proActive magazine

ISSUE 42
AUTUMN 2011

ELECTRIC VEHICLES
Dividing opinion

INDUSTRY INTERVIEW
Richard Parry-Jones

WELCOME

As Lotus Engineering settles into its new role of focusing solely on external customers, we have to continually focus on improving our services, delivering added value and ensuring our engineering capabilities are class leading.

In order to improve these things we are doing the following:

Improving customer focus - our customers are always right - well, not quite always but our main aim, apart from delivering on time and to the quality expected, is to help, guide and integrate our team into yours. We want our project delivery process to be seamless within your organisation.

This means, where applicable, using your systems, processes and methodologies. To have empathy with your goals, ambitions and working culture. Over the last three decades we have many examples where we have delivered projects by working with our clients in highly integrated teams. This benefits both parties by: reducing cost, generating empathy, creating a team environment and, for those customers who want to learn, a brilliant 'on the job' training environment.

Adding value - what do we offer that our competitors don't? Have you visited our stand at one of the major global automotive shows recently? If you have you will have seen the excitement and buzz generated by our forthcoming range of sports cars. No other Engineering services company displays itself in association with its cars the way we do. Our cars display our engineering capabiilities, they generate an awareness of some of the many things we are capable of. The Engineering section of our stand displays the technologies and services we offer but slso examples of our client's projects. This is fantastic PR.

Class leading capabilities - on the basis that there is always room for improvement, we have recently undertaken a full review of our capabilities and established areas where we could be better. We are rapidly filling these gaps and significant investment is underway with many of our facilities being upgraded. We are also adding new facilities over the next two years. But this is not just about facilities. Class leading capabilities have to be consistent across all of the engineering disciplines and processes to create an effective delivery capability that represents engineering excellence. This is our ambition.

Lastly, we need people. Lotus Engineering has a diverse project portfolio that encompasses everything from complete electric vehicle programmes and advanced high power density engine projects though to numerous ride and handling jobs and range extender electric vehicle research projects. The automotive industry is experiencing massive change with significant investment in new forms of propulsion, lightweight materials and processes and advanced engine technologies. These are core Lotus competencies and consequently we are experiencing significant growth.

If you're interested in being involved in these things, and as an automotive engineer who wouldn't be, visit the job application section on our website.

Mark James

Mark James
Director of Lotus Engineering

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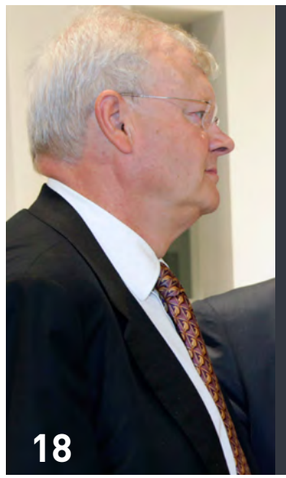

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proActive magazine is produced by Lotus Engineering with support from just-auto.com.

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SMALLER, LIGHTER AND SIMPLER

New 2-cylinder range extender engine from Lotus Engineering and Fagor Ederlan Group shows the latest development of the award winning Range Extender Engine and is perfect for small city cars.

In a small car where every bit of space and weight is vital, the new Lotus Fagor Ederlan Range Extender occupies substantially less packaging space (44% less) and 16% less weight in the vehicle than the larger three cylinder engine used in the revolutionary Lotus Evora 414E and the Jaguar Limo Green development vehicles. Almost as importantly, the engine and generator can be laid in any orientation from vertically to horizontally, where it has a height of just 327 mm, so the whole package can be located almost anywhere in the vehicle.

But with a small size comes a big and efficient punch. Producing 20 kW of power and 66 Nm of torque, the 0.9 litre 2 cylinder four stroke Lotus Fagor Ederlan Range Extender Engine operates at its most efficient engine speed range of between 1500-3500 rpm. However, the engine does not power the wheels directly but generates electricity via a generator to charge batteries which then provides electricity to an electric motor connected to the wheels.

Dany Bahar, Chief Executive of Group Lotus, explains,

"Almost without exception, the automotive industry agrees that the future of road transport will include the increased use of range extender hybrid engines. They are the perfect solution for city vehicles which do most of the driving under plug in pure electric mode, so having an occasional use range extender to literally extend the driving range of the vehicle beyond plug in mode is perfect so eliminating range anxiety."

Demand from Lotus Engineering's global client base has proven that there is a desire for a smaller and lighter range extender engine which would be more suitable for city and urban vehicles where weight and size are more important than top speed and acceleration.

Mark James, Director of Lotus Engineering, explains the thinking behind the new Range Extender,

"Ever since we first unveiled the range extender concept to the motor industry at the Frankfurt motorshow, just two years ago, we have been inundated with interest from vehicle manufacturers all over the world, all wanting a cost effective way of delivering a range extender solution. This has been achieved with the collaboration of Fagor Ederlan Group and now we have a production solution and are working closely with several global OEMs to deliver production applications."

Miguel Mateo, Commercial Director – Range Extender Business Unit for Fagor Ederlan, said, "

High technology is not just the concept or the end product, it is also the manufacturing process, which of course is related to how the product is designed in the first place and the Lotus Fagor Ederlan Range Extender is a perfect example of a high tech, elegantly simple design that is efficient and cost effective to manufacture. We have also included the Fagor Automation developed generator and inverter and integrated all of this technology into one whole package, so with Lotus we can deliver this solution to the global automotive industry."

THE LOTUS FAGOR EDERLAN RANGE EXTENDER IN MORE DETAIL - HOW IT WORKS

A range extender is used on series hybrid cars where the vehicle is powered by electric motors. How far the vehicle will travel on pure EV mode depends entirely on the size of the vehicle and the capacity of the batteries that the vehicle carries. However, in a city or urban environment, most vehicles will travel no more than 30 miles (50 km) so the batteries are typically specified to accommodate this distance. Should the driver wish to drive the vehicle further, the super efficient engine will start and power a generator which then supplies electricity to power the electric motor.

Light weight is critical for range extenders and even more so for small city and urban cars, where the engine is not being used all the time. Therefore the new 2-cylinder range extender engine weighs 16% less than the larger three cylinder engine at just 45 kg.

The engine is optimised to generate power at engine speeds between 1500-3500 rpm allowing a lightweight simple 2 valve per cylinder engine architecture and eliminating the need for a complex and expensive 4 valve per cylinder design. As well as an Integrated Exhaust Manifold, the Lotus Fagor Ederlan Range Extender engine has an innovative new Integrated Intake Manifold that gives a significant reduction in weight and package size. The generator supplied by Fagor Automation is driven directly off the crankshaft to reduce weight, package size and cost. The engine, generator and power electronics are controlled using a Lotus controller to improve communication and efficient running of the systems. The engine architecture and engine management system are designed to offer flex-fuel capability to allow the engine to run on renewable alcohol fuels.

A more powerful 30 kW two cylinder belt driven centrifugal supercharger ranger extender engine has also been developed by Lotus Engineering, for use where space and weight are more of a premium than unit cost.

Lotus Engineering and Fagor Ederlan Group also offer a larger and more powerful 1.3 litre, three cylinder range extender engine with the 50 kW supercharged variant used in the hybrid Evora 414Evolution.

The three cylinder supercharged engine uses a belt driven centrifugal supercharger to produce 50 kW peak electrical power at 3500 rpm and weighs just 58 kg. The naturally aspirated variant which produces 35 kW weighs 51 kg.

Lotus Range Extender engines have already been fitted to a number of concept and research vehicles including the Jaguar Limo Green research vehicle, the Proton Emas and Lotus' own Evora 414E.

IMAGES LEFT AND ABOVE

Two-cylinder range extender engine developed by Lotus Engineering and Fagor Ederlan Group

FRANKFURT SHOW:
MORE LOTUS THAN EVER!

9am (CET) Tuesday 13th September saw Group Lotus showcase three new cars, two new options and one special limited edition.

IMAGE BELOW

New V6 Exige being unveiled atFrankfurt Motorshow 2011

EXIGE S:

Raw performance, mind blowing agility and unparalleled ride and handling, these attributes are what people have come to expect from Lotus. And we donít like to disappoint. After months of media speculation Group Lotus proudly unveiled the latest addition to the family: the extraordinary new

Exige S, the ultimate lightweight high performance sportscar.

With a lightweight 1080kg chassis teamed with a V6 3.5 litre engine delivering 350 PS, the Exige S has a completely new exterior and interior

look and feel. The dramatic styling overhaul sees a completely new look for the Exige including a new front splitter and rear spoiler giving it a strong and aerodynamic profile.

EXIGE R-GT:

What better way to demonstrate Lotus' superior ride and handling than by re-entering the adrenaline filled Rally Championships? Showcasing the new Exige S' phenomenal performance, the Exige R-GT will participate in the newly formed FIA GT category of the FIA Rally Championship on asphalt in Monte Carlo, Tour de Corse and San Remo.

Powered by the same V6 3.5 litre engine as the new road Exige, significant changes have been made to the gearbox and the restrictors on the engine in order to control the power. Lotus will initially partner with several customer teams following the tried and tested method in which Lotus entered IndyCar and returned to Le Mans.

For Group Lotus' Director of Motorsport - Claudio Berro the return to rally has an extra special meaning:

My motorsport career started in rally, in fact, I even took part in the Talbot Sunbeam Lotus' Italian Rally championship winning a race in San Marino back in 1981 So this is a very nostalgic moment for me. As we unveiled the car in Frankfurt, alongside the original championship winning car, I had the chance to get back inside and the smell was exactly the same ñ it brought back many happy memories for me.

IMAGE TOP

Talbot Sunbeam Lotus rally car

IMAGES MIDDLE

Exige S (left and middle), Exige R-GT and Talbot Sunbeam Lotus (right)

IMAGE BOTTOM

Exige R-GT unveiled at Frankfurt Motorshow 2011

ELISE S:

Want more torque? Then the new Elise S is the answer to your prayers. The Elise S replaces the Elise SC with a new 1.8l super charged engine capable of delivering 220 PS and a power delivery which results in even more torque.

With the new engine and improved throttle response the Elise S gives an even more exhilarating and lively drive experience. The more efficient engine results in lower fuel consumption and CO2 emissions than the outgoing Elise SC.

