

proActive

magazine



ISSUE 43
WINTER 2011



WHERE WILL GLOBAL CAR
MARKETS BE HEADING IN 2012?

LOTUS LIGHTWEIGHT STRUCTURES

PROTON CAMPRO 1.6 CFE ENGINE

LOTUS NEWS - INDUSTRY NEWS - INDUSTRY INTERVIEW
VEHICLE EMISSIONS TARGETS - INSIDE LOTUS



NOT FOR THE FAINT **HEARTED** THE NEW 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 don't like to disappoint. Presenting the extraordinary new Exige S with its supercharged 345 hp V6 engine. The ultimate lightweight high performance sports car.

FIND OUT MORE AT LOTUSCARS.COM



LOTUSCARS.COM

Official fuel consumption, Lotus Exige S in mpg (l/100km): Urban 19.5 (14.5), Extra Urban 37.2 (7.6), Combined 28.0 (10.1).
CO₂ emissions: 236 g/km.

Welcome

This year will see the continued expansion of Lotus Engineering's third party consultants work and the further development of our position in technology leadership

A prime example of this is the continued development of the Lotus Evora 414E Hybrid, which is on plan to run during the summer months and will be on show at this year's Geneva motor show in March. The high number of technologies showcased on the car demonstrates the exceptional ability of Lotus Engineering to integrate and develop advanced technologies for exciting, efficient, lightweight and high performance niche vehicles. And it is in these areas that we are expanding to take into the automotive world.

Our expertise in the area of efficient performance has helped Proton develop its first forced induction engine that will be used in their next generation of vehicles going on sale in Malaysia, (read the Campro article for more detail)

Alongside this we are also working on a number of other efficient engine programmes, including an advanced engine downsizing project investigating the technologies necessary to produce small pressure charged 4 cylinder engines with equivalent performance to a naturally aspirated larger V8, whilst also providing a 35% improvement in fuel economy, and a pressure charged three cylinder 1.5 litre gasoline engine that provides a 15% reduction in CO₂ compared against a naturally aspirated 1.8 litre four cylinder engine.

This further highlights our commitment in developing high power density, low CO₂ engines that can be used in mainstream production vehicles as well as hybrid and electric ones.

Other projects continue to progress, in particular the development of the range extender engine/generator family with our production partner Fagor Ederlan. A developed prototype, which is now at an appropriate level of maturity to commence vehicle development programmes, will be displayed at the Geneva motor show.

Lotus Engineering is seeing strong growth within our American and Chinese business units. Our American office has won a number of large development programmes and is expanding the powertrain testing part of their business. All their test cells are running at full capacity 24 hours a day, 7 days a week.

Our office in China is also growing strongly with 8 new clients providing large volume projects in ride and handling, vehicle integration and manufacturing support areas; this confirms our view that China will be an important market for the business over the coming years.

This year will, no doubt, remain a challenging one for the industry, but all the signs are that the engineering services sector is picking up, particularly in the areas where

Lotus Engineering specialises. There are encouraging signs from our US and China operations, and our plans to open an Engineering office in Germany this year will further strengthen our customer base there.

This can only be good news for Lotus Engineering



Mark James

Mark James
Director of Lotus Engineering

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Lotus Motorsport hits major milestones

IndyCar engine fire-up and Exige R-GT shakedown

The first official Lotus IndyCar engine fire up in the new car took place on 22nd December at Dallara's headquarters in Varano Melegari, Palma under the watchful eye of Group Lotus Director of Motorsport Claudio Berro and technicians from the team.

Heading north to Turin, the Exige R-GT, the Rally version of the new Exige S, took centre stage with a quick track shakedown for the first time in full Rally specification. The car handled exactly as expected and the team were delighted with the results. Testing will continue in the new year ahead of the start of the 2012 FIA World Rally Championship season where the Exige will contend the FIA GT category on asphalt at events in Monte Carlo, Tour de Corse and San Remo.

Claudio Berro said: "The fire up in the car went really well, there were no nasty surprises and I think our partners are going to be very happy with the results. It was only October last year that we announced that we would become an IndyCar engine supplier and just 12 months on, we had an all new Lotus engine and four teams signed up - Dragon Racing, Bryan Herta Autosport, Dreyer and Reinbold Racing, and HVM Racing. We've still got a lot of work to do ahead of the start of the 2012 IZOD IndyCar season but so far I'm very encouraged by what I see."

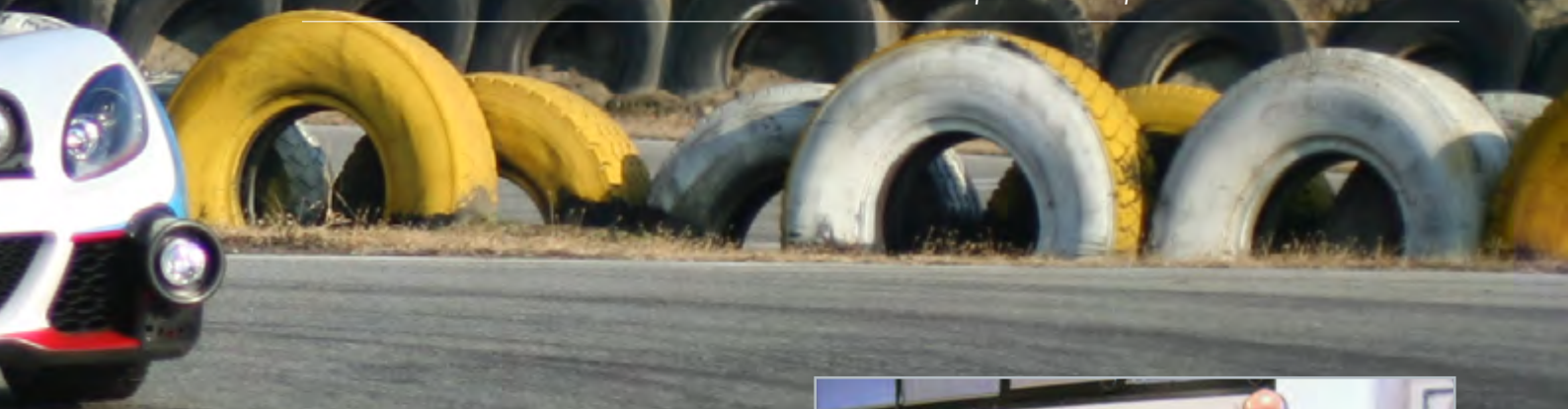
"And as for the Rally car, when you consider that we've only began working on this car in July, I think what we've achieved in that time has been incredible. For me the Exige S makes the perfect GT rally car, it has

an awesome 3.5-litre, supercharged engine, and we've managed to balance the weight perfectly to meet the minimum weight regulations. The shakedown today (23rd December) has only made us even more excited to show off the car in true race form early next year - I think we're doing the Lotus motorsport pedigree proud."

