIESEL IS FAST LOSING ANY CLAIM TO BEING INNOVATIVE”**

famous win at the Nürburgring 24 Hours with its 320d came eight years earlier.

Slightly more eco-friendly is methanol, which is derived from methane gas and a little better on the emissions front. It's been a staple of IndyCar (both Champ Car and IRL) competition for years. Although it can be renewable, it was initially introduced for safety reasons.

Although it burns with an invisible flame, it's less volatile and that's just why they made the switch after Dave McDonald's fiery shunt at Indy in 1964.

Methanol's alcoholic cousin bio-ethanol, made from fermented plant life, is a better and non-toxic option. So much so that the IRL series is switching over 100 per cent for next year (pictured). It's already been tried at Le Mans with the Nasamax project in 2003-'04, where it didn't disgrace itself. It's back at La Sarthe with Paul Belmondo Racing in 2007, plus there's the Techspeed Vauxhall Astra in the BTCC this year, so it seems to be gathering momentum.

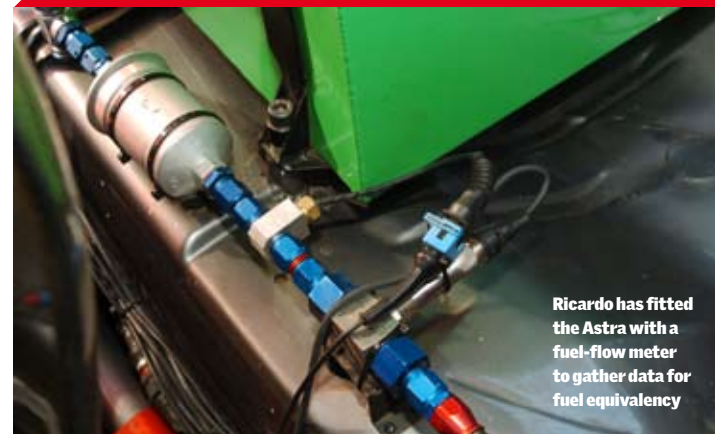
But neither of these are carbon-free, they just emit less of it and they're renewable.



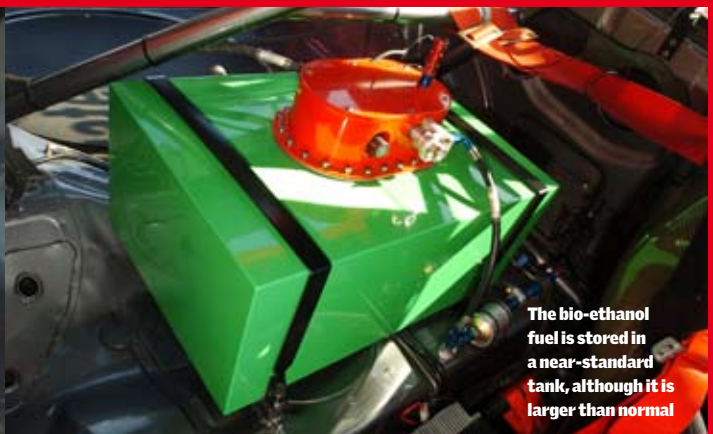
Nor is Liquid Petroleum Gas (LPG), a blend of propane and butane that has been tried in the BTCC. John George ran on LPG in a specially converted Honda Civic Type-R in 2004, but has now given up on the idea of LPG being able to match petrol performance levels.

Electricity can sidestep the question of carbon, but the nearest that's got to top-level

competition was the hybrid Panoz that ran at Le Mans in 1998. The technology is still primitive, as Max Mosley argues over the page. Hydrogen fuel looks promising since it's renewable and non-fossil in origin. But there are big complications for storage and it has a low energy density, so it's early days yet. *Richard Asher*