IMAGE TOP

New Elise S

IMAGE MIDDLE

Elise CR SPS Interior

IMAGE BOTTOM

MY12 Evora interior

TWO NEW OPTIONS

Evora S IPS:

The new Evora S with IPS (Intelligent Precision Shift) option is added to the award-winning Evora line-up with all the power and handling of the Evora S with the versatility of IPS. The S with IPS option features the 3.5l V6 supercharged engine delivering 350 PS and optimised IPS calibration. The paddle shift manual mode allows the driver the full and uncompromised Evora S experience with the added bonus of switching to automatic mode. This is the most versatile Evora yet.

The entire Evora model year 12 range has benefited from over 130 quality improvements including significant

changes to the transmission dynamics, engine performance, improved IPS calibration and interior trim upgrades. The model year 12 Evora S IPS on display in Frankfurt showcases the first physical evidence of Lotus new era in action.

Elise SPS:

The SPS (Serial Precision Shift) is the latest gearbox option available for the 1.6l Elise. The SPS option utilises new lightweight robotised automated manual transmission technology to allow the driver to switch between manual and automatic driving modes via paddles fixed to the steering column giving an even more direct connection with the road. The SPS option showcases

Lotus' clever approach to increasing the pure driving experience through innovative use of lightweight technology.

ONE SPECIAL LIMITED EDITION

Evora GTE road car:

All hail the mighty Evora GTE road car. Producing over 444 PS from the race developed Lotus Evora GTE engine, this is, quite simply, the most powerful Lotus road car ever built. Yet contrary to its extreme roots, the Evora GTE road car also delivers a comfortable and refined element to its high performance driving characteristics. Originally designed as a special limited edition for the Asian market, production will now be expanded on the Evora GTE road car to meet demand and reach further markets.

Lotus Lightweight DNA:

Clever use of carbon fibre has been integrated extensively throughout the exterior and interior of the car, this is one major contributors to the 105kg weight reduction versus the base Evora. Carbon fibre has been used for all the bodywork modifications including the front and rear bumpers, the rear wing and the doors.

IMAGE TOP

New Evora GTE

IMAGES RIGHT

Evora GTE renderings

LOTUS CHIEF ENGINEER AWARDED:
ELECTRIFYING 100 AWARD

Earlier this year many of the most influential people in the world of automotive, energy and transportation gathered at the Henry Ford Museum in Dearborn, Michigan to celebrate the "Automotive News Electrifying 100".

The Automotive News Electrifying 100 is a first time listing of 100 of the most influential people leading the automotive industry towards a more electric-powered future of hybrid and EVs. Named on this list are many of the worlds movers and shakers who are pushing vehicle electrification forward and includes key people from major automotive manufacturers, leading industry suppliers, energetic start-ups, venture capitalists, government officials, battery companies and infrastructure entrepreneurs.

Lotus Engineering's Chief Engineer for Electric & Hybrid vehicles, Phil Barker, was named on the list for his outstanding contributions over the last few years in the area of electric and hybrid vehicle technologies.

Phil Barker has worked at Lotus Engineering for over seven years and during that time he has been responsible for the formation and leadership of a group dedicated to hybrid and electric vehicle projects. More recently, Phil has been responsible for the development of products and engineering services to offer third party clients and as a result Lotus Engineering has conducted many hybrid and electric vehicle projects for clients all over the world. These projects have included technology research, concept studies and demonstrator vehicles, using cutting edge technologies and innovation.

On receiving his award, Phil said

"it is a great honour to be awarded in this way by Automotive News and to be in such company as listed in the "Electrifying 100". The award is really for the whole team at Lotus Engineering that are dedicated to working in the world of hybrid and electric vehicles and pushing the boundaries of alternative transportation."

Mark James, Director of Engineering, said

"this award demonstrates that Lotus Engineering is one of leading automotive engineering consultancies in world when it comes to the development of electric and hybrid vehicle technologies."

He continues,

"in addition Lotus Engineering is continuing to look at all ways to help reduce carbon impact and increase sustainability within the automotive industry."

Lotus Engineering has seen an increasing demand from its global client base for EV and HEV technologies, demonstrating its clear leadership in this field. □

FRANKFURT SHOW:
BLACK CABS GO GREEN

At eCarTec in Munich Germany and Testing Expo in Michigan, USA, Lotus Engineering displayed a high technology London Taxi.

Developed by the UK Government's Technology Strategy Board funded consortium of Intelligent Energy, Lotus Engineering, LTI Vehicles and TRW Conekt, this London Taxi is very different.

It is a plug in hybrid, but not a "traditional" hybrid (where the electric motor uses electricity stored in a battery and generated from an internal combustion engine). The electric motor in this taxi uses electricity generated from a Hydrogen Fuel cell which is stored in a lithium polymer battery pack, so the emissions are just water vapour!

Although designed to operate in a congested city environment with stringent emission regulations, the taxi offers no penalty in terms of vehicle performance or restrictions to cycle regimes.

Capable of achieving a top speed of over 130 km/h (80 mph), courtesy of the 100 kW and 550 Nm (peak) electric motor, the Hydrogen Fuel Cell London Taxi has a range of 250 km (150 miles) on the New European Drive Cycle, enabling the vehicle to operate for a full day without the need for refuelling – and if it does need to refuel, this takes only about 5 minutes.

A BRILLIANT PIECE OF PACKAGING AND IMPROVED PERFORMANCE

There are no external visual differences when compared with the conventional London Taxi, so one of the biggest design challenges for Lotus was to ensure the new powertrain

OTHER LOTUS NEWS

GORDON MURRAY JOINS GROUP LOTUS

Group Lotus adds design legend to the Lotus Advisory Council

Group Lotus is delighted to announce the appointment of Gordon Murray to the Lotus Advisory Council. Murray will work alongside automotive industry icons Bob Lutz, Tom Purves, Prof. Dr. Burkhard Göschel and Frank Tuch to advise Group Lotus on current and future development.

JEAN ALESI TO TAKE ON THE INDY 500 WITH LOTUS

Scheduled for 27 May 2012, Group Lotus brand ambassador Jean Alesi will make his return to competitive racing flying the flag for Group Lotus at the worldís biggest motorsport race - the 96th Indy 500.

Despite his considerable experience, Jean has never before taken on competitive oval racing. Following a 12 year stint in F1 from 1989 to 2001, Alesi moved onto DTM racing and then last year made his most recent competitive race appearance in the Le Mans Series.

LOTUS MOTORSPORT SIGNS PETRONAS

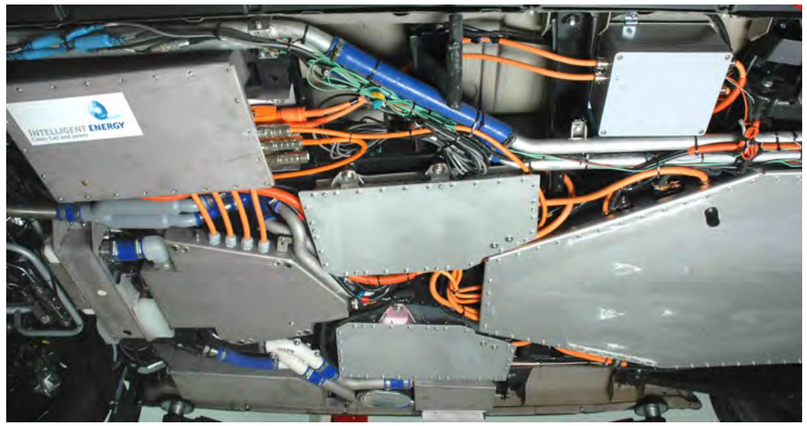
Multi-year premium partnership agreement signed as PETRONAS become Lotus' Official Lubricants Partner for GT Motorsport

IMAGE RIGHT

Underside of fuel cell taxi

IMAGE BELOW

Fuel cell taxi outside the Lotus factory



could be fitted within the vehicle with no impact on the passenger or luggage space. This meant that packaging all the subsystems around the chassis and body system, originally designed for a conventional front engine rear drive layout, necessitated some very creative thinking from the designers and build team.

The engine bay houses the 154 litre hydrogen storage tank. The 30 kW hydrogen fuel cell system is located between the driver and front passenger, the 14 kWh,116 kW lithium-ion polymer battery pack is positioned under the floor of the rear passenger compartment and the electric drive system is mounted behind and beneath the rear passenger seat.

Drivability is similar to the standard taxi with simulated automatic transmission "creep" and "engine braking", the latter provides energy regeneration under braking. In addition, the electric driveline, fixed ratio transmission and a bespoke independent rear suspension system all contribute to giving this taxi a very smooth ride. □

US: GM INTRODUCES 'FRONT CENTRE AIRBAG'

General Motors says that it will introduce the auto industry's first front centre airbag, an inflatable restraint designed to help protect drivers and front passengers in far-side impact crashes where the affected occupant is on the opposite, non-struck side of the vehicle.

The front centre air bag will be introduced on the Buick Enclave, GMC Acadia, and Chevrolet Traverse mid-size crossovers in the 2013 model year. This new safety feature will be standard on Acadia and Traverse with power seats and all Enclaves.

The front centre air bag deploys from the right side of the driver's seat and positions itself between the front row seats near the centre of the vehicle. This tethered, tubular airbag is designed to provide restraint during passenger-side crashes when the driver is the only front occupant, and also acts as an energy absorbing cushion between driver and front passenger in both driver- and passenger-side crashes. The airbag also is expected to provide benefit in rollovers, says GM.

GM says that its analysis of the National Highway Traffic Safety Administration's Fatality Analysis Reporting System database, found that far-side impact crashes, which the front centre airbag primarily addresses, accounted for 11% of the belted front occupant fatalities in non-rollover impacts between 2004 and 2009 involving 1999 model year or newer vehicles. These far-side fatalities, where the occupant is on the non-struck side of the vehicle, also represent 29% of all the belted front occupant fatalities in side impacts.