TOP: Lotus Exige R-GT rally car in testing. RIGHT: Lotus IndyCar engine and Exige R-GT interior

"I think we're doing the Lotus motorsport pedigree proud"

Claudio Berro, Director of Motorsport



Four partner teams to run Lotus IndyCar twin turbo V6 racing engines in 2012

Lotus Motorsport will supply engines to Dragon Racing, Bryan Herta Autosport, Dreyer and Reinbold Racing and HVM Racing.

Engine supply partnership agreements will enable Lotus Motorsport to build long term technical and commercial collaborations with these teams.

Lotus Motorsport is rapidly readying its new twin turbo V6 IndyCar engine for the rigors of racing. Director of Motorsport Operations, Miodrag Kotur said: "At

the LA show last year, we announced that we will be an engine supplier to IndyCar and exactly 12 months on, we are here with an all new Lotus engine and four teams, ready to go. The numbers that the engine is already achieving in our dyno testing are extremely encouraging so our hard work is well and truly paying off."

"Each of these racing organizations, as Lotus partner teams, will benefit from the extensive testing and development work of the others to more quickly achieve the mutually

desired competitive results.

In addition to the new Lotus V6 twin turbo IndyCar engine, work is continuing on a new Lotus Motorsport facility in Indianapolis, which will give the company a base close to the action and its partner teams."

Lotus secures government backing

Group Lotus awarded multi-million Regional Growth Fund

The Department for Business, Innovation and Skills (BIS) formally confirmed that Group Lotus' bid for funds from the second round of the Regional Growth Fund (RGF) has been successful

One of the main purposes of the Regional Growth Fund is to support growth within the UK manufacturing sector. Lotus recognised that the Government was seeking applications which would enable private sector organisations to invest in projects that would create jobs and secure long-term growth. Lotus' growth plans are completely aligned with the Fund's objectives and will go some way towards rebalancing employment between the public and private sector in the South Norfolk region.

The grant will be put to good use supporting the industrial research element of the production of Lotus' future product range. This significant development will go towards ensuring that the manufacturing of future Lotus

products remains in the UK for the foreseeable future and in the process create a considerable number of new jobs over the next five to six years.

Commenting on the news, Group Lotus Chief Executive Officer, Dany Bahar said: "This is great news for all those concerned about Group Lotus moving production overseas, to say that we're pleased with the result would be an understatement. We are an authentic British automotive manufacturer with an incredible heritage and an exciting future ahead, this funding will play a role in assisting with the realisation of our business plan to produce a new range of sports cars with best in class performance and emissions."

"We would like to thank everyone for their

support during the bid process. The local authorities, MPs and the local enterprise partnership have all played a role in helping us secure this funding – we're very grateful, it's nice to know people feel strongly enough to act on our behalf."

Business Secretary Vince Cable said: "We need to be doing all we can to enable businesses and organisations to create much needed jobs and

inject private investment into the economy.

"We have announced today that a further 162 projects will benefit from the fund, and expect to deliver a huge number of jobs across their businesses and in the supply chain.

"This is a very significant boost to local communities, and the Regional Growth Fund will help businesses like Lotus to drive local growth."

"We need to be doing all we can to enable businesses and organisations to create much needed jobs and inject private investment into the economy." Vince Cable, Business Secretary

Chris Evans signs-off 'Freddie' Evora

Broadcaster and car enthusiast Chris Evans visited Lotus to agree the final spec of the Evora S he bought at auction to raise money for Freddie Mercury's charity Mercury Phoenix Trust.

At a glamorous, star-studded event at the Savoy in September, the great and beautiful gathered to mark the late Freddie Mercury's 65th Birthday and boy, was it a party! A guilt-free party at that, for at the heart of the celebrations was a very deserving cause, the Mercury Phoenix Trust who work relentlessly to improve education and awareness of HIV and AIDS in the developing world. During the evening a bespoke 'Freddie inspired' Evora S was sold at auction to self-confessed "car geek" Chris Evans.

Chris' well documented purchase was followed by a visit to Lotus Headquarters to agree the final design and specification of the new addition to his established and considerable car collection.



be Original, be Lotus

Located at the Group Lotus HQ, Hethel, UK, the new retail concept clearly demonstrates the reinvigorated identity of Lotus, one befitting the current and future collection of cars planned for 2013 and beyond.

Part of a global strategy, the Hethel store is the first LOTUS ORIGINALS retail experience to open in Europe and finally gives customers the chance to try the collection before they buy having only been able to buy online since March 2011.

Commenting on the launch Group Lotus Director of Licensing and Merchandise Wiebke Bauer said: "The team have worked incredibly hard to put together a range of apparel and accessories that will appeal to even the most hard to please Lotus enthusiast. Our focus throughout has been on quality and ensuring a truly authentic

Lotus experience for the customer. This shop opening is just one of the many small but important steps we are currently taking as part of the overall brand development strategy. Our next major step will be the official LOTUS ORIGINALS store opening in London early next year - which we're very much looking forward to."

Alongside the shop, Group Lotus also showcased the new look customers can expect from Lotus dealerships in the future. The dealership environment has a modern look and feel with an inviting lounge area where customers can browse the Lotus library or leisurely spec their new Lotus! Lotus' latest cars will be on display with full paint and trim swatches to complete the Lotus shopping experience.



Group Lotus goes grassroots

With the move into karting, Group Lotus becomes the first car manufacturer to have a presence at the entry level of motorsport and provides a very special opportunity for early talent spotting. Some of today's most famous and successful motorsport personalities cut their teeth in karting – the newly crowned FIA F1 World Champion Sebastian Vettel is the perfect example of the benefits of early driver development as are his peers, fellow former World Champions Jenson Button and Lewis Hamilton.

But Lotus isn't just interested in spotting the driving talent of the future, the potential to work with young people showing an aptitude for design and engineering is recognised as a very special opportunity for Lotus.

Competing under the 'Lotus Racing Karts' banner and forming part of the Lotus Motorsport division, Lotus Racing Karts will field a factory backed team, operated by Jefra Racing out of its headquarters near Treviso, Italy. With a formidable racing pedigree spanning over 40 years, Jefra Racing has competed in many classes of motorsport. Lotus hopes that this invaluable experience teamed with leadership from Team Manager Franc Jeranic will form the basis of a truly competitive team.

And Franc Jeranic is the man to impress – talent spotted and recruited by him will have all the latest homologated material at their disposal, including two new chassis models 'Colin C30' and 'Jimmy C32' giving the Lotus Racing Karts team the edge as they take on the CIK-FIA international karting events for KF and KZ categories and the World Karting Championship for KFI category.