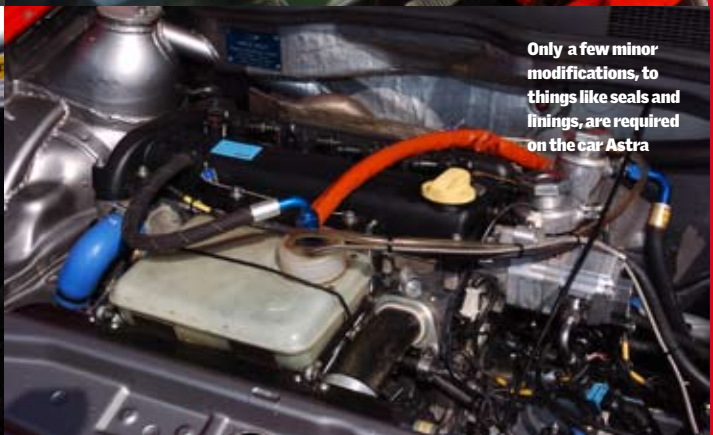
Ricardo has fitted the Astra with a fuel-flow meter to gather data for fuel equivalency



The bio-ethanol fuel is stored in a near-standard tank, although it is larger than normal



BTCC race winner Hughes was full of praise for the eco-friendly Astra



Only a few minor modifications, to things like seals and linings, are required on the car Astra



Fiona Leggate, the car's regular driver, (right) gives Warren Hughes a few tips before his test

# LEAN AND GREEN

## TECH SPEC

### PETROL V BIO-ETHANOL - THE FACTS

	PETROL	BIO-ETHANOL
DENSITY (KG/M3@20C)	764	789
ENERGY DENSITY (MJ/LITRE@20C)	32.8	21.2
FUEL VOLUME IN TANK (LITRE)	100	155
FUEL WEIGHT (KG)	76	122
ESTIMATED WEIGHT OF EMPTY FUEL TANK (KG)	88	139

NOTE Figures are for 100 per cent bio-ethanol  
Compiled by Ricardo on behalf of EEMS.

BTCC race winner Warren Hughes sampled the bio-ethanol Vauxhall Astra that's making waves in the series and, as he tells EDD STRAW, liked what he saw

**W**arren Hughes is impressed. In a cacophonous sport, it is performance that shouts loudest and, on his first experience of the Vauxhall Astra Coupé British Touring Car racer, Hughes finally has some idea of what he was up against during his two-and-a-half years fighting for scraps off the griffin's table from 2001-'05 as an MG works driver. The chance to test one of the most successful British Touring Cars of all time couldn't fail to impress, but Hughes's positive reaction is more significant than mere appreciation of a great racing car. What's most remarkable is that, despite the fact that the Tech-Speed Motorsport example regularly raced by Fiona Leggate is propelled by bio-ethanol, the only references he makes to engine performance are strictly positive.

Having started the day unsure what he was in for, Hughes was expecting to encounter some non-specific shortcoming in a car propelled by bio-fuel. However, after a morning pounding around Mallory Park using the magic gas, he's sold on the idea of adopting green fuels. "Your general perception as a layman is that you're probably going to be giving away a little bit of performance," says Hughes. "I didn't have any expectations of which particular area, I just thought it may feel a little bit sluggish or might be difficult to map the engine. But it's not. As soon as you ask the engine to pull, the power is there. It's particularly strong at low revs. My impression is that there's absolutely no performance loss." In terms of motorsport's willingness to listen, this speaks far louder than any volume of environmental studies, no matter how academically excellent they may be. Much credit must go to the government-backed Energy Efficient Motorsport (EEMS) body for recognising the importance of practical examples of alternative fuel technology succeeding in high-profile motorsport. The EEMS's message, or at least one of them, is that the industry must embrace the fact that going green doesn't equate to going slowly. Still not convinced? Just take a look at the speed

trap figures of Leggate in her Thurlby Motors-owned car over the past 12 months. The ex-works, Triple 8-built machine's Sodemo engine was converted to bio-ethanol by Triple 8 Special Projects Manager Rapheal Caille in the first half of last season, with Leggate making her debut half way through the BTCC year. The conversion to bio-ethanol, which is an alcohol-based fuel made through the fermentation of crops such as wheat, involves no physical change in hardware. However, the treatment of certain parts is required, as well as a change of small items such as seals and linings. Tech-Speed boss Marvin Humphries, who has a wealth of experience running Vauxhalls and enjoys close links with Triple 8, has been more than satisfied with the engine's performance. Even bio-ethanol's water attracting qualities, which would usually lead to the car being emptied of fuel between usage, have not proved a problem. Tech-Speed has simply left the car with fuel in during spells of inactivity. "From a performance point of view I don't think that

