

RACE TECH

INTERNATIONAL

レーシング・テクノロジー

RECOVERY POSITION

HOW KINETIC ENERGY RECOVERY SYSTEMS (KERS) WILL TRIGGER F1 STRATEGY WARS – WE RUN A SIMULATION

PLUS

• ALTERNATIVE FUELS AND POWERTRAINS

LE MANS TECHNICAL DEBRIEF

• F1 AND SUPERCARS AS 'GREEN' TEST BEDS



ALTERNATIVE TREATMENTS

Alternative fuels have provoked more talk than action. The EEMS (Energy Efficient Motorsport) 'Future Fuels in Motorsport' conference debated the barriers blocking the uptake of these new technologies. **John Coxon** reports

THIS debate gathered some of the great and the good of motorsport to stimulate further discussion. Hosted by the Oxford Brookes University, on June 22, the event attempted to address some of the inevitable barriers to the wider uptake of new fuel and powertrain technologies.

The politics of energy, to which we all as energy users of one form or another subscribe, would currently seem to revolve around the net emission of carbon dioxide. To a lesser

extent, depending upon your geographical location, the security of supply is also an issue.

Gone from this particular platform, for the time being at least, is the effect on air quality – the air toxics and carcinogens – the NOx (oxides of nitrogen) or VOCs (volatile organic compounds). While a few countries are introducing the mandatory use of catalyst technology in some racing categories, as far as these particular proceedings were concerned, that is no doubt something for the future.

To paint the backdrop against which the rest of the day's proceedings were to be viewed, Professor Emeritus of Cardiff University introduced the keynote speech. He told the audience that energy efficiency was not simply a passing phase but a long-term issue affecting all of us. He reminded us of the events of the first major oil crisis of 35 years ago and that, since then, fuel economy has ranked very highly with most major vehicle manufacturers.

BELOW Shell has enjoyed high-profile success at Le Mans in the past two years, including this season's defeat of Peugeot. It has Biofuels to Liquid technology under development for 2008



BELOW The Formula Zero kart forms the foundation of a plan to one day develop a zero-emission race car



Furthermore, he went on to say that any subset of activities associated with these manufactures could not be seen to be divergent and that motorsport could be pivotal in assisting with the design of the motive power in the future. "It is still very clear," he said, "the issue is that there is no (fuel) solution at the moment other than petrol or diesel that stands head and shoulders above the others and that is why the motorsports community has so many alternatives."

Summarising, he suggested that the motor racing industry could well be

winning Audi he explained that although the diesel combustion cycle had been around for over 110 years or so, it was because of the pressures on fuel efficiency that motor racing was being used to showcase the latest fuels and help develop engine technology. He pointed out that while diesel engine design was inherently more fuel-efficient, the latest in GTL fuel (Gas to Liquid) technology also gave improved carbon to hydrogen ratios, producing lower levels of carbon dioxide.

Synthesized from natural gas, he stated that GTL fuels are not biofuels but the product of the Fischer-Tropsch process



ABOVE & BELOW Modifications to fit twin injectors into the inlet manifold of the CNG Mitsubishi rally car



Vegetable oils, that many think of as the ultimate in biofuels, should be reserved purely for the kitchen

pivotal in selecting the motor vehicle of 2030. "The environmental issue is not going to go away, it is a challenge and the solution awaits. Ladies and gentlemen, start your engines. It is going to be an interesting further 35 years and some of you may still be around at the end of it."

Following an emotive plea from another EEMS ambassador, David Brabham, recovering from his GT1 victory at Le Mans two days earlier, Richard Karlsletter of Shell Global Solutions began the fuel options debate with an insight into diesel fuel technology.

As the fuel supplier to the 2007 Le Mans-

which gave a fuel that was a much cleaner burner with high levels of cetane – essential for a top quality compression ignition fuel. Karlsletter did, however, claim that for the 2008 Le Mans any competitor running on diesel fuel will have the option of using the latest in BTL (Biofuels to Liquid) technology which will be identical to the current GTL product but have over 90% reduction in well-to-wheel CO₂ emissions over current pump fuels. "Oh and vegetable oils," he reminded us, "something that many might think as the ultimate in biofuels, should be reserved purely for the kitchen."

The second speaker, another familiar face to

EEMS, was race car owner and 2003 and 2004 Le Mans contender John McNeil. An independent energy consultant, McNeil is probably best known in motor racing circles for introducing bio-ethanol to Le Mans in his Team Nasamax Reynard-based sports racer. Starting by explaining the differences between E5, E10 and E85 etc as being the percentage of ethanol in a gasoline ethanol mixture, McNeil did admit that he thought that the current fashion of adopting bio-ethanol for motor racing could be, "just a little too popular" at the moment.