The production of karts and components is licensed

by Group Lotus to Wildkart, specialists in aeronautics precision engineering since 1996 and manufacturer of karts since 2002. Today, Wildkart is regarded as an authority in kart chassis and components, providing services and solutions to many karting suppliers and brands. The fit with Group Lotus is enhanced by the mutual commitment to innovation, technology and development. *"Our entry into karting is exciting on many levels" comments Miodrag Kotur, Director of Operations for Lotus Motorsport. "Not only are we nurturing new talent and widening our motorsport programme, but we also have an opportunity to join forces with two world-class specialists. It is exciting to see Lotus Motorsport grow in such an authentic, fresh and exhilarating way."*



Lotus F1 naming dispute resolved

Proton, Group Lotus, I Malaysia Racing Team and its owner Tony Fernandes are delighted to announce that the legal dispute in the English Courts relating to the "LOTUS" and "TEAM LOTUS" brands has now ended amicably with the parties agreeing settlement terms earlier this month.

The terms of the settlement are confidential but the deal sees the "LOTUS" brand reunited under

the sole ownership of Group Lotus. This includes the rights to the "LOTUS" and "TEAM LOTUS" names in Formula 1 motor racing.

I MRT will race in the 2012 Formula 1 season under the name "CATERHAM F1 TEAM" and will use a "CATERHAM" chassis.

Group Lotus Chief Executive Officer Dany Bahar: *"On behalf of Group Lotus and Proton I would like to express how pleased we are that this matter is finally closed and*

we can now focus on looking forward to the future. We understand that this has been a very difficult and confusing time for the fans of the sport and the Lotus brand, so we are glad to have reached a clear resolution on this important matter – I would like to take this opportunity to thank our fans for their continued support, it means everything to us."

Lotus Cars takes on Chinese market

A major milestone event in Group Lotus' history as the first Lotus showroom in China was declared officially open for business. The formal opening ceremony at the showroom in Beijing was overseen by senior representatives of Group Lotus and Lotus China alongside Clive Chapman, the son of Lotus Founder Colin Chapman.

China-based sports car enthusiasts had their appetites for the Lotus brand whetted with the first public unveiling of the Evora GTE Road Car and the FI-inspired customer race car, the TI25, before being introduced to the rest of the current Lotus line-up. The Beijing Showroom features six models, the Elise R,

Elise SC, Evora, Evora IPS, Exige S 240 and the Exige S 260. Speaking at the launch Li-Chen Zhang, President and CEO of Lotus China said: *"This is the first showroom that the Lotus brand has set up in China since entering the Chinese market on June 15 and it's a very proud day for all of us who believe so strongly in the brand. We truly believe that the Chinese market will completely embrace the Lotus philosophy of performance through lightweight and innovation through clever design – we sold around 300 units before we even opened the showroom so the initial interest and orders put forward indicate that our faith in the brand is well placed."*

Group Lotus Chief Executive Officer Dany Bahar said: *"East Asia and in particular China represents an interesting market for Lotus and this latest development is a crucial step in the strategic plan we have for expansion within this important region. We see many exciting opportunities for growth within the Chinese market and we could not ask for better partners than Lotus China to join us on this journey. The response we have had from China to the current and new Lotus range has been incredible particularly the demand for the Evora GTE Road Car – this activity confirms our suspicions that now is the perfect time to really push in this market."*

The showroom, situated in the fashionable Chaoyang district, also represents another key event in Lotus' journey as it's the first showroom in the world to adopt Group Lotus' new corporate identity alongside a dedicated boutique for Lotus Originals. Covering a total area of 600 m², the uniquely designed showroom has two floors, the first is dedicated to the cars, sales and Lotus Originals with offices on the second. A further ten showrooms are expected to be opened in China in 2012.

"We see many exciting opportunities for growth within the Chinese market and we could not ask for better partners than Lotus China to join us on this journey" Dany Bahar, Lotus CEO





Kimi Räikkönen back in F1 with Lotus in 2012

Lotus Renault GP is pleased to announce that Kimi Räikkönen will race for the team next season. The 2007 World Champion, who left Formula 1 at the end of 2009 to pursue a career in rallying, has decided to make a comeback at the pinnacle of single-seater racing. He has now signed a two-year agreement with Lotus Renault GP.

Kimi's F1 roll of honour includes 18 wins, 62 podiums and 16 pole positions. This experience and success is sure to help the team make a step forward next year.

The 32 year old Finn's commitment indeed makes for a vote of confidence in Lotus Renault

GP, demonstrating the team's determination and new philosophy for the seasons ahead.

Kimi said: "I'm delighted to be coming back to Formula 1 after a two year break, and I'm grateful to Lotus Renault GP for offering me this opportunity. My time in the World Rally Championship has been a useful stage in my career as a driver, but I can't deny the fact that my hunger for F1 has recently become overwhelming. It was an easy choice to return with Lotus Renault GP as I have been impressed by the scope of the team's ambition. Now I'm looking forward to playing an important role in pushing the team to the very front."



Industry news

from the Detroit motorshow

Volvo lauds XC60 plug-in hybrid as "3-in-1"

When Stefan Jacoby, President and CEO of Volvo Car Corporation, presented the new XC60 Plug-in Hybrid Concept at Detroit, he described it as 'actually three cars rolled into one'.

At the touch of a button, the driver decides how the available power from the combination of the high-performance petrol engine and the electric motor is to be utilised.

The driver chooses the driving mode via three buttons on the instrument panel. The buttons give the car three distinct temperaments: Pure, Hybrid or Power.

In Pure mode the car is powered solely by its electric motor as much as possible. The range according to the European certification driving cycle NEDC is 28 miles. Hybrid mode is the standard setting whenever the car is started. The petrol engine and electric motor co-operate to provide maximum driving pleasure with minimum environmental impact.

According to the European

certification driving cycle NEDC, CO₂ emissions are 53 g/km (2.3 l/100 km) - which translates into fuel economy of over 100 mpg. The car has a total operating range of up to 600 miles (960 km).

In Power mode, the technology is optimised to create maximum possible power. The petrol engine with 280 hp and 380 Nm (280 lb.-ft.) is combined with the electric motor with 70 hp and 200 Nm (148 lb.-ft.). The electric motor's instant torque delivery contributes to the car's acceleration from 0 to 60 mph in 5.8 seconds (0-100 km/h in 6.1 seconds).

"No other manufacturer delivers fuel economy and electrical range on this level in a capable performance car with a total of 350 horsepower," said Stefan Jacoby.