we've suffered at all," says Humphries. "We haven't had any problems with the engine, its installation or the ancillary parts. Not even the fuel tank. It has been run exactly the same as we would usually. We haven't fussed it, we have deliberately run it as a normal car and we haven't had a problem with it. "Sodemo assured us that the power was there, and they know what power the regular engine should have. One of the things we had to make sure of was that we had a car with proven performance. This project has been good from our perspective. It hasn't cost us anything extra as far as running the chassis goes, although you do have to use a little bit more fuel which makes it a little more expensive." This highlights one of the misconceptions that the EEMS, which is also pushing a variety of different alternative fuels beyond bio-ethanol, is eager to address. The natural mindset in this petrol-driven age is to think in terms of miles per gallon. That is shorthand for efficiency and value. The layman might interpret the fact that the Astra uses in the region of 20 per cent more fuel by volume than when running on petrol as an economy deficiency on the part of bio-ethanol. Not so. Bio-ethanol, in reality, burns more efficiently than petrol and to get equivalent performance it's a simple case of modifying the injector jets and engine mapping to increase the fuel burned. "This is something we have to get people thinking about," says Steve Bunkhall of EEMS. "You've got to get

away from thinking about volume of consumption and think about energy consumption." With changing attitudes essential to EEMS's work, Warren Hughes's reaction to a crash-course in green fuels is revealing. "I'm just finding out about a lot of this now," he says. "Motor racing in general has a real conflict of interest in some ways because of the perception that it isn't good for the environment. With things like bio-ethanol working so well, it's making it a lot more acceptable. Based on what I have experienced, there's no reason why the whole industry shouldn't be going in that direction. There's no downside to it. "The thing that would really send the message home is for major categories to run it. If all the manufacturers in touring cars, or even F1, were running on bio-ethanol, the shift would be towards that. The message is that there is no performance loss. Results speak volumes in motorsport, and results are what will change people's perceptions about what is possible and to ensure that green fuels are no longer seen as a whacky idea." In that regard, the British Touring Car Championship is an ideal showcase for the project. Both Bunkhall and Humphries are effusive in their praise of BTCC supremo Alan Gow and the championship technical boss Peter Riches, who have allowed bio-ethanol to run in the series. While fuel-based equivalency strategies are still relatively

new currency in the motorsport mainstream – although the idea has been around for decades – the 85 per cent mixture of bio-ethanol to petrol run by the Astra allows the octane level of the fuel to be lowered to the 98 figure stipulated for the BTCC. Indeed, leading motorsport engineering firm Ricardo is running fuel-flow metre technology on the Astra to gather data for an equivalency based on calorific value of fuel. It is projects such as this which, with the promotional power of series like the BTCC, are working not only to attract attention to alternative fuels within motorsport, but also to promote it on a practical level. "The BTCC is a high-profile manufacturer championship. Both Alan and Peter have been very supportive and totally behind what we are doing. They deserve some recognition for that," says Bunkhall. "Because it is bio-ethanol, this car gets reported in places that would never cover motorsport. You have to be pragmatic – if you want another good reason for embracing alternative fuels it is bringing new money in. Sponsors will be increasingly conscious of not being involved in something which is destroying the environment." For Hughes, there's very little convincing left to be done. "I hadn't even heard of bio-ethanol until this project started," he says, "but it's raised my awareness. Touring cars have a wide appeal to the casual spectator – it's the perfect platform. It seems very clear that motorsport has no excuse not to go in this direction." ❧

# OPEN ALL HOURS

The Le Mans rulebook is ready for all types of alternative fuels. By GARY WATKINS

The Le Mans 24 Hours. Is there anywhere else in world motorsport where such a wide range of machinery can compete on equal terms? Look back a few years and the battle right at the front of the field was fought out by open-top V12s, coupés with twin-turbo V8s and flat-sixes, and even a front-engined roadster. Look forward a few years, and it seems certain that conventional petrol cars and a growing number of turbodiesel racers will be joined by petrol-electric hybrids, bio-diesels and prototypes fuelled by bio-ethanol and, perhaps, hydrogen.