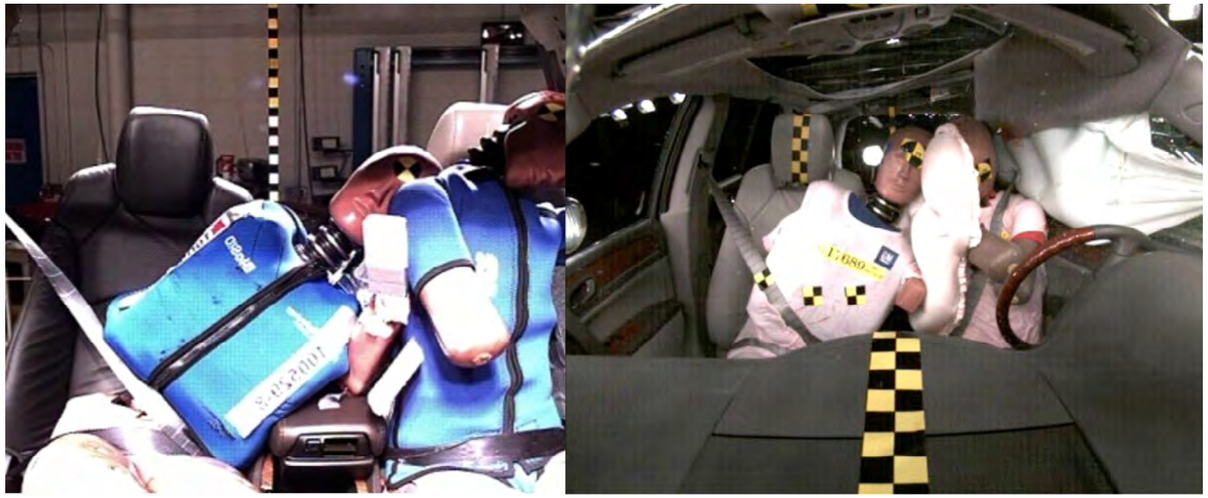
"The front centre airbag is not required by federal regulation, and no other airbag in passenger vehicles today offers the type of restraint and cushioning this air bag is designed to provide for front occupants," said Scott Thomas, senior staff engineer in GM's advanced restraint systems.

"The front centre airbag has real potential to save lives in side crashes," said Adrian Lund, president of the insurance Institute for Highway Safety. "GM and Takata are to be commended for taking the lead in this important area."

GM and technology supplier Takata developed the front centre airbag over the course of three years, testing many design iterations to achieve packaging, cushioning, and restraint for a variety of crashes and occupant positions. Numerous elements of the airbag's jointly patented cushion design address the restraint's unique performance characteristics while considering a range of occupant sizes.

IMAGE BELOW

CENTRE AIRBAG TESTING



"While no restraint technology can address all body regions or all potential injuries, the front centre airbag is designed to work with the other airbags and safety belts in the vehicles to collectively deliver an even more comprehensive occupant restraint system," said Gay Kent, GM executive director of Vehicle Safety and Crashworthiness.

"This technology is a further demonstration of GM's above-and-beyond commitment to provide continuous occupant protection before, during and after a crash.

Author: Dave Leggett.

GM and technology supplier Takata developed the front centre airbag over the course of three years

UK:
DIESEL HYBRIDS SET FOR GROWTH IN EUROPE

Researchers at Frost & Sullivan believe that diesel hybrids will play a key part in lowering average CO_2 emissions in Europe over the next five years.

The firm also suggests that further industrial cooperation between OEMs is also a possibility in order to overcome high costs in this area.

Frost & Sullivan estimates that in 2015, every other car sold in Europe will have CO_2 emissions in the range of 101-120 g/km. It says that diesel hybrids are likely to have a positive impact on the European market and further increase the share of diesel engines in the region.

Although the initial costs are higher, diesel hybrids provide higher performance, lower CO_2 emissions and better fuel efficiency, says F&S. However, the researchers also note that the principal drawback of diesel engines has been in controlling particulate matter (PM) and emissions of oxides of nitrogen (NOx).

"European car manufacturers have adopted different strategies to reduce PM and NOx emissions, and one of those adopted is engine downsizing," says Research Analyst, Bharath Kumar Srinivasan, from Frost & Sullivan. "However, downsizing a diesel engine will result in higher NOx emissions." Automotive OEMs therefore need to develop diesel engines, which meet low CO_2 targets whilst complying with EU emission standards (Euro norms) at the same time. The PSA Group added a hybrid kit to a diesel powertrain and has unveiled the diesel Peugeot 3008 Hybrid4 with 200 bhp and CO_2 emission as low as 99 g/km. The diesel powertrain produces a power output of 163 bhp and the electric motor generates an additional 37 bhp. Both powertrains are capable of running independently, thus offering the flexibility of using the all-electric mode within cities and making it a zero-emission vehicle.

F&S says that diesel hybridisation will be a significant trend toward meeting the 2020 targets of 95 gm/km, set by the European Commission. However, the higher costs of the technologies involved in a diesel hybrid, like the Hybrid4 technology, have been a key limitation to the launch of diesel hybrids. Attractive packaging is therefore expected to be a crucial proposition.

"PSA has managed to combine the best of technologies into a single package," Srinivasan says.

"The Peugeot 3008 for instance, a crossover vehicle, allows multi-purpose use and is more practical for covering long distance travel. It therefore has an added advantage over electric vehicles, for which the driving range is often an issue – especially for travel between cities."

With the leading volume brands - Fiat, PSA, Renault & Volkswagen - all having a strong diesel portfolio, a joint development of diesel-hybrid solutions could prove beneficial F&S suggests.

Not only does it lower development costs, it also offers the required economies of scale with the potential for large volumes. PSA's cooperation with BMW for hybrid components and the BMW-Daimler-GM joint development of the two-mode hybrid, although expensive, are successful examples of joint development.

F&S says that based on current market perspectives, the demand for diesel hybrids is set to grow to more than 300,000 units by 2016-17.

Author: Dave Leggett.

UK:
JLR HAILS GOVERNMENT SUPPORT FOR £557M NEW ENGINE FACILITY

Jaguar Land Rover (JLR) has praised UK government support for its decision to locate a new GBP355m (US$557m) advanced engine facility in the British West Midlands.

"I would like to pay tribute to the strong support we have received for this project from our key partners," said JLR Mike Wright. "The constructive and collaborative support we have received from the government, our trade union colleagues, local authorities, local MPs, and of course our employees has been crucial in enabling us to reach this very significant decision."

The engine manufacturing facility is expected to create up to 750 highly-skilled engineering and manufacturing posts at JLR, along with thousands more highly-skilled manufacturing jobs in the supply chain and the wider UK economy.

The news comes as Jaguar Land Rover continues with a raft of new models and developments such as the recent launch of the Range Rover Evoque, the new Jaguar XF with a four-cylinder turbodiesel engine and significant enhancements to the XK range, Land Rover Discovery, Defender and Range Rover.

As part of our long-term strategy for the JLR business, we will design, engineer and manufacture a new family of advanced engine," said JLR CEO Ralf Speth. "This is a major commitment for our company and we will produce these advanced, highly-efficient engines for future Jaguar and Land Rover models at a new facility in the UK.

"As we invest GBP1.5bn a year for the next five years on new product developments, expanding our engine range will help us realise the full global potential of the Jaguar and Land Rover brands.

"The all-new family of 4 cylinder engines will increase JLR's capability to offer high performance engines with class-leading levels of refinement, whilst ensuring continued significant reductions in vehicle emissions."

Jaguar Land Rover employs more than 19,000 people directly in the UK and supports up to 140,000 jobs in total through the supply chain, dealer network and wider economy

Author: Simon Warburton..

FRANKFURT SHOW:
INFINITI TO SHARE MERCEDES PLATFORM

Nissan's luxury brand, Infiniti, will launch a new compact car in 2014 using the same platform as Mercedes-Benz's B-Class, unveiled at the Frankfurt show.

Infiniti also will use Daimler's four and six-cylinder petrol and diesel engines in its next generation G class from 2013 as it looks to grow sales in Europe where fuel-hungry V6 and V8 petrol engines are now mostly out of step with buying habits.

No decision has yet been made on where this new car will be built but it is thought likely it will be outside Japan - Nissan now sells more cars in China alone than its homeland. Daimler and the Renault-Nissan Alliance signed a co-operation agreement last year aimed at cost savings.

Carlos Ghosn, head of both Renault and Nissan, said this latest development marked a deepening of the partnership. The companies also agreed to use Renault motors and Daimler batteries for electric versions of Daimler's Smart and Renault's Twingo, which will also be based on the same vehicle architecture.

"Our strategic cooperation is moving on a fast track and has now extended well beyond the original agreement," Ghosn said at a joint press briefing with Daimler boss Dieter Zetsche. Answering questions from journalists, the two men said that they were talking to each other about how to work together and no region was off limits in terms of where the new compact Infiniti could be built but they were anxious to make sure investments did not overlap.

The two CEOs have previously announced that three- and four-cylinder engines built by Renault will be made available to Mercedes-Benz for its Smart and A-Class models and be built by Renault in France.

Author: Graeme Roberts.

JAPAN:

SUBARU SWERVES TOYOTA HSD AND OPTS TO GO IT ALONE ON HYBRID TECH

Sources at Subaru have told just-auto that the company has decided - contrary to expectations - not to buy-in Toyota's full hybrid HSD system for future Subaru hybrid models, but to develop its own mild hybrid system instead.

A Subaru executive who spoke to just-auto in September 2011 on condition of anonymity has confirmed that the company will launch a hybrid model in Japan in 2013 - as indicated in Subaru's "Motion-V" strategic plan for 2011 to 2015. But, that executive said, contrary to expectations, Subaru's hybrid will not utilize the Toyota Hybrid Synergy Drive (HSD) system mated to an existing Subaru boxer engine. Instead, Subaru's stubbornly independent engineers have created a Honda-style mild hybrid, without the ability to run solely on electric power at low speeds.

FRANKFURT SHOW:

FORD'S 3-CYLINDER 1 LITRE ENGINE CONFIRMED FOR EUROPE MODELS

Ford has confirmed the first production applications for its smallest-ever EcoBoost engine at the Frankfurt Motor Show.

The 1-litre 3-cylinder EcoBoost engine is destined for three models in Ford's European product range - first the Focus, followed by C-MAX and then the all-new Ford B-MAX.