"The beauty with this plug-in hybrid technology is that you can keep all the power and capacity of your present car, combined with an even better range,"

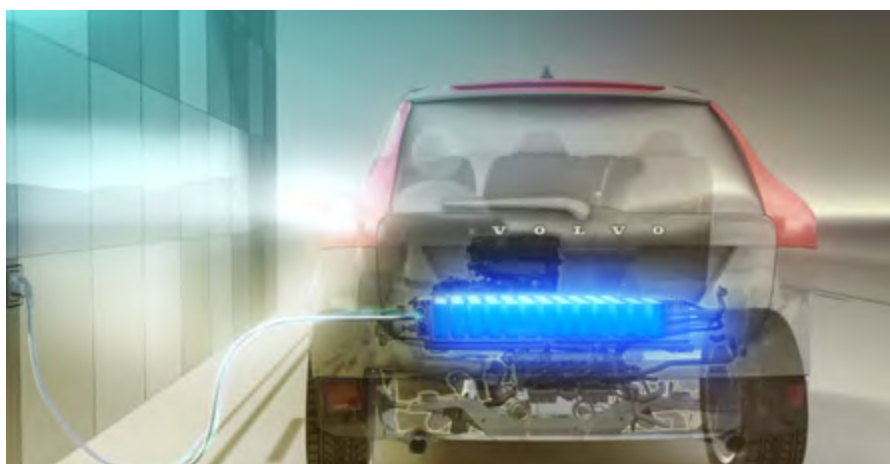
Stefan Jacoby said. "The XC60 Plug-in Hybrid Concept gives you up to 35 miles all-electric range. Or you can drive it as a super-efficient hybrid with a fuel economy of over 100 miles per gallon according to the European driving cycle."

An electric motor producing 70 horsepower - combined with a 280 horsepower, four-cylinder turbocharged gasoline engine - also gives the driver a total of 350 horsepower.

"The XC60 Plug-in Hybrid Concept features an engine from our all-new, state of the art, four-cylinder engine family. Our new four-cylinder powertrains will get performance on today's



RIGHT: X-ray illustration with technical components highlighted. The petrol-electric Volvo XC60 Plug-in Hybrid Concept is an electric car, a highly economical hybrid and a powerful high-performance car all rolled into one. The preferred driving mode is chosen via three buttons on the instrument panel: Pure, Hybrid or Power



LEFT: The rear axle of the XC60 Plug-in Hybrid Concept is driven by an electric motor producing 70 horsepower. It is supplied with power from a 12 kWh lithium-ion battery pack installed under the floor of the load compartment

six-cylinder level. At the same time, they will also give consumers better fuel economy than present four-cylinder engines," Stefan Jacoby said.

He added: "A diesel-electric plug-in hybrid is coming to our European dealers this year and we are busy preparing a gasoline version for the American showrooms."

Volvo Car Corporation's North American dealers welcomed the introduction of a plug-in hybrid.

"A gasoline plug-in hybrid would be an excellent addition to our product offer," said Patty Hooley, member of Volvo's North American Dealer Council. "To

me, the plug-in hybrid speaks both classic Volvo safety and responsibility as well as cutting edge Volvo innovation."

Jacoby also said that electrification is one of our four major focus areas for Volvos and that the three cars in one plug-in hybrid 'takes hybrid technology into the next level'.

"This ingenious blend of state-of-the-art combustion technology and innovative electrification creates a bridge to a future where all-electric cars become more established on the roads."

"In the XC60 Plug-in Hybrid Concept we demonstrate that our forthcoming four-cylinder engines offer the same high performance as

today's sixes. At the same time, their fuel consumption will be lower than in current four-cylinder engines," says Peter Mertens, Senior Vice President Research & Development at Volvo Car Corporation.

"It's time to stop counting cylinders," Mertens says. "Four-cylinder engines are the most effective way to quickly reduce CO₂ emissions and fuel consumption without compromising customer expectations when it comes to driving pleasure and performance."

Author: Dave Leggett





American Honda sold only 4,703 units of the Civic Hybrid in 2011. Will VW have more luck with its new rival?

VW chases segment leadership with Jetta Hybrid

American Honda sold only 4,703 units of the Civic Hybrid in 2011. Will VW have more luck with its new rival?

It already offers four and five cylinder petrol engines as well as a 2.0-litre diesel. Now the US market's Volkswagen Jetta is going after leadership of the compact segment by adding a petrol-electric powertrain to the mix.

VW had confirmed at the Detroit show in January 2009 that there would be a hybrid version of the then-unseen new generation Jetta sedan. The car has now made its global debut at the 2012 edition of the show.

The new Jetta Hybrid is powered by the combination of a 150 hp 1.4 litre inline 4 cylinder direct injection gasoline ('TSI') engine and one 27 hp electric motor; just as was a previous two-door Jetta concept.

Unlike many other hybrid vehicles, this front-wheel drive car will have a standard seven-speed dual clutch DSG gearbox, not the more common CVT. As in the Touareg Hybrid SUV, the Jetta Hybrid features a clutch that decouples the gasoline engine from the drivetrain when in electric drive or coasting modes. The car is said to be able to run in EV mode for up to two kilometres and at speeds of up to 44 mph or 70 km/h before the petrol engine kicks in.

The Hybrid is claimed to weigh 'less than 3310 lb', which VW of America says means that its weight has increased by 221 lb. The division does not note what it is comparing that measurement to - most likely the 1.4-litre Jetta that is available in other markets.

This new variant gains aerodynamic modifications including

a special front spoiler, a rear diffuser and a rear spoiler. There are also unique headlights with LED running lights, LED rear lights and special 15-inch alloy wheels with low rolling resistance tyres. 'Hybrid' badges feature on the front wings, bootlid and also on the grille, where the Volkswagen logo sits on a blue background.

The 2013 Jetta Hybrid is expected to be in US market VW dealerships in November.

Author: Glenn Brooks



Unique rims, recharging points in the grille and decals set the EV apart from the existing Ray

Kia launches EV with petrol engine sound

Kia Motors has launched its first plug-in car, the Ray EV. The new model is an electric version of the Ray, a city car that is sold only in the South Korean market.

The Ray EV is powered by a 50 kW electric motor and a high-capacity 16.4 kWh lithium ion polymer battery pack. Kia claims that each has been engineered for a 10-year life cycle. They are installed under the rear seat and cabin floor. The car weighs 187 kg more than the Ray, which is powered by a 1.0-litre petrol engine.

One novelty of the new model is the recorded sound of a small petrol engine, which is automatically broadcast when the Ray EV is moving forwards or backwards below speeds of 20 km/h (12 mph).

The little car is said to have a top speed of 130 km/h (81 mph), while recharging can be as rapid

as 25 minutes via a fast-charger or as slow as six hours via a 220 V household socket.

Kia has also made an attempt to prevent range anxiety via the instrumentation. This not only shows electric motor operation, battery status and distance remaining but also features an EV-specific navigation system. The nearest locations of slow/fast recharging stations can be displayed on the seven inch screen. There is also a circular shaped area in which the car can travel, allowing the driver to see which destinations are reachable without a recharge.