The same attitude to rule-making that allowed the front-engined Panoz to win American Le Mans Series races against the all-conquering, hi-tech Audi R8 is now encouraging a wave of alternative and green fuels. The Automobile Club de l'Ouest, which runs the 24 Hours and writes the rules for the Le Mans series in America, Europe and Japan, has a long-standing attitude towards technology that shouts 'everyone can come and play'. Don't forget that more than 40 years ago, a gas-turbine Rover-BRM twice competed at Le Mans.

You won't find sections on hybrids or hydrogen-powered cars in the Le Mans rulebook. Yet should you bang on the ACO's door asking to run a car on bio this or bio that, carrot juice or whatever, the men in blazers will more than likely go away and write some regulations for you. That's what happened when Audi decided it wanted to prove the performance credentials of its TDI diesel technology in the world's greatest sportscar race.

"We will welcome all types of fuel in the future. There is only one set of rules that offers this opportunity - Le Mans rules," says ACO sporting director Daniel Poissenot, who points out that new power sources will initially be allowed only in the prototype classes, particularly in LMP1. "We have to offer manufacturers and teams a chance to prove new technology."

The British Nasamax team found that to be very much the case when it raised the possibility of racing a prototype powered by bio-ethanol in the middle of 2002. A year later, it fielded the first car in more than 20 years to race at Le Mans on anything other than petrol.

"The ACO was very accommodating," says Nasamax founder John McNeil, a research physicist in the week and, on and off over the past 20 years, a team owner and manager at the weekend. "Our ideas were all very new to them and, quite rightly, we had to prove there was no fire risk and that we could use the same refuelling kit, but they showed themselves very keen to go through an educational process about new fuels."

This open-door policy is unlikely to result in the whirr of gas-turbines being heard on the Circuit de la Sarthe in the near future, but there are a growing number of projects involving alternative fuels that could, or even should, come to fruition in time for next season's 24 Hours.

British engine specialist Zytek Engineering, which these days also builds its own chassis, is working on a successor to the Panoz Q9 hybrid it developed in conjunction with Panoz in 1998. Ian Dawson, whose Taurus Sport team brought diesel back to Le Mans in 2004, has a bio-diesel prototype up

and running and plans to enter the 24 Hours next year. Meanwhile, Paul Belmondo Racing is trying to put together an LMP2 assault using E85 fuel, an 85-15 per cent mix of bio-ethanol and petrol.

Less likely to make the grid is a hydrogen-powered version of Mazda's LMP2 engine. There are also rumours of a major motor manufacturer looking at LPG, or a bio equivalent. LPG isn't new at Le Mans, of course: the Idée Verte team appeared at pre-qualifying with a gas-powered WR in the late 1990s.

Nasamax should be regarded as the pioneer of alternative fuels in sportscar racing, but it is the success of the Audi, first at Sebring and then at Le Mans, that has been the catalyst for the raft of projects listed above. The R10 turbodiesel may have only limited green credentials, but it has proved that alternatives to petrol are much more than just a novelty.

The arrival of new sources of power at Le Mans, particularly renewable ones, offers motorsport a unique opportunity to compare the environmental credentials of a wide variety of fuels. "Le Mans is the ideal playing field for new fuel technologies to be run against one another," says McNeil.

The task for the ACO is to equate the performance of the different fuels, just as in the past it had to equate V8 twin-turbo Audis with Judd V10-engined prototypes. It stated during Le Mans week, and then firmed up with a press release two weeks ago, its intention to base tank capacity on the energy value of a particular fuel from next season. That means smaller tanks for more energy-rich fuels and an increased capacity for those with a lower calorific value.

It is an idea that the ACO has already embraced. Back in the second year of the Nasamax project in 2004, the British team's heavily revised prototype was allowed a 135-litre tank, a big increase on the 90 litres afforded to petrol LMP1 cars. The reason is that bio-ethanol has 60 per cent of the energy of petrol. By the same principle, expect the Audi R10 to have a tank reduced in capacity by nine to 10 litres in 2007.

That alone will not peg back the massive advantage Audi enjoyed over its petrol rivals at Le Mans last month. It is generally reckoned that the R10s had a power advantage in excess of 100bhp, courtesy of a favourable air-restrictor. The problem for the ACO is that restrictors, the way horsepower

has been controlled at Le Mans since 1994, aren't so relevant to diesel engines. Controlling fuel flow, and therefore energy input, as put forward by the Energy Efficient Motorsport (EEMS) initiative in the UK, might be a better solution.