The new 1.0-litre engine is the latest addition to Ford's global family of EcoBoost engines, which currently range in capacity from 1.6 to 3.5 litres globally. Downsized EcoBoost engines feature turbocharging, direct injection and other technologies and replace larger engines with no loss of performance and with lower fuel consumption.

PRODUCT EYE:

NISSAN'S SUPERCHARGED MICRA

Nissan's strategy at the small car end of the market has changed quite a bit in recent years. In Britain, the small and relatively unadventurous Micra (called March in Japan) hatchback produced at the Sunderland plant was key. It was high volume and a pretty straightforward proposition in the days when B-segment superminis ruled the roost in small cars in much of Europe.

Nowadays however, Nissan's strategy is to offer more models at the small car end, each one pitched at a distinct market niche and possessing its own particular design and engineering origins. There's the Pixo, a very low-cost four-seater City Car made in India and sharing platform with the Suzuki Alto. Then there's the Note, a tall five-door hatchback made at Sunderland and based on the last Micra's platform. The standout of the Nissan small car group is probably the Juke, which looks like a shrunken Qashqai – and is also built at Sunderland.

FRANKFURT SHOW:

GM'S OPEL/VAUXHALL WANTS EMISSIONS CONSISTENCY

Alain Visser, sales and marketing head of GM Europe's Opel and Vauxhall brands, would like to see some evening out of environmental standards across Europe.

"Every country has its own variations and tax levels on emissions and, despite the fact we have a European Union, many of these standards have become too ingrained in each country - we would expect some consistency or guidelines."

Half of the automaker's sales are now 'EcoFLEX' models equipped with technologies aimed at reducing emissions and fuel consumption.

FRANKFURT SHOW:

JOKERS EXTEND VW UP BRANDING

Jokers at the Frankfurt show have already found a new name for Volkswagen's new city car, the Up, as a result of the vast array of different body styles and personalisation possibilities making their simultaneous world debut. It is being called the Up Yours.

It had been expected that the new car, which has been prefaced over the past two years by various design concepts, would appear in the initial three-door form only, possibly with the promised electric version, the e-Up, alongside it.

Q&A
RICHARD PARRY-JONES

Interviewed by just-auto editor Dave Leggett

Richard Parry-Jones is best known for his time as a automotive engineering leader at Ford

Until his retirement from Ford at the end of 2007, he spent nearly ten years as Group Vice-President in charge of R&D for all of Ford and its subsidiary companies worldwide, leading a staff of 30,000 professionals in a network spanning 15 countries. He now does some consulting and is also chair of the UK government's 'Automotive Council'.

DL: What are you up to at the moment?

RP-J: It's quite a variety really. There's my consulting company – I work for a variety of blue-chip companies in a mixture of automotive and what might be termed 'technology intensive' industries, such as energy and aerospace [for more, see Richard Parry-Jones' consulting company website URL: http://www.rpj-consulting.com/].

I am also continuing to work as a government advisor on a variety of topics, mainly manufacturing regeneration, but also energy issues.

DL: How does the role as co-chair on the Automotive Council relate to that?

RP-J: The Automotive Council is a subset of that, focusing on manufacturing in the UK in the automotive sector, the automotive sector being seen as bedrock of manufacturing. The automotive sector is being used as a pilot or pioneer for industrial policies and strategies that it is hoped can be adopted across a number of sectors.

As an example, we have recently launched the 'see inside manufacturing' initiative with the government. That's an initiative in which we invite pupils and – more importantly – teachers into modern industrial manufacturing facilities to show them what a modern manufacturing facility is really like and to blow away some of the myths. That whole initiative was piloted by the automotive companies under the leadership of the Automotive Council. We did one in the middle of the year and there will be another event in October. And, based on the experience from these two pilots, the 'see inside manufacturing' initiative will then be rolled out across other UK manufacturing sectors. I think that's a great example of how the automotive work we are doing can be used as a kind of development test-bed for policies applied generally across manufacturing.

DL: Is this initiative being driven by politicians?

RP-J: Yes. Both Vince Cable and Mark Prisk, ministers with responsibility for manufacturing in the UK, are very much behind it. And there is a lot of work from officials undertaken to get companies involved and make an initiative like this work. Getting the right companies to participate is important.

DL: And it's all part of a broader initiative...

RP-J: Yes, that's right; it's really about regenerating manufacturing in the UK, growing manufacturing in the UK. For example, stakeholders include investors who might spend money overseas or in the UK. A part of our work is updating their perceptions of the competitiveness of the UK, but another key aspect is obviously skills for the future and attracting young people into the sector and we feel that the advice they are getting – from parents and teachers – while it may be well intentioned, is not very well informed. Most of the parents and teachers giving advice have no idea what modern manufacturing is all about. In the past we have had various programmes to bring children into factories, but the problem there is that you only reach one at a time. For every teacher we can get into a factory, that can mean reaching out to, say, 30 or 60 children. By updating the teachers' perceptions, they should be able to give better advice to the pupils. There's a focus in our approach now on getting to the teachers.

The original idea for this came from a conversation between myself, a government minister and Bentley. People at Bentley said that they thought it important to get teachers involved, a kind of 'bring a teacher to work' day, and it went from there.

DL: And the current government's approach has not been very different to that of the previous one, which set up the Automotive Council?

RP-J: It has actually been a pretty seamless transition. Initially it seemed that there was some scepticism from some, and I was worried that there would be an attitude that that was the old government's policy and therefore it must be wrong, so let's start again. But once we explained what the work is really about and ministers were fully briefed on that, they could see the logic. From that point onwards government ministers have been solidly supportive.

DL: And the origins of this go back to the idea of having an 'active' industrial policy?

RP-J: Yes, the idea was to have a strategy, where should we specialise and how could government work with industry to support those sectors where we could make a difference if we were to have any chance of having a major manufacturing sector in the future. It is certainly not about special case pleading or asking for bailouts for failed companies. We do not support government help for fundamentally failed companies. But it's not about being passive either. The basic idea is not to wait till the patient is nearly dead and then to act ineffectively and late (usually in a way that could not avoid failure, the case in the past at times), but to assist healthy companies with good business models to grow in the interests of the national economy and to develop an appropriate strategy to support that – with the right education, R&D help, the right infrastructure, the right conditions and so on.

> **Automotive was clearly at the heart of what was considered strategic**

Automotive was clearly at the heart of what was considered strategic, as was aerospace and pharmaceutical for example, all coming under the heading of 'advanced manufacturing'. And the policies were developed under [previous government's industry minister] Peter Mandelson's stint when he adopted many of the recommendations submitted by myself and others under the aegis of the reports of the NAIGT. The Automotive Council subsequently emerged from that period of policy discussion. Peter Mandelson was the first co-chair, with me.

When the government changed, Vince Cable took over as co-chair of the Automotive Council and the work has continued.

DL: But the Automotive Assistance Programme (AAP) designed to help suppliers over short-term financial difficulties a few years ago, when the banking crisis hit, attracted a lot of criticism didn't it?

RP-J: Yes, because it didn't work as well as it should have done. The supplier industry in the UK did not get as much assistance as it should have done because of the execution of that particular programme and the onerous conditions associated with it. Lessons have been learnt.

But there are other financial interventions that have worked well and supported companies in the right way. A good example is the Regional Growth Funds (RGF). If you look at the projects approved under that, automotive did rather well. And the reason for that is that in every case, automotive was saying 'we have a good business and we're making money, but we would like to add further capacity or increase production to grow our business in the UK. Are you willing to help us?'.

And that's the kind of situation where a boost to the UK manufacturing base can be achieved, but it's about the whole picture – skills, good business models, right infrastructure and competitiveness. Grants alone can't rescue anything, but they can tip the balance – if other conditions are in place – to secure greater investment and growth for the UK.

And I believe it represents good value for money for the taxpayer.

DL: So where does RGF stand now?

RP-J: There are currently applications in for 'round 2' and the approvals will be announced by the government in due course. I hope that when they look back at the experience with rounds 1 and 2, they will conclude that these are very good programmes, representing very good value to the taxpayer (they ultimately generate much more tax revenue than they cost). I hope they will view it as a key tool to generate more growth in the UK economy and decide to continue with it.

IMAGE ON RIGHT

Richard Parry-Jones, Mark Prisk and Dany Bahar at Frankfurt Motorshow 2011 (left to right)

DL: As I understand it, the Automotive Council works with two important sub-committees that do much of the groundwork – one is technology led, the other is concerned with the development of the supply-chain. What kinds of things are emerging as key issues for the UK automotive supply-base?

RP-J: Well, there are a whole range of factors being closely looked at in relation to what we can source in the UK currently, the health of the supplier sector overall, the state of new technologies and how we become more competitive in areas where it is vital that we are present and active for future growth – a 'sourcing roadmap'.

What do we need to get more competitive in the supply-chain? One thing we are looking at is collaborative procurement so that we can improve economies of scale for suppliers. Obviously we have to be careful so that competition rules aren't broken, but collaborative procurement in some areas could play a greater role. Skills enhancement is another important area, particularly management skills.

And access to finance has emerged as an important issue for the smaller companies, the tier 2s, 3s and 4s. They struggle with access to finance in the UK and there are complex issues at work in that area that we are discussing – it has also been discussed at an SMMT Open Forum and we are forming a working-group to look specifically at financing.

Communications is also an important area of activity, to effectively communicate initiatives. There's also a perception gap that we need to work on to improve the image of the industry more widely. The reality and the perception remain very different and that's something we are working hard to change.

RICHARD PARRY-JONES

Richard is an automotive engineering leader who worked for the Ford Motor Company for 38 years between 1969 and 2007.

Until his retirement from Ford at the end of 2007, he spent nearly ten years as Group Vice-President in charge of R&D for all of Ford and its subsidiary companies worldwide, leading a staff of 30,000 professionals in a network of Product Development centres in 15 countries. He was also the Company's Chief Technical Officer for the last 8 years.