There are at present 500 slow/fast recharge stations in South Korea, and the government plans to increase that figure to 3,100 stations by the end of 2012.

As stated previously, Kia intends to build and deliver 2,500 units

of the Ray EV during 2012. Each will be supplied to government departments and public offices. Both the Ray and the Ray EV come down the same production line at the Sohari plant.

Author: Glenn Brooks

Chrysler-built Lancia Thema gets ZF's eight-speed automatic

Fiat Auto's new Lancia Thema, the rebadged Chrysler 300 for Europe (excluding the UK) now reaching showrooms - is the latest model to use ZF's eight-speed automatic transmission.

The supplier claims the new transmission, also used by an increasing number of European automakers, including Jaguar Land Rover's 2012 Range Rover and Discovery model lines, reduces fuel consumption by up to 14% compared with a five-speeder.

The ZF box is fitted to Thema models with the V6 petrol engine.

ZF said the fuel efficiency gains are due to an "innovative gear set

design" with four planetary gear sets and five shift elements. Since there are only two shift elements open per gear, the inner drag losses in the transmission are considerably reduced. Also a higher total spread of 7.05 reduces fuel consumption by lowering the speed level. The modern torsional vibration damper system in the torque converter, which allows for a rapid lock-up of the torque converter clutch, also has a positive impact on consumption and CO₂ emissions.

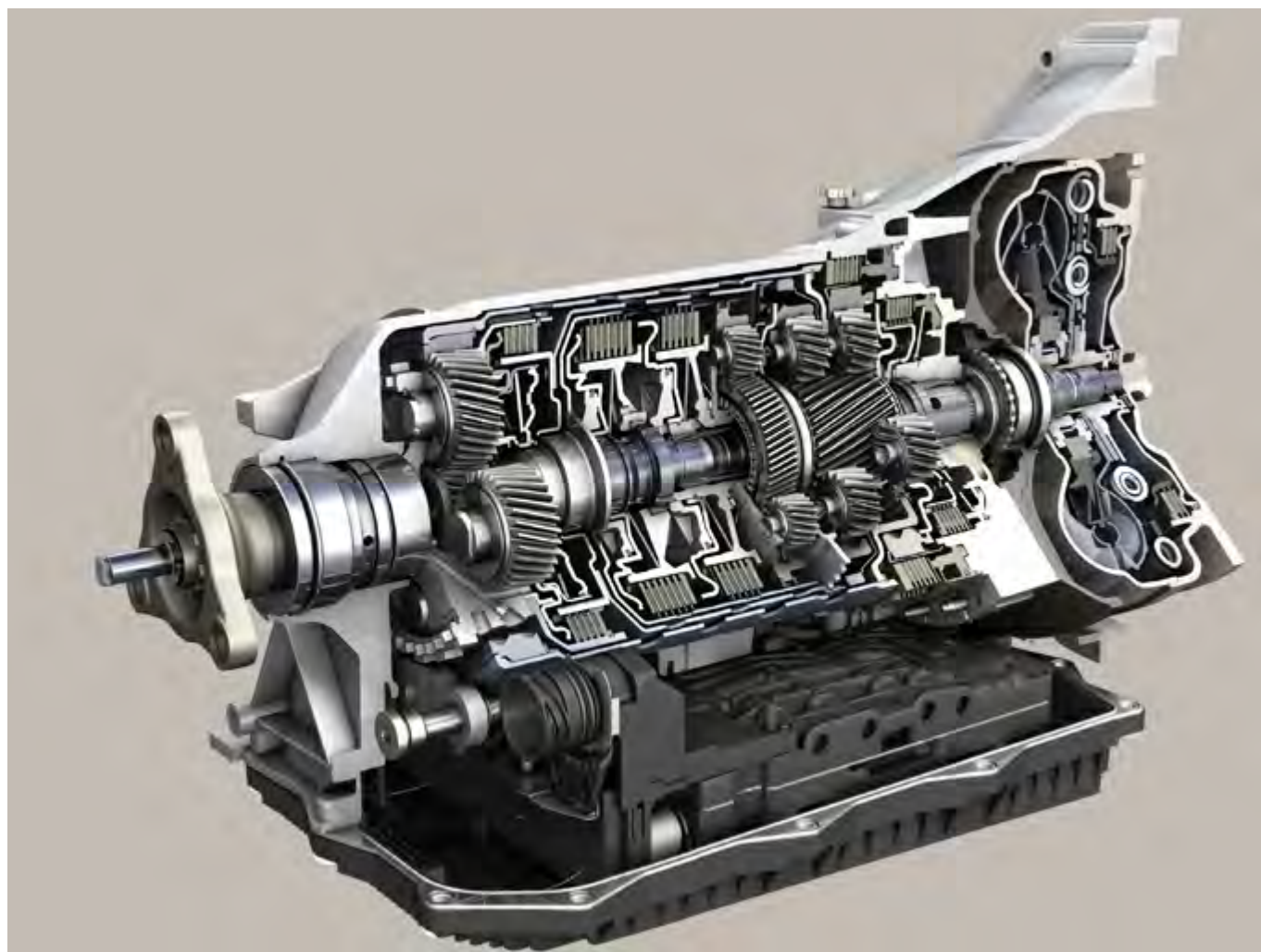
The new transmission also has extremely short response and shift times below a perceivable threshold allowing double shifts and direct

multiple shifts.

ZF also produces the Thema's gear shift lever mechanism as well as a damper and leveling system for the cars which are built by Chrysler in North America.

Author: Graeme Roberts

BELOW: ZF supplies 'Shift-tronic' gear selector mechanism and suspension components for the Thema, Lancia's variant of the Chrysler 300



Johnson Controls shows HUD for volume car segments

Johnson Controls says it is showing a new and cost effective technology called a 'Combiner Head-Up Display' in the ie:3 demonstrator car that is cheap enough for volume car applications.

The new product is fully integrated in the instrument panel and specifically selects and prioritises key driver information and projects them onto a screen in front of the driver.

"Johnson Controls' expertise in the design and manufacture of automotive interior systems and electronics, combined with insight from market and consumer research, enables the company to offer driver information systems that are customized to the needs of the target group and brand identity of a vehicle," said Andreas Maashoff, director of industrial design for Johnson Controls Automotive Experience. *"Our innovative Combiner Head-Up*

Display in the ie:3, can be seamlessly integrated into the instrument panel of each vehicle."

JCI says that the cost-effective technology in full colour projects key driver information onto a transparent screen that comes out of the instrument panel and is located in the driver's primary field of vision. The positioning of the system enables the driver to perceive and process the relevant information displayed, such as speed, traffic sign recognition or turn-by-turn navigation, much faster than on standard displays positioned outside the primary field of vision, it is claimed.

A high-resolution, full-colour graphic display delivers impressive 3-D graphics, JCI says. The projected image appears at a virtual distance of around 1.80 m, which the eye can read without any further accommodation.