That would go some way to creating the level playing field the ACO insists it is trying to achieve, but many of Audi's competitors suggest it had another advantage this season. The spec petrol supplied by Shell at Le Mans is little more than 98 octane super unleaded; the make-up of the verbose-sounding Shell V-Power Diesel used in the R10 is less clear. Of particular concern is the percentage of the secret 'ingredient x' in the fuel, known as Gas To Liquid diesel.

GTL is a synthetic diesel made from natural gas that has both a higher cetane number (diesel's equivalent to an octane rating) and is cleaner than its oil-based cousin. It is added to premium diesels for obvious reasons. The allegation levelled at Shell is that its racing diesel has a higher GTL content, to boost power and to avoid the smoke frowned upon by the ACO, so is not the same stuff available in your filling station.

"If we could use the same fuel that was used in Formula 1 back in the early 1990s, we could have an extra 50-60bhp," says one prototype team principal. "There are additives that could give you better consumption, too. There is no way what Audi is running is normal diesel."

That is something denied by Shell, although it concedes that the percentage of GTL in its racing diesel will remain confidential. The company's technical motorsport manager, Mike Copson, points out that the fuel meets European standards for road diesel and that it could be used in any car.

"It is not neat GTL," he says, "and it is not rocket fuel." It is easy to see why Poissenot says the challenge faced by the ACO in creating an equivalency between different fuels will be "interesting but challenging". Its job will only be further complicated by the arrival of hybrids, which use regenerative braking systems to charge batteries which then supply a power boost down the straights.

Zytek won't go into details on its negotiations about the rules for such technology, but it appears that a hybrid car would be given a smaller air-restrictor as a trade-off for the power produced by its electric motors. There is an argument that if the ACO really wants to prove its green credentials there should be no such penalty. The reason? Because the regenerative systems are effectively recycling energy.

The next step might be a formula based on carbon emissions. That's probably decades away, but Le Mans has a chance to become a platform where alternative and renewable fuels can be showcased. It is an opportunity motorsport probably cannot afford to miss. ■



Audi won this year's Le Mans with a turbodiesel, though the equivalency formula is a bone of contention



Nasamax blazed the trail for alternative fuels in sportscar racing



Taurus Sports ran a diesel-powered Lola in 2004



# CHANGE FOR GOOD?

The FIA's proposed Formula 1 rules may have little effect on the racing and merely be window dressing. By MARK HUGHES

**A**s part of the drive to make Formula 1 more 'on message' environmentally, the FIA wants to introduce energy recovery systems to F1 by 2009 and ideally a totally new engine formula for 2011, whereby the prescribed limit is no longer engine capacity but energy flow rate. These changes would radically shake up the technology of F1. But in isolation their effect on the racing would probably be minimal. The energy recovery system, whereby energy created in braking, would be stored and re-used to enhance acceleration would give the cars a 'push-to-pass' facility. With current technology it's estimated that a lap's worth of braking would generate an extra 60bhp for 9 seconds, though the hope is that it will be more like 120bhp for 15sec by the time of its introduction. Would that create more overtaking? So long as everyone's systems were roughly equivalent, no – because the facility could be used for defensive purposes as well attack.

Such technology on road cars will save fuel. Because on the road you're simply achieving the acceleration and speed

desired by a different means – replacing some fuel-burning acceleration with captured energy-powered acceleration.

On track, you're saving no fuel. Because you'll go as fast as the car will let you, not as fast as traffic, safety or speed limits dictate. You will therefore use maximum fuel and get this acceleration boosted by the stored energy, not replaced by it.

In essence, it would be window dressing in F1, and potentially very expensive. It would save no fuel and have little effect on the racing. But at least the competitive drive might lead to efficiency technology that could be used in road cars.

As for the 'fuel efficiency engine', with energy flow as the limit, it would become all about how efficiently you converted that energy into power. The obvious answer becomes turbocharging – opening up a whole can of worms. Maybe that would have to remain specifically banned. After that, it becomes about the engine's thermal and frictional efficiency.