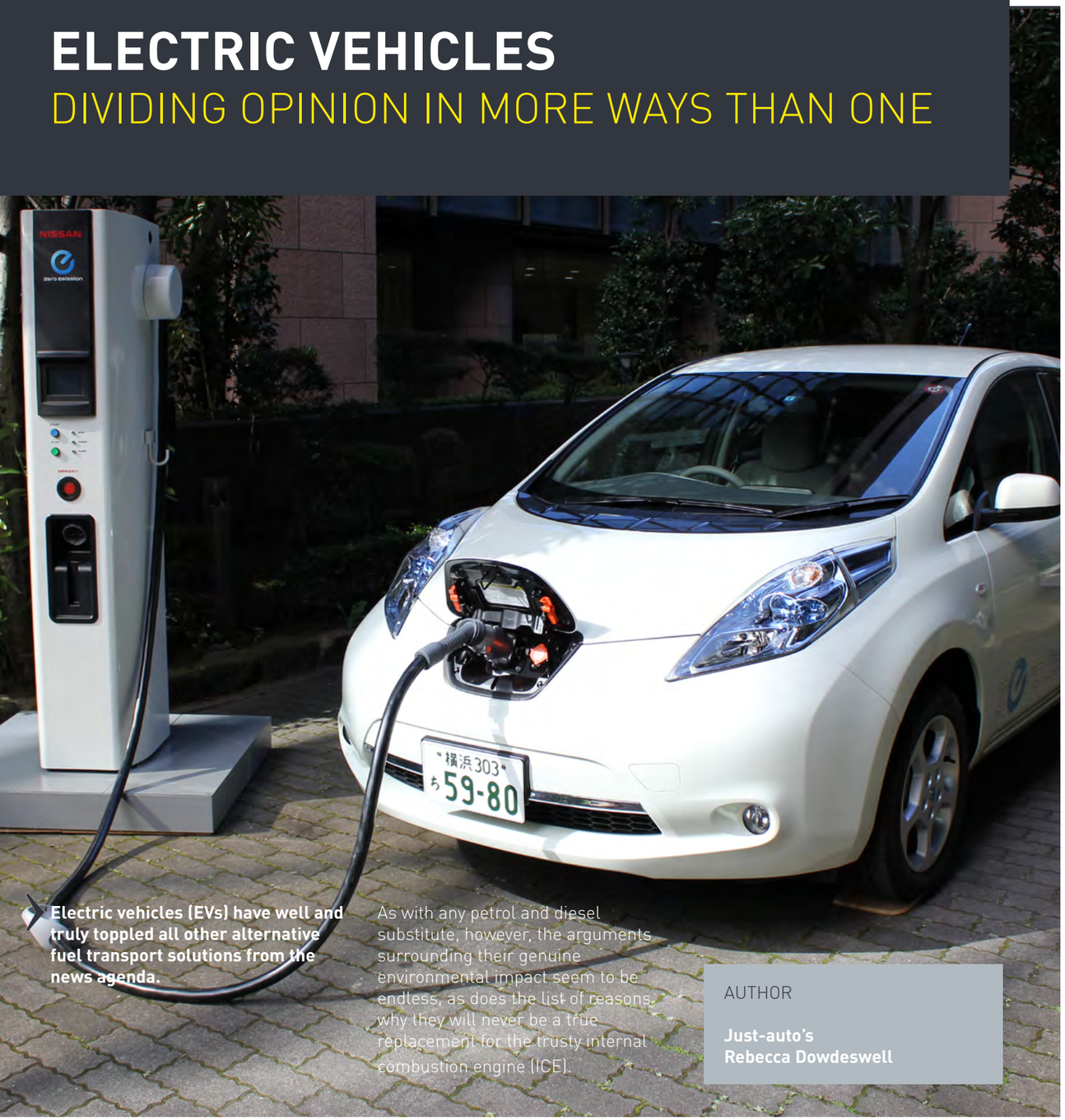
During his career at Ford he has lived and worked in many countries outside the UK, including 7 years in the US and 5 years in Germany. He was responsible for developing all the Ford Europe cars launched between 1993 and 2008, and for many Jaguar, Land Rover, Aston Martin and Volvo products.

He served as the Chairman of the Ford Global Product Committee for 10 years, and as Chairman of the Supervisory Board for Ford Germany, and was Chairman of the Mazda Advisory Board for many years.

His contribution has been recognized externally in numerous ways, including 8 products winning major Car of the Year awards. He was named Man of the Year in 1994 by the top British publication Autocar and in 1997 by the U.S. magazine Automobile. In 2001 he received the Golden Gear Award for outstanding automotive achievement from the Washington Automotive Press Association. In 2006 he was awarded a special award by Autocar magazine for his career contribution to the industry.

ELECTRIC VEHICLES

DIVIDING OPINION IN MORE WAYS THAN ONE



Electric vehicles (EVs) have well and truly toppled all other alternative fuel transport solutions from the news agenda.

As with any petrol and diesel substitute, however, the arguments surrounding their genuine environmental impact seem to be endless, as does the list of reasons why they will never be a true replacement for the trusty internal combustion engine (ICE).

AUTHOR

Just-auto's Rebecca Dowdeswell

IMAGE LEFT

Nissan Leaf

Supporters claim that EVs are inherently more efficient than ICE cars even when the electricity they run on comes from a coal-fired power station, that they are perfectly practical for the typical everyday needs of the average driver and that with government grants they will be affordable.

Allies also point to their immense energy storage capabilities when combined en masse and thus the potential that EVs have in actually taking pressure off otherwise stressed-out electricity grids, as well as their smart mobility role in preventing global gridlock.

Sceptics, on the other hand, say EVs are (and always will be) too expensive and that they are impracticable because of their range limitations and the vast weight of their batteries. As a result, they say, EVs will never be anything more than a niche solution, and an interim one at that until the holy grail of green motoring – the hydrogen fuel cell – is reached.

Critics also insist that EVs are not even environmentally-friendly unless the electricity they run on is generated by nuclear or some kind of renewable energy (e.g. wind/solar/tidal), which in most cases it isn't.

Here, we take a closer look at one of the many environmental debates which surround EVs as well as hearing some surprising comments from some of the car manufacturers themselves.

The Chevrolet Volt and Nissan Leaf were both launched to a fanfare at the end of 2010. Each has been hailed as showcasing the very best of new-generation EV technology, albeit in different ways. The Volt is a range-extended electric car with a supplementary internal combustion engine, in theory meaning that its drivers will never suffer from 'range anxiety' (otherwise known as a flat battery).

Meanwhile, the Leaf has no back-up engine, the downside of which is that it is strictly limited to a range of 80 – 100 miles, but the upside of which is that it really is 'zero-emission' at road level.

Other, lower-profile EVs are also being marketed as on sale in the UK and Europe, or soon to be so. These include the Mitsubishi i-MiEV, over 5,000 of which are already on European roads according to Mitsubishi, and rebadged versions of that car, the Peugeot iON and Citroen C-Zero. Then there's Renault's Fluence ZE, the smart fortwo electric drive, the Tata Vista EV and the Toyota Prius Plug-in.

Yet try and actually buy any of these cars and you may be surprised as they are in extremely short supply. For example, General Motors (GM) and Nissan both plan to build just 20,000 units of their respective EVs in 2011, the vast majority of which are restricted to US test fleets. Of the few EVs that have made their way to Europe, these cars are less on-sale, and more on-lease, and even then, just as is also the situation in the US, often not to the average man or woman on the street.

Of course, now that the first EVs have been launched, production will start to ramp up. Next year, for example, GM will more than double its 2011 numbers, having recently increased its 2012 production target from 30,000 to 45,000 Volts (10,000 of which have been earmarked for Europe, in the form of the Vauxhall/Opel Ampera).

IMAGE BELOW

Chevrolet Volt

By 2015, GM says it will have the capacity to build and sell 120,000 Volts and Amperas. Yet still, this would only be equivalent to 1.3% of its global volumes, assuming GM sales of around 9M in 2015.

Trying to calculate how clean a car is on the basis of what comes out of its exhaust pipe is becoming a progressively more primitive mode of measurement – not least if the vehicle in question does not even have an exhaust pipe!

The fact that EVs are usually described as zero-emission (because of their lack of road-level exhaust gases) infuriates their critics who quite rightly point out their true and full environmental impact can only be

HOW DO YOU MEASURE TAILPIPE EMISSIONS WHEN YOU DON'T HAVE A TAILPIPE?

gauged when considering the lifecycle emissions of electricity. The problem is that that this is easier said than done.

It is a fact that EVs use their energy more efficiently than ICE-powered cars. Some studies have shown that an electric car can run at as much as 90% efficiency across the whole driving range from a hard acceleration launch to cruising.

Cars powered by an ICE typically reach up to 35% efficiency if they're cruising at 60mph in steady motorway conditions, but amazingly, can slump to as little as 2% efficiency in other driving conditions, such as stop and start driving in cities, or driving that involves a lot of hard acceleration and braking. And then there is the argument that generating electricity on a mass scale in a power station – regardless of how that electricity is produced is substantially more efficient than having millions of mini-generators (i.e. cars with petrol- or diesel-burning engines) on our roads.

IMAGE ABOVE

Renault Twizy, Fluence Z.E, Kangoo Van Z.E., ZOE (left to right)

U.S. electric sports car manufacturer Tesla Motors uses data from one of the world's few remaining large-scale diesel-powered utility companies to claim that with one gallon of diesel, you can either run an ICE car for 38 miles or use that gallon of diesel to produce electricity and run an equivalent EV for 89 miles.

So is there no truth behind the argument that EVs simply displace emissions from the road to the power station?

RENAULT NISSAN
THE EXCEPTION TO THE NORM

Franco-Japanese conglomerate Renault Nissan has made the most ambitious EV sales predictions to date and has an EV programme to match, endeavouring to be the first major vehicle manufacturer to launch a full range of EVs onto the market.

Company executives have gone on record several times to predict that EVs will make up around 10% of total global industry volumes by 2020. Hot on the heels of the launch of the Nissan Leaf will soon come Renault's Megane-based Fluence ZE EV, allegedly followed in 2012 by various electric cars, including the Renault Zoe C-segment car and the Twizy two-seater urban car) and electric light commercial vehicles.

However, few of Renault Nissan's competitors are as bullish, with Mitsubishi so far being the only other major rival to publically concur with such large-scale beliefs.

BLINK AND YOU'LL MISS THEM EVEN IN THE LONG TERM?