With the Johnson Controls Combiner Head-Up Display as a standalone unit, this technology is no longer for the premium vehicle segments only, the company says, adding that the display is cost-effective for the volume vehicle segments as well.

Conventional systems integrated into the windscreen require the technology to be calibrated separately with the windshield, but that is not the case with the independent Combiner Head-Up Display. There is also no need to adhere a film to the windshield. Additionally, the company points out, this product eliminates additional costs that are required with a traditional heads up display when a windshield is damaged or needs to be replaced.

Author: Dave Leggett



LEFT: The new low-cost unit from JCI offers the possibility of the head-up display experience in volume segments of the car market



Industry Q&A

Steve Cropley

Interviewed by just-auto editor Dave Leggett

Steve Cropley is editor in-chief of Haymarket motoring group, which includes Autocar and several other magazines and websites

You attended the Tokyo Motor Show a few months back. What were your main impressions?

I was delighted to see a strong recovery in creative energy since the 2009 event. Two years ago Tokyo was so lacklustre people started saying the important Asian shows would in future be in India and China. But despite the recession and the earthquake, the Japanese showed considerable optimism in 2011, and quite a lot of fighting spirit.

Any Tokyo highs and lows stand out?

The Toyota GT-86 was the stand-out, I thought, closely followed by Akio Toyoda himself. Had a short drive in the car, which was as good as it looked. Mr Toyoda showed a lot of determination to change and improve his company's image, and seemed to me to know how to do it. I was glad Honda appeared to be moving back into the sporty car business, and as usual there were some "challenging" concepts from the likes of Suzuki and Daihatsu.

The auto industry is facing a number of challenges right now.

Besides the possibility that market growth will stall in some places next year, there are the constant demands to save cost and reduce environmental impact.

Are you optimistic about the industry's ability to manage these challenges?

I absolutely am. Every time the industry is presented with another difficult hurdle, it seems to me to soar over it. The main danger, I believe, is that legislators have seen the industry comply with difficult demands so often and so promptly that they might start thinking it's easy!

Which car companies do you look at and think 'yep, they know what they are doing'?

The Volkswagen group impresses me most at present. They seem able to bring appropriate products to market quicker than others (look at their provision of twin-clutch gearboxes for Polos and Golfs) yet provide a depth of technical development that leaves others standing. They're also the world's most successful group at managing

a series of marques using the same fundamental mechanical bits. And by the way, their sales volume is still going up despite the bad times.

Are there any particular trends in the automotive marketplace that you think will be big over the next ten years?

Lots of things stand out. First, I'm struck by the fact that nothing sells really well unless it looks great. So I reckon the emphasis on emotive design can only grow.

Technically speaking, I think we've seen most of what we'll see over the next decades: batteries will improve in potential and lightness, hybrid powertrains will grow lighter and more compact, knowledge about storage and dispersal of hydrogen will get better, piston engines will improve in emissions without losing performance.

New technology? I think we're standing on the threshold of a new age of car connectivity that may keep one vehicle out of the path of another, which should help eliminate accidents altogether.

Traffic congestion is the one I can't see improving much. I think



STEVE CROPLEY

Steve joined Wheels Magazine (Sydney) in 1973 before moving to CAR (London) in 1978 becoming Editor in 1981. Steve Launched Buying Cars in 1989 which was later sold to Haymarket Publishing in 1991. Since then Steve has been working for Haymarket motoring group as Editor-in-Chief. Steve is also Columnist and reporter for Autocar and carries out various assignments for Autosport, What Car?, and FI Racing. Steve helped instigate a postgrad auto journalism MA course at Coventry University in 2004. Steve was appointed visiting professor, automotive journalism in 2004.

“The auto industry is facing a number of challenges right now. Besides the possibility that market growth will stall in some places, there are the constant demands to save costs and reduce environmental impact”

we can make some improvements with real-time traffic and navigation systems, but I get the feeling the best solution, as ever, is going to be to travel when others don't.

What's your feeling on electric cars and making them work for the consumer? Do you get a sense – from the people you talk to, of real revolutionary technological change being imminent or do you think we're seeing some hype from some manufacturers in particular?

I think it'll be a matter of gradual improvement, and as long as this continues they'll be fine.

Batteries improve in power density by roughly 10 percent a year, we're told, and they already work quite well. I know that if my missus and I had a current-spec Nissan Leaf at our place in the Cotswolds, it would do most of our short-haul mileage: our most common journeys are between three and 25 miles. But we'd need a long-haul car as well.

What's your role at Autocar these days and how else do you fill your time?

Officially, I'm editor-in-chief of Haymarket motoring group, which as well as Autocar includes several other magazines and websites. I write a lot and get involved in a bit of management, though I have never wanted to be a shiny-bum and avoid it as much as possible. To me, being a frontline feature writer, road tester, news reporter and columnist is the important job, and what I'm best at so I try to stick to it.

How do you see motoring journalism and publishing changing?

We're certainly well into the web era, and all our motoring websites are rocketing ahead. We've also learned how to sell advertising for them, so they're pretty profitable, too.

Print certainly isn't expanding, but it's hanging in there. Autocar (117 years old) has just posted a circulation increase. One advantage of having well-known print brands is that the reputation of those publications attracts people to their websites.

To me, all the talk of "citizen-journalists" taking bread from the mouths of old-style journalists is well and truly over-played. Web consumers are losing their naivety: they know much of what you turn up at random on websites is dross and so have learned to look to familiar brands for quality.

Car companies with stories to tell still want access to credible journalists. Thus these are the people who will continue to break stories and guide opinion.

Do you still go on car launches Steve? Name one that was particularly memorable...

Yes, I do car launches. That's a big part of the job. But I'm interested in people: I've always said stories about cars are actually stories about people, either those who have created or will sell a new model, or those who will buy and use it.

Most memorable launch recently was that for the Range Rover Evoque in Liverpool, only a few miles from where the car is made. The launch displayed the model very well, emphasised the model's Britishness,

provided excellent photographic opportunities, allowed hacks to meet company bigwigs easily, and it was over promptly. We need all of those things.

Do you always drive to get from A to B or do you also regularly use other modes of transport in your daily life?

I drive if I can, though some destinations are better reached by air. We're time-poor: the whole idea is to get stories and post or publish them ahead of the opposition. But I always enjoy driving. I do a lot of it and motorsport remains my hobby.

What was the last car you drove that put a smile on your face?

The Land Rover Discovery 4 with new ZF eight-speed automatic I was driving this very morning put a smile of deep contentment on my face. It's a fine machine. With this and a few other refinements, they've pushed the practical fuel mileage beyond 30 mpg. That's a terrific achievement for a 2.5 tonne car. Gives you a flavour of what might be possible when big cars get lighter, as they surely will.