Criticizing the food-versus-energy hysteria in the media, he pointed out that 40% of all foodstuffs in the UK, according to statistics, go directly into land fill without ever getting used. The bad practice of chopping down trees to plant suitable crops from which to produce first-generation biofuels will inevitably occur, he said, when quick profits can be made.

These first-generation fuels, however inefficiently produced, are not sustainable but will stimulate a market which will support the development of a second generation using different methods and resources. "A first-generation fuel of RME (Rape Methyl Ester) will, for example, give a potential energy yield of around 40 GJ per hectare," he stated. "In comparison, a really advanced second-generation combination technology could give as much as 1000 GJ of primary fuel energy per hectare."

Grown in the right place, with the right methods, he said that biofuels do not have to compete with food products. Indeed, they can be complementary. He gave the example ▶

of two and a half crops per year, over 7.5 million hectares, with a yield that could be sugar juice, food grain (from the flower on top) and leaf and cellulose material to be converted into either ethanol or bio-diesel.

When it comes to Compressed Natural Gas (CNG), the storage issues associated with energy density make the fuel more applicable to heavy duty vehicle operation rather than competition. However, the third speaker, Roland Wolk, Head of Communications at OMV, a gas utility company based in Vienna, outlined the activities of Stohr Racing with their Mitsubishi Evo IX rally car in Austria.

The primary function of the project was to improve the image of the fuel and to generate publicity in areas other than the specialist gas utility press. With somewhere near 6.4 million gas-powered vehicles on the road worldwide, however, it is evident that in many parts of the world there must be significant advantages to adopting it as an everyday fuel. The reasons for this, Wolk pointed out, are that not only does it produce around 20% less CO₂ than an equivalent gasoline engine, but that many of the toxic and regulated engine out emissions (oxides of nitrogen, carbon monoxide, non-methane hydrocarbon and particulates) are substantially lower.

When biogas (methane produced from the decomposition of vegetable matter) is used, the fuel is more or less carbon-neutral. In addition, while known oil reserves amount to something like 30 years or so at current usage, natural gas supplies will continue for at least another 70-100 and tend to be in more politically stable countries.

“ The issue is not going to go away. Racing will be pivotal in selecting the car of 2030 ”

The modifications to the vehicle were surprisingly minimal, being only the installation of a large 200 bar (3000 psi) CNG fuel tank and a change in fuel injection in the inlet manifold. Competing in a separate category for alternative fuels in 2006, for 2007 the team wished to compete in the main Group N class alongside the more usual gasoline-powered vehicles. Unfortunately, the regulations state the use of only one injector per cylinder and this turbocharged Mitsubishi unit needs two per cylinder to produce its 200 kW (with 500 Nm of torque!). It is just another example of the hurdles that alternative fuels have to overcome to be accepted against more normal machinery.

Jon Horsley, technical director of Zytec, leaders in hybrid engine technology, said: “Hybrids are there to make an engine or vehicle work

better in an area of operation that it won't work at, like low-end torque. Race cars, however, are all about power.”

He went on to claim that hybrids are very useful in racecars in getting around the regulations. For instance, in the engine air restrictor engine categories of LMP1 and LMP2, when the engine is not using all the air it can consume through the air restrictor, it can effectively be stashing that power away temporarily in the form of stored electrical energy in a battery.

HYBRID DREAM

In theory, at least, the technology can be applied to any form of racing where regulations allow but there are very many major issues to be solved before the technology can be widely applied. “When you are trying to get the maximum out of a battery, for instance, it is very difficult to guarantee that consistency of operating response every lap for 24 hours,” he said. “There are issues, regulation issues and instrumentation issues.”

The challenges for hybrids in motor racing are battery weight and packaging, as well as consistent handling and braking. Horsley did acknowledge, however, that Zytec was working on an LMES hybrid plan as well as a KERS Formula One project, the results of which might break cover in the next couple of years.

While GM has admitted to increasing its research into fuel cell technology in the Netherlands, a group of fuel cell enthusiasts led by Eelco Rietveld and Godert van Hardenbroek are using proprietary fuel cell technology to promote and accelerate the uptake of emission-free transport. Called Formula Zero, their ultimate aim is to develop a true zero emission formula race car package.