UK Government-commissioned report published in late 2007 thinks there is. The King Review stated that:

"clean cars are dependent on clean power and, as the world moves towards EVs, countries' road transport CO2 emissions will increasingly be determined by the composition of their power generation sector."

The fact that coal-fired power stations – such as those that dominate the UK - only run at around 30% efficiency, does not help EVs' cause. In countries such as France where most electricity is nuclear, the numbers are completely different, but who wants to go down that road in the light of recent events in Japan? And while it is true that renewables – such as tidal, solar and wind – can all make a contribution, the possibility of those becoming a serious contributor to large-scale energy production are distant, at best.

IF THE WORLD'S ROADS AREN'T CLOGGED WITH EVS IN 2011, WILL THEY BE IN 2020?

Many experts think not, which could be considered surprising given the intense hype which has surrounded EVs for several years and which shows no sign of stopping anytime soon.

At the Geneva Motor Show in March 2011, Ford Motor Company's Director of Global Electrification, Nancy Gioia, told just-auto.com:

"Our global fleet today is about 1% electrified, which includes our hybrids. By 2020, we expect 10 – 25% of our global fleet to be electrified. Of that 10 – 25%, we expect circa 70% of them to be hybrids, 20 – 25% plug-in hybrids and the remainder [5 -10%] battery electrics."

In other words, Ford expects that a maximum of 17.5% of its global sales will be hybrids by 2020, and a minimum of 7%.

IMAGE BELOW

Mitsubishi MiEV

Between 2 and 6.25% of its total sales will be of plug-in hybrids (like the Chevrolet Volt) and just 0.5 – 2.5% will be pure electric cars, it thinks.

Many other forecasts are just as muted. Auto forecasting house JD Power, thinks that EVs will account for only 2% of total light vehicle sales by 2020, while IHS Global Insight is even more cautious, predicting that EVs will make up around 1.1% of passenger car production by 2020 and just 0.9% of total light-vehicle production in that year.

But if EVs aren't the future, what are? GM for one is clear on this.

"We think the future of individual mobility lies in electric cars powered by fuel cells with hydrogen as the fuel"

Dr. Lars Peter Thiesen, GM's Manager of Hydrogen and Fuel Cell Deployment Strategy, recently wrote in an official company document.

"Fuel cells have two decisive advantages over batteries: first, hydrogen's high energy density allows a completely emission-free drive range of several hundred kilometers. Secondly, fuel cell vehicles can be fuelled in only three minutes, a much shorter time than battery recharging. We have invested billions in developing this propulsion technology and we're now confident we will bring it to production maturity by 2015."

TERNARY BLENDS OF GASOLINE

For each country, there is a limit beyond which sustainable ethanol cannot be made from biological feedstocks.

This fact has been used by some on occasion to rule alcohols out as viable long-term energy carrier for transport.

This is unfortunate, because in most respects, the low-carbon-number alcohols (which include ethanol) offer a very attractive alternative to a transport energy economy based on electricity or molecular hydrogen, both of which will entail significant extra cost being absorbed by the consumer in the long term because they require radically different vehicles, distribution infrastructure, or both.

AUTHORS

James Turner and
Richard Pearson

Transition to an energy economy based on alcohols would be an evolutionary process and not a

PRELIMINARY TEST RESULTS OF A CONCEPT TO CIRCUMVENT THE BIOMASS LIMIT OF ETHANOL

revolutionary one. This is because, unlike the alternatives, the alcohols are miscible with gasoline, which alleviates the supply infrastructure and vehicle storage issues. While a small on-cost is incurred with adoption of alcohol/gasoline flex-fuel technology, this is likely to be in the region of only $100-200 per vehicle, and not in the $10,000 per vehicle region which a 100 mile range traction battery or molecular hydrogen storage system would cost. As such, flex-fuelling is attractive except for supply of fuel to the marketplace.

Lotus has been conducting tests on a fuel blending concept intended to circumvent the biomass limit of ethanol by co-blending it with both methanol and gasoline. Briefly, for any binary gasoline-ethanol mixture (such as E85), a ternary blend of gasoline, ethanol and methanol can be substituted in which the volume fraction of each individual component is chosen to yield the same stoichiometric, or chemically-correct, air-fuel ratio (AFR). For E85 this AFR is 9.7:1, and a family of equivalent, or 'iso-stoichiometric', ternary blend fuels can be created ranging from E85 to M56 (see Figure 1).

In order to describe the volumetric proportions more accurately, these two limit blends would be termed G15 E85 M0 and G44 E0 M56, and the family of blends is generally described as GEM blends.

Importantly, all of the iso-stoichiometric blends have been found to have essentially identical volumetric energy content (based on the masses and densities of the individual components). This suggests the possibility that drop-in blends equivalent to E85 can be created which could distribute the available ethanol across a greater total volume of fuel supplied. Since gasoline is displaced, a more beneficial situation is arrived at if the methanol used is better from a carbon intensity or energy security viewpoint.

At the same time, based on the mass proportions of the individual components, the latent heat of the blends was calculated and found to vary by 2%. Thus the essential prerequisites to produce truly drop-in fuels are satisfied.

Vehicle tests were then conducted using a production flex-fuel vehicle supplied by Saab Automobile Powertrain AB. A procedure was drawn up in order to change the test fuel and condition the vehicle identically for each blend, and then to operate it on one cold and two hot New European Drive Cycle (NEDC) tests.

Results, in terms of tailpipe CO_2 and vehicle energy utilization, are shown in Figures 3 and 4, respectively.

An initial test programme has been conducted to investigate these GEM blends and is reported in detail in a recent SAE paper [1]. This article will report some of the results. In order to perform this test, a control gasoline was quarantined, and four blends specified, blended and tested. These blends were:

BLEND A – G15 E85 M0

A test fuel representing a nominal 'E85' blend.

BLEND B – G29.5 E42.5 M28

This test fuel splits the available ethanol across twice the total volume of fuel.

BLEND C – G37 E21 M42

In a manner similar to Blend B, this blend splits the available ethanol across four times the total volume of fuel. Additionally, methanol is twice the volume of ethanol, and the total volume of alcohol is approximately twice that of gasoline

BLEND D – G44 E0 M56

This is the extreme of range of ternary blends at 9.7:1 stoichiometric AFR, and is the binary methanol-gasoline equivalent of the nominal E85.

After accurate blending, the fuels were and analyzed for various properties including octane number, which is shown in Figure 2.

~Immediately apparent is that the octane numbers are constant across the entire family of GEM blends; this fortuitous linear blending relationship for alcohols in 'gasoline' has only recently been shown by others [2].

Note that, in general, the alcohol blends have better energy utilization than gasoline: this is of the order of ~ -5% when the vehicle is hot, with important ramifications for wellt to-wheel efficiency in a renewable energy economy.

During testing in the emissions lab two malfunction indicator lights (MILs) were illuminated, but only when binary gasoline-methanol blends were tested, i.e. G44 E0 M56. No such lights occurred when ethanol was present in the blends. This underlines that a co-solvent is necessary when gasoline and methanol are blended together. Ethanol is known to be an excellent co-solvent for these two components. Note that other co-solvents for methanol and gasoline exist, and the question of which and how much co-solvent is necessary is one that requires further work.

When the emissions laboratory test work had been completed, the vehicle was fully fuelled with Blend C and the car driven on a road trip from Norwich to Trollhätten. This first tankful of fuel was used for 425 km with an average fuel consumption 11.88 litres per 100 km (23.75 mpg Imperial, 19.78 mpg US). There was no MIL activity during this trip and eight cold starts were performed, including one at -4°C, with no perceptible difference in starting to subsequent tanks of gasoline.

As a consequence of this work it is believed that such ternary blends have the potential to become drop-in alternatives to equivalent-stoichiometry ethanol-gasoline blends. Further work is warranted to prove this claim. Immediately, this means testing a car with a physical alcohol sensor, a difference to the car employed, which utilized an indirect approach for initial AFR control based on the fuel tank level sensing system. This is often referred to as a virtual sensor.

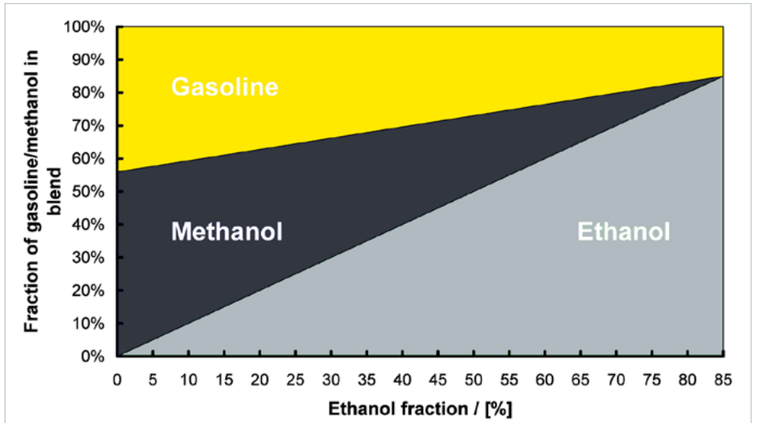


Fig. 1: Family of iso-stoichiometric GEM blends equivalent to conventional E85.

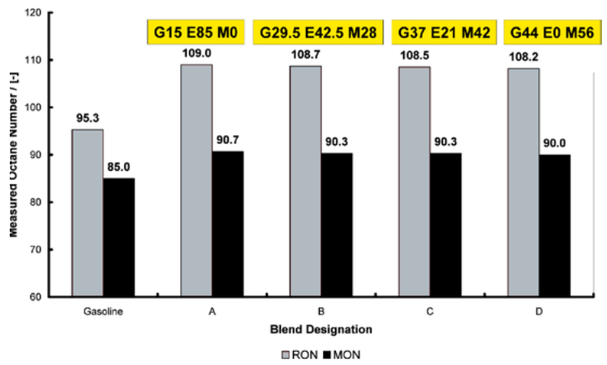


Fig. 2: RON and MON results for four GEM blends.