Then yesterday I was driving my own Ariel Atom, a 525 kg mid-engined car with 300 bhp of supercharged power on tap. Goes like a guided missile...

What's your favourite car of all time?

Can't restrict the choice to one, sorry. I'd like a vintage "WO" Bentley, a 4.5 litre, probably. For long trips I'd choose that Discovery I was just telling you about. For diving about, I'd choose a Fiat 500 TwinAir (I love that tiny turbo engine) and for track days and hillclimbs with my son,

something we've done together for 14 years, I'd stick with the Atom.

And for some reason, just at the moment I've got a penchant for owning a 50's Austin, but I'm hoping that will pass.

Author: Dave Leggett



ORIGINALS



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Lotus Lightweight Structures

lightweight component manufacturing

Trading from Worcester, in the West Midlands region of the UK, Lotus Lightweight Structures Ltd (LLS) was originally founded over 10 years ago by the Norsk Hydro Group to serve automotive customers requiring lightweight niche volume vehicle structures based on bonded aluminium technologies. Lotus purchased the business in May 2008, and is continuing to invest in the growth and expansion of the facility to meet future business needs.

In addition to supplying Lotus Cars, LLS enjoys a diverse customer base, delivering not only bonded aluminium products, but anything from component surface treatments (anodised parts) to final assembly of full vehicles. Since its founding, it has supplied aluminium products to a range of premium automotive industry customers and major OEM's – including BMW Mini, Jaguar Land Rover, Aston Martin and Tesla Motors.

The continuing development of low-carbon vehicles – with increasingly aggressive vehicle mass reduction targets – has led to a number of ongoing activities developing solutions for various city car and commercial vehicle projects, featuring a number of different fuel and energy sources, including battery electric vehicles and hydrogen fuel cells.

In more recent years, there has also been diversification of the business outside of the automotive industry. In addition to supplying products for aerospace industry, LLS is working with companies in the renewable energy field, supporting the development of new technologies and products to capture and harvest 'greener' energy from renewable sources, as part of strategies being executed to assist in achieving the reductions in greenhouse gas emissions that are being

mandated by various governments and regulatory bodies throughout the world.

The 8,000 m² facility in Worcester houses the major manufacturing processes including final assembly of its different product offerings, and is currently capable of delivering up to 10,000 automotive chassis frames per annum – as well as a multitude of other minor parts and sub assemblies. Through its experienced staff, LLS offers a highly flexible and integrated approach to delivering its product range, supported by close working partnerships with strategic suppliers, who themselves have a strong track record of delivery.

This allows LLS to provide a 'one stop shop' of product delivery from concept through engineering, production and post production services.

The foundation technology of bonded aluminium has a number of critical advantages when compared to other processes that may normally be considered:

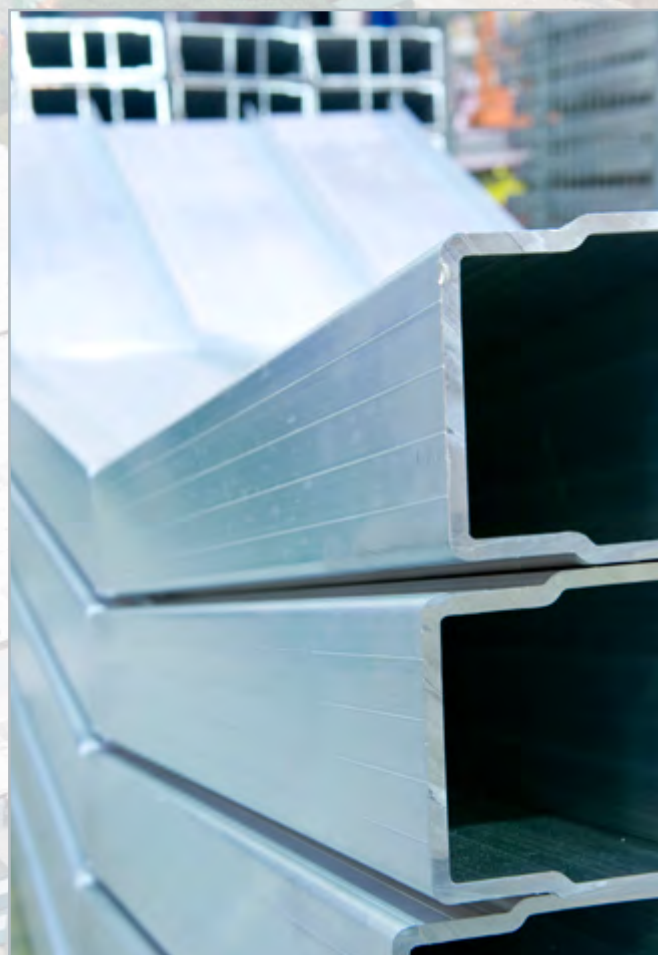
- In comparison to welding there is no heat affected zone
- Joints can tolerate dimensional variances
- Dissimilar materials can be joined (eg alloy to composite)
- Joint surfaces/designs can ensure maximum strength
- Short lead time to first prototypes
- Relatively low budget tooling and set-up costs – which can be a significant factor for low volume production, or 'start-up' businesses

**Lotus Lightweight Structures
facility in Worcester**

Lotus Cars are well known for their use of lightweight bonded and riveted aluminium chassis structures, less-well known is that they are manufactured by a wholly-owned subsidiary of Group Lotus

Worcester Facility

- Ten CNC machine tools (3,4 and 5 axis) producing extruded aluminium components for integration into structures
- Three Robotic MIG welding cells and manual TIG
- Structural aluminium anodising line producing up to 5 flight bars per hour capable of surface treating cast, sheet and extruded alloys
- Climate controlled clean room assembly facility with robotic adhesive application, assembly tooling, curing ovens and self piercing fastening systems
- Full metrology capability with four automated CMMs up to full vehicle scale
- Electric vehicle conversion facility with vehicle ramps, material marshalling, test and buy off capability
- Engineering and process development capability enabling project management, process development and product design
- Supply chain management including procurement, supplier management and logistics
- Quality accreditation to ISO TS 16949



Wellingborough Plant

In addition to the main facility in Worcester, LLS operates its own high quality structural anodising plant from a 5,000 m² facility in Wellingborough.

The facility is capable of anodising 400,000 m² per annum and also acts as a logistics co-ordination hub for key customers. This is currently one of only a few facilities commercially available within the UK and Europe that is capable of anodising parts to such a high standard.



LLS makes all of the chassis for Lotus Cars and the Roadster chassis for Tesla Motors



Workshop converting Ford Transit Connect vans to electric drive for Azure Dynamics



Robot applies adhesive
to a platten of aluminium
extrusions

Azure Dynamics

When Azure Dynamics (AZD) were looking for a partner to convert a series of light commercial vans to pure electric drive, LLS sprung into action!