There are contrasting pulls here and which of thermal or mechanical efficiency ended up being the differentiator in competitiveness would determine the type of engines we'd see. If thermal efficiency were dominant then multi-valve, multi-cylinder engines would still be the way to go. Smaller

cylinders in multi-cylinder engines have better heat dissipation than bigger cylinders.

But if frictional losses were the more important differentiator, you'd limit them by having fewer cylinders. Valve area would cease to be a critical limiting factor – because you would already be defining the flow rate. So depending upon where you fixed the flow limit, you could end up with four-cylinder, eight-valve engines, probably through a four- or five-speed gearbox to further limit frictional losses. Definitely not very F1.

If thermal efficiency turns out the dominant differentiator, the regs would have to be very strict on the materials that could be used, since engine manufacturers could seek to limit heat losses by exotic materials with higher heat tolerances.

The combination of engine and regenerative energy device that best suited the energy flow limit would be another area of investigation, experimentation and expense. Because of the entirely different usage from road cars, this solution would almost certainly be very different to that arrived at there. F1 would still be spending fortunes on solutions that were racing-specific, even though there would be shared technology. Just as there is now. Again, it's window dressing.

It won't actually be saving fuel unless the racing-driven research sparks new technology in road cars.

Ideally, these changes need to be made in conjunction with a limit on downforce. There would be two economy-related benefits then. The regenerative power device would be far more effective, lengthening braking distances, increasing the energy input into the device – and making overtaking easier. And drag reduction would become much more important, thereby better aligning F1's efforts with those of the road car industry. Downforce is spoiling the quality of the racing and now it's becoming clear it's going to be a barrier in aligning the economy drive of the industry with the competitive drive of F1. Getting rid of it is actually a more important a factor in creating a greener F1 than engine regs are.

The whole ethic of racing – to get round a track quicker than the next guy – ensures that technologically its answers are only rarely going to be relevant to energy conservation. Fuel savings in a road car are used to consume less fuel. There are no fuel savings in a race car – make it more efficient and you'll use that efficiency gain to go faster for the same amount of fuel. But the perception is more important than the reality. ☐

**'Green' F1 will continue to look the same unless the sport grasps the need to reduce downforce**

## MEAN GREEN: WHAT THE EXPERTS SAY

"FROM OUR point of view it would be a very good opportunity to work on some different technology. Obviously there is the issue of who pays for it, but that's the same as anything in motorsport. I don't think anyone can ignore the fact that there is a problem and that motorsport must look at doing something about it, but it would take the manufacturers and championship organisers to lead it at this level."  
**Dick Bennetts**  
West Surrey Racing

"**DOWE** want an economy run or an absolute performance run? That's something that needs to be determined. But **Max [Mosley]** has a clear vision that he wants to use F1 to try to promote newer alternative technology within the industry. His strategy is to use F1 and its marketing power to promote alternative directions of the primary movers within automotive technology."  
**John Howett**  
President, Toyota F1

"WHAT WILL really make the difference – as has happened at Le Mans – is the major automotive manufacturers choosing to embrace the idea of energy efficiency in motorsport. As the industry we have to be ready with our engineering solutions to facilitate that. Energy-efficient solutions are going to be very expensive to research and develop, so we have to engage with the mainstream automotive companies."  
**Chris Aylett**  
CEO, Motorsport Industry Association

"**THERE'S** A hardcore group that will be affected when new energy sources are seen to do well on track. It convinces what we call 'opinion leaders and early adopters'. These trailblazer types would be convinced that those technologies work. We're talking about petrolheads adopting something when they're convinced of the motoring efficiency of new technology."  
**Paul Flatters**  
Chief Executive, Future Foundation

"**EVERYONE** WITHIN the fuel industry knows that it is possible to make fuels that burn clean with less effect on the environment. However, the current situation is that the governing bodies are focusing too much on the current standards for Premium Unleaded and Super Unleaded, which are designed to cater for usage on a daily basis, so focus is on cost and volume manufacturing other than the environment and performance."  
**Anders Hildebrand**  
MD, Anglo American Oil Company

"**IF YOU** want to race with an alternative fuel it's not always clear how you work around the regulations. We've been working with Ricardo to look at fuel flow regulations. In the BTCC we are testing a fuel flow meter to demonstrate how you can use fuel flow limiters to restrict power and create an energy equivalency formula based on different calorific value, so we give the same energy flow."  
**Steve Bunkhall**  
Project leader, EEMS