It is possible to show that GEM ternary blends with a high proportion of methanol can be cheaper than gasoline on a cost per unit energy basis. This is because methanol is much cheaper than gasoline (and ethanol) on a volumetric basis. Using wholesale prices of $3.00/US gallon gasoline, $2.30 for ethanol and $1.30 for methanol, Blend C is slightly cheaper than gasoline per unit energy. This does not include the ~ 5% improvement in energy utilization for the blend, which would translate into a similar reduction in operating costs for the consumer.

While this calculation uses a price for methanol based on its manufacture from fossil feed stock, and assumes that taxation would be on a per unit energy basis, the result does underline the fact that since methanol is cheap to produce it allows a situation where an affordable alternative fuel technology could actually be preferable financially for

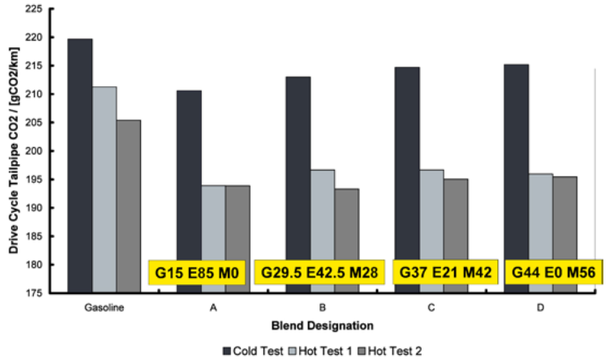


Fig. 3: Production flex-fuel vehicle CO_2 emissions when operated on four GEM blends on the NEDC.

the customer without government subsidy. Neither electrification nor a molecular hydrogen economy permits this.

Furthermore, once large volumes of methanol are being used for transportation, there then exists an evolutionary route to effective decarbonisation through the ease by which it can be made from waste or CO_2 which could be extracted from the atmosphere to solve fully the issue of greenhouse gas emission and energy security [3-17].

It is intended to revisit the economics of ternary blends and report on some initial materials compatibility tests in a later article, but in conclusion here it seems that they could permit evolution to a carbon-free end game where vehicles remain affordable and the taxation system is stable.

The process can begin immediately if the necessary vehicle durability testing of the ternary blends is satisfactory. Furthermore, the needs of all stakeholders in transportation are satisfied:

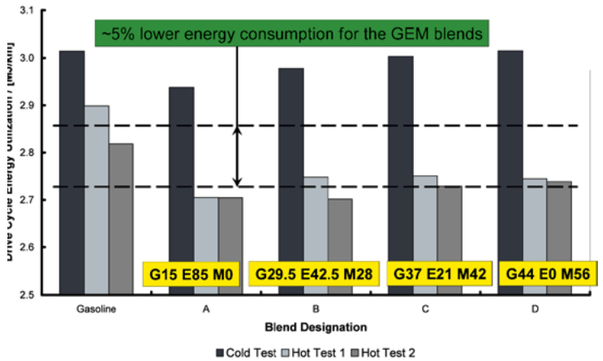


Fig. 4: Production flex-fuel vehicle energy utilization when operated on four GEM blends on the NEDC.

- Governments: because there will be a lower immediate investment in renewable energy and there is no requirement for immediate government subsidies.
- Fuel companies: (a) because the production of renewable methanol from recycled CO_2 will ultimately free manufacturers from their reliance on fossil-derived feed stocks sourced from geopolitically sensitive regions or geophysically challenging environments; (b) because there will be no step-change required from a liquid fuel infrastructure to an alternative which will entail greater expense.
- Vehicle manufacturers: who are struggling to make profit anyway, and for whom this approach ensures that they will not have to write off existing and expensive production lines.
- Vehicle customers: who will still be able to purchase affordable vehicles and fuel.

When renewable methanol is used, it is believed that no long-term alternative strategy presents such an attractive combination of attributes. Instead of being ruled out essentially due to the limited supply of ethanol, the alcohols are ruled in as a potential incumbent energy carrier for transportation.

ACKNOWLEDGEMENTS

Lotus Engineering would like to acknowledge the help and assistance of the partners in the project, including BioMCN, Saab Automobile Powertrain AB and Inspectorate.

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VEHICLE LIGHT-WEIGHTING AND SUSTAINABILITY

AUTHOR

Jason Rowe

The British automotive industry is a large and critical sector within the UK economy.

It accounts for 820,000 jobs, exports finished goods worth £8.9bn annually and adds over £10 billion to the UK economy each year.

However, the UK automotive industry is currently facing great challenges; road transport released 132 million tonnes of CO_2 in 2008, accounting for 19% of the total UK annual CO_2 emission and its global competitiveness is also threatened by the emerging new economic powers, such as China and India. Additionally, the UK government is committed to reducing CO_2 by 80% in all sectors by 2050 and the EU requires 95% recovery and reuse of end of live vehicles (ELVs) by 2015.

A solution to these challenges comes from the development and manufacture of low carbon vehicles (LCVs), and this is clearly presented in the vision of the UK automotive industry set by the New Automotive Innovation and Growth Team (NAIGT).

STRATEGIC IMPORTANCE OF VEHICLE LIGHT-WEIGHTING

Whilst hybrid or electric powertrain systems provide opportunities for lower tailpipe emissions and improvements in fuel economy, the key system components typically increase vehicle mass by 100-40 kg for C-class vehicles with hybrid systems, as demonstrated by the new 2012 Honda Civic sedan hybrid models which will add 100 kg (9.4%) to kerb weight over the non hybrid models.

From US based figures , an average of 9.0% increase in mass has been seen for hybrid vehicles over their non-hybrid equivalent models (Figure 1). These statistics included compact cars, large saloon (sedans), crossovers, full-size sport utility vehicles, luxury vehicles, and full-sized pick-up trucks. At the upper end of the spectrum in terms of vehicle size, the BMW ActiveHybrid X6 weighs 260 kg (11.0%) more than its non-hybrid counterpart.

The scene is different for electric vehicles; a C-class vehicle typically shows a mass increase of 500 kg or more subject to the vehicle's range. In addition to the increases in weight from the powertrain systems there is also a continuing trend in overall vehicle mass increase, owing largely to product enhancements in passenger comfort, infotainment and safety performance requirements.

These additional mass increases offset some of the true potential benefits that these newer powertrain systems offer -- consequently there is a major opportunity to achieve considerably greater vehicle performance through weight reduction by the deployment of lightweight materials and innovative lightweight vehicle architectures.

A review of the energy usage in the vehicle system provides an understanding of the benefits of the alternative powertrain systems and weight reduction.

Figure 2 shows the energy budget for a B Class vehicle operating on the NEDC with a 1.4 litre gasoline engine. For this drive cycle, about one third of the energy produced as work is imparted as kinetic energy of the vehicle and about one third is used to overcome rolling resistance, both of which are related to the vehicle mass.

Figure 3 shows that the much higher tank-to-wheel efficiency of a battery electric vehicle (BEV) means that, potentially, for the same proportion of drive cycle energy losses, there is a greater proportional benefit to the total vehicle energy requirement in reducing the mass of the BEV than for the conventional vehicle.

Vehicle light-weighting is an effective approach to improve fuel economy and reduce CO_2 emissions. CO_2 emissions per km are directly related to vehicle curb weight . Studies have shown that for every 10% reduction in vehicle weight a 3.5% improvement in fuel efficiency can be gained (depending on drive cycle) . In terms of greenhouse effect, this means that every 100 kg weight reduction results in CO_2 reduction up to 3.5 g of CO_2 per kilometre driven . In addition to these primary benefits, vehicle light-weighting reduces the power required for acceleration and braking, which provides the opportunity to employ smaller engines, transmissions and braking systems. These savings have been termed secondary weight reduction and would allow further reductions in CO_2 of up to 8.5 g/km.

APPROACHES TO VEHICLE MASS REDUCTION

A critical requirement for achieving future generation low emission vehicles with enhanced fuel economy may be addressed directly through optimisation of vehicle mass.

A wide range of opportunities are available to achieve weight reduction within the vehicle key systems including body-in-white (BIW); closures; interior trim and equipment; powertrain and chassis. To achieve suitable weight reduction a number of different strategies may deployed from methods such as material substitution through to structural optimisation, and increased structural and functional integration. In opting to use lightweight materials many improvements in mass reduction will typically be accompanied by increases in manufacturing or bill of material (BOM) costs and therefore careful consideration in the deployment of weight reduction strategies is essential where material substitution alone may be inefficient.

One of the major systems of the vehicle is the BIW which represents about one-quarter of the overall vehicle mass and is the core structure of the vehicle. The BIW is so fundamental to the vehicle that sometimes it is the only portion of the vehicle that is researched, designed and analysed in mass reduction technology studies . Over many years there has been a fundamental material shift from wood, cast iron and steel to high-strength steel (HSS), advanced high-strength steel (AHSS), aluminium (Al), magnesium (Mg) and polymer matrix composites (PMCs).

Between 1995 and 2007, the use of aluminium in vehicle structures increased by 23%, PMCs by 25% and magnesium by 127%.

Further vehicle mass reduction can be achieved by mass-optimised design technology. Mass optimisation from a whole vehicle perspective opens up the possibility for much larger vehicle mass reduction. For example, secondary mass reduction is possible since reducing the mass of one vehicle part can lead to further reductions elsewhere due to reduced requirements of the powertrain, suspension and body structure to support and propel the various systems.

New and more holistic approaches that include integrated vehicle system design, secondary mass effects, multi-materials concepts and new manufacturing processes are expected to contribute to vehicle mass optimisation for much greater potential mass reduction.

As reviewed by Lutsey , there have been 26 major research and design programmes worldwide on vehicle mass reduction.

Compared to a steel structure, the HSS intensive body structure by the Auto Steel Partnership achieved 20-30% mass reduction, the aluminium intensive body structures of the Jaguar XJ, Audi A8 and Audi A2 achieved 30-40% mass reduction and a multi-material body structure featuring more a mix of 37% aluminium , 30% magnesium and 21% PMCs by the Lotus High Development Programme achieved 38% mass reduction.