The first project was to develop a fuel cell-powered kart. Seeking out and forming strong associations with state of the art technology suppliers, their first prototype is powered by an 8.2 kW fuel cell system using compressed hydrogen stored at 200 bar pressure and oxygen from the air. The DC electric output from this fuel cell is relayed to a Gravatron electric motor via an HE DATA 1000 amp controller.

Under braking the excess energy of the fuel cell is redirected to a series of boost capacitors which temporarily store it and can re-release up to 40 kW of extra power for up to 10 seconds for that extra turn of speed out of corners. As Rietveld admitted, “It is the torque output of the electric motor that gives the 295 kg machine its real speed.”

The kart holds the FIA record for the fastest 1/8th mile (200 metres) ▶

BELOW The hybrid battery and controllers in the Honda Insight



BELOW The WATT4, an electric-powered hill climb single-seater



BELOW Barwell Motorsport has made history with the first high-profile victory for bio-ethanol power in the GT3 category



from a standing start, but one of the major concerns is the safety and ease of handling of the hydrogen storage medium. Using a complex safety system which shuts down should a leak occur, the latest innovation is a cartridge (hydrogen) fuel system – referred to as ‘click and go’ – which should be available towards the end of the year.

In the second session of the day, on regulations and scrutineering, Peter Riches and John Symes represented the motorsport controlling bodies and rule makers. They emphasized that their major consideration was for safety and that when approached with a precise request they would consider any proposal on its merits. Their problem was that, faced with so many differing technologies, it was hard to pre-empt what competitors might request in the future.

The general feeling from the audience,

WATT4, the vehicle was conceived to make an outright bid for the British Hill Climb Championship. Having previously designed a number of single-seater challengers for this type of competition, where technical regulations are minimal, Ogilvie was looking to produce the ultimate challenger for this type of competition.

“Held at 12 venues around the country and typically between 1000-2000 yards in length on narrow tarmac roads, speed hill climbing places emphasis on traction off the startline, acceleration from low-speed corners and a top speed of no greater than 140 mph,” Ogilvie said when outlining his thinking process.

It was clear that he was thinking outside of the box, as befits someone who at one time had worked under the late Colin Chapman. “With the ideal motive power giving high torque at low speed, and the

motors, one at each corner, taking their power from 120 kg of Lithium-ion batteries housed in crash proof containers. With total motor control and active power distribution, and housed in a car weighing around 450 kg, it is considered there will be significant performance advantages over current challengers. With costs reputed to be no more than current machines, Ogilvie is looking for interested parties to support the project.

The second speaker at this afternoon session was Mark Lemmer of Barwell Motorsport. Competing with an E85 bio-ethanol-fuelled car in a GT3 Aston Martin DBRS9 in the British GT Championship the main issues were increasing the size of the fuel tank by 40% and ensuring that the E85 fuel was flushed out after use to reduce any problems with the fuel corroding any of the fuel lines or adversely affecting any elastomer seals.

Next, Paul Andrews of Oaktec talked about his Formula 1000 Honda Insight rally car. The car was initially rallied in 2005 as standard but it quickly became apparent that with its tall gearing and manual gearbox, the car was initially uncompetitive. However, changing to the Honda optional CVT (continuously variable) transmission, competitiveness was transformed to the point where the car won the 2006 championship with several rounds to go.

TITLE-WINNING CAR

Further development over the winter of 2006/7 saw the latest in programmable software installed to change the regenerative braking characteristics. Despite being a championship-winning car, the engine internals remain completely as standard.

Finally Graham Fuller of Minister Power talked about its E85-fuelled Caterhams as used in Formula Women – the only one-make championship as yet authorised to use a biofuel.

It is clear from the 100 or so teams, organisers, companies and competitors attending the conference that the concept of energy efficiency in motorsport has captured the imagination of many. With a little planning and co-ordination by the appropriate groups, and a realistic approach to some of the issues, there is little doubt that motorsport, even at the grass roots level, could have a significant influence over the way forward. ■

‘ The challenges for hybrids in motor racing are battery weight and packaging, consistent handling and braking ’

however, some of whom were competition organisers, was that the MSA was far from supportive. The criticism was that it often introduced barriers to the club competitor, many of whom would be willing to support any ‘green’ initiatives.

The final session of the day started with a presentation from ex-Lotus F1 designer Martin Ogilvie on his electric-powered single-seater speed hill climb challenger. Called the

ease of combining four-wheel drive, electric power was considered to have real possibilities,” he said.

His approach to the regulatory authorities provoked a positive response, provided that together with Peter Riches he helped to write the necessary regulations. The design as currently envisaged will consist of four individual 400 volt 125 kW DC brushless electric