"**WE CAN** use motorsport as a great platform to use new technology, whether the new technology is around performance, fuel or changing perceptions. When we went to the USA for Sebring with the R10 we were quite open to say, 'We're not here to change the world, we're here to change perceptions.' Motorsport is a great way of doing that. If we make diesel successful at the race track, people change how they perceive it."  
**Mike Copson**  
Technical motorsport manager, Shell

## DON'T PANIC, MR ECCLESTONE

**NOW YOU** can call me a Neanderthal if you want – it's what environmentalists love to do if they find themselves losing a debate – but do we really need a green crusade in motor racing, especially from our own motorsport media?

Yes, we might have to look to do our bit to show we're being responsible, perhaps by making everyone use a 10 per cent bio-ethanol mix, but we really don't have to lead the way with sweeping changes – leave that to the vast industry that drives our world.

Ours is a simple sport fuelled by speed, noise and adrenalin. Contests that should be great occasions fought out between teams on equal terms for the entertainment of both contestants and spectators alike – and nothing more.

Le Mans has already been ruined by the ACO handing Audi a PR exercise on a plate – so desperate were they to have a major manufacturer in their line-up – and just because we've had the hottest July day since, er,



**Tiff Needell**

1910, we really don't need to panic ourselves into more legislative measures.

Unless the anti-anything brigade gets on our case, there is no pressure to rush in sweeping regulation changes to ensure that only hybrids and 'new' fuels win races. Yes, encourage them to challenge on a level playing field, but please don't bend over in a panic.

Mind you, there are still people who have a weird concept of what a level playing field is. I bumped into one diesel disciple at the Motor Show who thought my suggestion of equal

capacities for all fuels so unfair that we should re-limit petrol engines down to the whispering levels of his oil-burners.

If you really want to highlight new fuels at events like Le Mans, re-introduce the famous 'Index of Performance' prize for them. It was something which no one really understood, but it always seemed to find a French winner in the days when they had no chance of overall victory!

Maybe we should have a 'Formula Environmentale' where the new technologies can all get together and have their own world of silent racing and it's the designers that do the winning rather than the drivers.

But please leave the real racing to a single-fuel format and if the pressure really builds, simply do what we did during the oil crisis in the 1970s: reduce race distances by whatever proportion is deemed necessary. Indeed, the way modern circuits seem to deter overtaking, fewer laps might make the racing better!

## NEW TECHNOLOGY WON'T SPOIL SPORT

**IF YOU'RE** a die-hard reader of this magazine, you'll probably agree with everything Tiff says (above). That's why I asked him for his opinion. He's a purist in the best tradition.

But wait, we haven't lost the plot. Autosport is not on a revolutionary crusade here to change the essence of your beloved sport forever. This is about inevitable evolution and a change of attitudes to accept this.

An assumption that new technology equates to a dilution of motorsport's true spirit of speed, power and noise is off the mark. Regs incorporating room for alternative technology can and should be written in a way that do not penalise traditional (and still numerically dominant) petrol engines. Equality might not be easy, as the rule makers at Le Mans found this year with Audi's turbodiesel,



**Damien Smith**

but that's not a good reason to sidestep the problem.

During the course of our investigation we have been disappointed by the *laissez-faire* attitudes we encountered. According to some, it is up to the manufacturers who choose to race to set the agenda, while motorsport just follows the trends. What a cop-out.

Why can't motorsport take a lead on environmental

concerns? No-one seriously argues that racing is a major enemy to the environment – it's a drop in the ocean in the grand scheme of things – but we're talking about image and perception here. If our sport takes the initiative on promoting new technology, what a forward-thinking message that would send to a world where energy is high and rising on the agenda.

During a visit to Autosport's office a couple of weeks ago, Sir Jackie Stewart told us about the hostility he faced as he campaigned for improved safety. It wasn't considered "manly" to worry about such things, he said.

Likewise, we expect to face criticism for being too 'right on'. But, as with safety, we believe alternative technology will become a defining subject in motorsport and it's time to embrace that. View this as an opportunity, not a problem.