It is clear that although a single material approach can achieve substantial mass reduction the greatest potential comes from an integrated multi-material approach

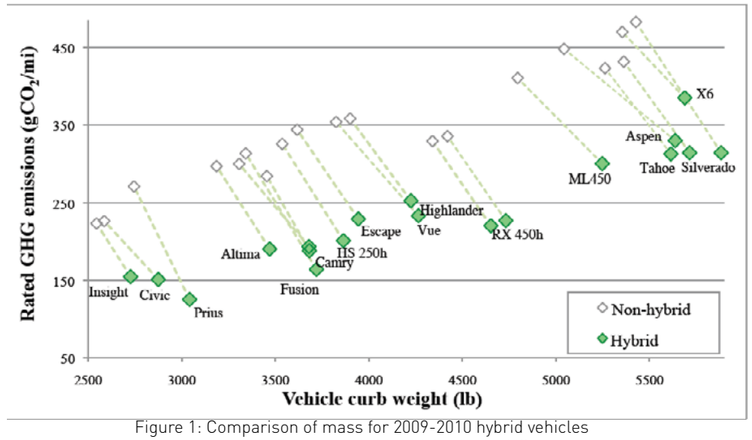

Figure 1: Comparison of mass for 2009-2010 hybrid vehicles versus similar non-hybrid vehicles in the US

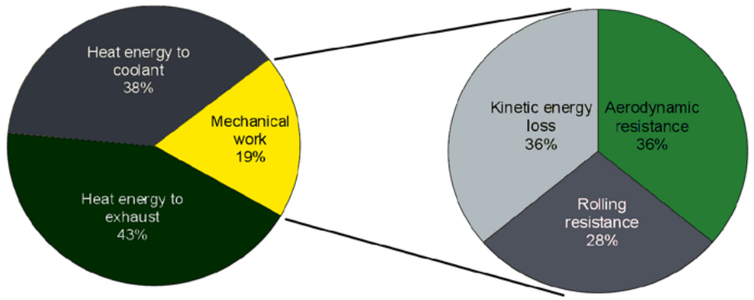

Figure 2: Energy budget for B-class vehicle with 1.4 litre gasoline engine.

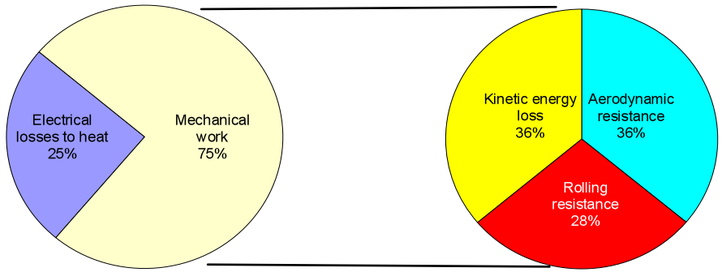

Figure 3: Energy budget for B-class battery electric vehicle

that exploits the mass and functional properties of Al, Mg, PMCs and AHSS.

Despite the greater use of the higher cost advanced materials, mass-optimised vehicle designs could have a moderate or even slightly negative cost impact on new vehicle if a holistic vehicle design approach is applied.

The Lotus High Development Programme demonstrated a 32% whole vehicle mass reduction could be achieved with a 2% reduction in cost, whilst the VW Super Light Car achieved a 35% body mass reduction for a cost of <€8 for every kilogram of mass reduction. The combination of a multi-material concept and a mass-optimised whole vehicle design approach can achieve significant mass reduction with a minimal or moderate cost impact on vehicle structure and it is most likely that the future materials for LCVs are an optimised combination of Al, Mg, PMCs and AHSS**.**

THE DRIVE TOWARDS SUSTAINABILITY

Closed-loop recycling of advanced automotive materials, however, has been missing from nearly all the LCV programmes worldwide, which have concentrated on the reduction of CO_2 emission during the use phase of vehicles produced from primary advanced materials.

The production energy of all primary automotive materials is always much greater than that of their secondary (recycled) counterparts . For instance, production of 1 kg aluminium from the primary route uses 45 kWh electricity and releases 12 kg CO_2, whilst 1 kg of recycled aluminium uses only 5% of that energy and generates 95% less CO_2.

Detailed life cycle analysis (LCA) has shown that a primary Al intensive car can only achieve an energy saving after more than 20,000 km driven compared with its steel counterpart, while a secondary Al intensive car will save energy from the very beginning of vehicle life.

If all the automotive materials can be effectively recycled in a closed-loop through advanced materials development and novel manufacturing technologies, the energy savings and cost reduction for the vehicle structure will be considerably more significant.

SUMMARY

The vision of automotive manufacturers is that future low carbon vehicles (LCVs) are achieved by a combination of multi-material concepts with mass-optimised design approaches through the deployment of advanced low carbon input materials, efficient low carbon manufacturing processes and closed-loop recycling of ELVs.

Advanced materials will include Al, Mg and PMCs, which are all supplied from a recycled source. A holistic and systematic mass-optimised design approach will be used throughout the vehicle (including chassis, trim, etc.) not only for mass reduction and optimised performance during vehicle life but also facilitating reuse, remanufacture and closed-loop recycling at the end of vehicle life.

Novel manufacturing processes will be used to reduce materials waste and energy consumption, shorten manufacturing steps and facilitate parts integration and ELV recycling. Fully closed-loop ELV recycling will be facilitated by new materials development, novel design approaches, advanced manufacturing processes and efficient disassembly technologies, all of which will be effectively guided by a full life cycle analysis.

The themes described in this article have been developed from Lotus market research and the TARF-LCV 2011 (towards affordable, closed-loop recyclable future low carbon vehicles structures) programme submission (reproduced with the kind permission of Professor Zhongyun Fan, Chair of Metallurgy at Brunel University).

INSIDE LOTUS
CLAUDIO BERRO

DIRECTOR OF LOTUS MOTORSPORT

Interviewed by just-auto's Simon Warburton

Lotus' motorsport pedigree reads like a roll call of some of the most famous and evocative names of all time.

Names that peer out from the sport's distinguished history such as Moss, Hill, Fittipaldi, Andretti, Senna and Clark, while F1, IndyCar, Le Mans, GP2, GP3 and Evora GT4, are an illustration of the many competitions in which the manufacturer finds itself.

The company's deep involvement in motorsport reflects the company's desire to demonstrate its transfer of technology from track to road car through the medium of competition, so it's no surprise there's a genuine heavyweight in the form of Claudio Berro to head up the racing team.

SW: How long have you been in motorsport and what does it mean to you?

CB: I have been in motorsport for 30 years. I started in 1979 as a rally co-driver with Turbo Lotus in Italy and we competed in rallying for the World Championship.
I stayed for five years and then [went to] Alfa Romeo and Ferrari. Motorsport is in my blood. Then ten years with Peugeot Italy, then touring car programmes. Jean Todt called me to join him in 1994. Two years ago I decided to join Lotus.

SW: So why Lotus?

CB: I wanted to work at a company that wanted to invest in motorsport, not necessarily a lot of money [but] for motorsport for Lotus is life. Same story at Ferrari and Alfa Romeo. Lotus's story is Formula 1, it's clear. The genius of Colin Chapman and genius inventions such as composite chassis, wing, ground floor effect, Lotus is highly technical in Formula 1.

SW: What are some of the new innovations Lotus is bringing to motorsport?

CB: We are building our engine for the future – it is a fantastic challenge. Today we have a Toyota engine, but when we have our own engine, the spirit of the car is [there].

SW: There has been a lot of discussion about how motorsport can become greener. To what extent are electric vehicles the future and could they realistically compete in motor racing?

CB: I was with the FIA and they talked about creating a new single seat electric car. The rules are not 100% fixed but it is on the way. The main problem is the battery stock for energy, but motorsport competition in the future will be a big evolution in batteries. The next step will be automotive propulsion including racing.

It's clear the technology is expensive. You lose a lot of energy [through braking] but if you can recover it, it is a way to the future, maybe for single seat racing.

SW: Is there a timetable envisaged for electric motorsport racing?

CB: [Perhaps] within the next two to three years minimum – it will not be before 2015 – it will be difficult to have a standard energy recovery system. For Toyota, Volkswagen, it is easier to work in these areas. Toyota produces fantastic Prius cars, but for us in GT cars, this area is complicated now.

SW: Isn't part of the reason motorsport fans enjoy racing, the roar of the engines, the smell of the oil, isn't that all part of the experience?

CB: We have some systems in Lotus Engineering to create some artificial noise. Of course a racing car needs noise, some racing oil, the smell. Lotus Engineering has created some testing for some different types of noise with experimental electric cars.

SW: Is it possible to race electric cars at the same speeds as in conventional motorsport?

CB: It is possible to achieve the same racing speed with electric cars. We have one dealer in Holland who has an experimental Elise – the concern is the weight of the battery. [For example] for two hours continuous racing, we produce the Tesla here and it has two hour capacity.

SW: How important is Lotus Engineering to what you do at Lotus Motorsport?

CB: We have a link with Lotus Engineering and motorsport, in some areas we have a very strong link with them. The capacity of Lotus Engineering is in all scenarios. There are some very open scenarios in Lotus.

> "We are building our engine for the future – it is a fantastic challenge"

ENGINEERING

LIGHTWEIGHT ARCHITECTURES
EFFICIENT PERFORMANCE
ELECTRICAL AND ELECTRONIC INTEGRATION
DRIVING DYNAMICS

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Lotus Engineering is at the forefront of efficient performance and clean fuel technologies, and leading the way in hybrid and electric vehicles.

Our multi-skilled technicians and engineers have extensive experience in developing and testing a wide range of powertrains including gasoline, diesel or alternative fuels as well as hybrid and electric systems.

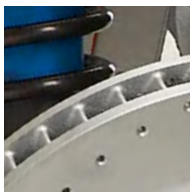
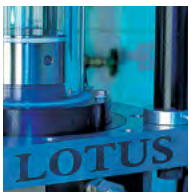
Over forty global test cells and emissions laboratories provide clients with comprehensive development and testing capability, from discrete tests to full development and validation on small or large powertrain programmes, all to the latest worldwide legislation, emissions and conformity of production (CoP) requirements.

We have an extensive range of flexible testing services delivered from our engineering centres located in Michigan, USA and in the UK.

LIGHTWEIGHT ARCHITECTURES - EFFICIENT PERFORMANCE - ELECTRICAL AND ELECTRONIC INTEGRATION - DRIVING DYNAMICS





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