AZD were looking for a suitable assembly facility and build process for their Electric Transit Connect product. The EV production experience available within the Lotus Group includes assembly of the Tesla Roadster (at Lotus Hethel facility, located in the East region of the UK), which meant that LLS could access and offer tangible, 'hands-on' production EV vehicle experience and knowledge.

Combined with the existing TSI 6949 accreditation, this was a major factor of the AZD selection process, and meant that the project could be delivered quickly, in a safe working environment, with excellent quality results.

LLS receive donor vehicles in a 'glider' configuration – a partially built vehicle without any powertrain fitted. Following a small amount of disassembly, the EV powertrain and battery pack are then installed into the vehicle. Once the vehicles are re-assembled, they undergo a final test to ensure full functionality, before being 'bought off' by AZD.

From the initial contact (in early 2011) to signing the contract took just a few weeks, with the first pilot-build vehicles being delivered back to AZD just a few weeks later. Steady run at production rate was achieved during the summer of 2011.



New Lotus Esprit

The first of the 'New Era' vehicles to be produced by Lotus Cars will be the new Esprit supercar, which will be launched during the second half of 2013.

The body and structure approach being adopted for the Esprit is different to that currently used on the Lotus Evora vehicle.

With a strong focus on enhanced quality levels – including the adoption of some body panels in aluminium – Lotus Cars undertook an 'open market' quotation and sourcing exercise for the production of the complete BIW assembly.

Having been pitched against some very established and reputable body manufacturers based in mainland Europe, LLS was nominated during the summer of 2011 to be the production supplier for the complete BIW assembly.

In addition to offering a clear commercial advantage over these other potential suppliers, a key part of the LLS proposal was the support and involvement of a number of key strategic partners as part of the overall business bid. The involvement of these key strategic partners will ensure that the product, quality and service delivery

will befit the Esprit as the flagship model standing as the milestone for Lotus' new era, and includes:

- Comau – for tooling and process equipment
- Premier Automotive – for prototype build
- ADM – for body skin panels
- Wincanton – for logistics

The current focus on this project is producing the first phase of prototypes, for evaluation purposes.

The Esprit BIW will comprise of 300+ individual parts. LLS engineers are working in close co-operation with the Lotus Cars product

development team in order to provide simultaneous engineering and design for manufacture expertise. Second phase prototypes are scheduled for late 2012, with the start of production specification bodies in early 2013.

The approach being followed has a strong emphasis on co-operation with the customer (Lotus Cars) and supplier partners to ensure that there is completely transparent communication enabling the shortest possible lead times.



The Future...

It goes without saying that this is an extremely exciting and challenging time for LLS as part of the overall journey for the Lotus Group.

New developments and projects within the fields of low carbon vehicles, aerospace and alternative energy will all present exciting business diversification opportunities.

In addition to the Esprit programme, LLS is working closely with Lotus Cars on all their new product body programs, with the Lotus Elite following hotly on the heels of the Esprit.

What is clear is that LLS intends on becoming a benchmark in the lightweight, low volume, premium quality automotive body manufacturing sector!

**Authors: Luke Bennett
and Scott Thompson**

Global car markets

Where will they be heading in 2012?

As we enter 2012, there is much uncertainty over where the global vehicle market is heading. Dave Leggett considers some of the issues and talks to the professional forecasters

Carlos Ghosn got it right late last year when he said that the automotive industry was heading for record sales in 2011. That's right, the final numbers have yet to be crunched, but it is sure to have been a record year. You might be surprised that is the case given the doom and gloom in the press, but it is largely explained by the contrary movements of the US and Chinese car markets in recent years. Just as the US market was collapsing in 2009, the Chinese market was more than taking up the slack as it displaced the US as the world's biggest national vehicle market. And the global total is also benefiting now from US sales that are coming back from the nadir of 2009, as well as yet higher sales in China. And there are other places around the world that have logged substantial growth – like Russia, for example (again coming off a low base) and ASEAN at a time when the car market in Western Europe is struggling due to anaemic economic growth and post-scrappage 'payback'. The net result of all that is an expanding global market.

And production has been rising particularly strongly in emerging markets. PwC-Autofacts estimated global vehicle assembly at around 74 million units in 2011, with a further expansion in 2012 to a baseline total of 79.2 million units.

Although many market uncertainties will carry over into 2012, Autofacts remains optimistic that

the global automotive industry outlook will be positive, assuming that a policy resolution in the European Union materialises in the near-term.

"A lot depends on how the situation in Europe with sovereign debt pans out," said Autofacts analyst Calum MacRae speaking to just-auto. There are risks, particularly associated with Europe.

"China, in particular, has been a major positive from a global volume perspective, and we expect Asia-Pacific to continue to be positive in 2012, but the global scenario planning range is weighted firmly on the downside. A lot depends on what happens in Europe and on the scale of any financial instability, the effects of which could be felt across the world. Overall growth of vehicle assembly next year could slow to nearer 1%."

And that's a key point. The 2012 outlook comes with a high degree of uncertainty due to problems in Europe. Early last year, it looked like the global economy – and automotive markets – were bouncing back quite strongly from the unprecedented recession of 2009. As volumes picked up in North America – alongside still healthy growth in the BRICs and other emerging markets – OEMs and suppliers experienced a surge in volumes which, combined with leaner post-recession restructured cost bases, quickly fed into better healthier bottom lines.



“A lot depends on how the situation in Europe with sovereign debt pans out” Autofacts analyst Calum MacRae speaking to just-auto

Europe's debt problem

By the summer of last year it was becoming clear that Europe has a very serious structural problem, associated with large national debts and a single currency, that has potentially severe implications for economic growth prospects. The money markets wobbled with the realisation that economic growth prospects were deteriorating, not helped either by the continuing impact of higher energy prices on real incomes. While Germany's economy has experienced an export-led boom driven by strong demand in Asia and a highly competitive euro currency, cumulative national debt problems have piled up elsewhere, exacerbated by emergency bank bailouts from governments in 2009. Sovereign debt continues to loom large as a constraint to Europe's projected economic performance. A region-wide fiscal contraction with 'austerity budgets' in many countries will inevitably

reduce economic activity, and consumer demand for goods, this year.

The big fear is that a disorderly default on sovereign debt in Europe could turn into a bigger financial crisis that would hit the international financial system again. And Europe does not exist in isolation. If demand for goods and services in Europe falls, export sectors in other regions of the world will feel some consequences, meaning that the global economy is impacted. Moreover, the fiscal stimulus levers that offset the impact of recession in 2009 (for example through scrappage incentives on cars in Europe) won't be available this time round, given the state of public finances.

What's the worst that could happen?

What's the worst that could happen? That's a rather big unknown and depends on the nature and depth of any highly adverse economic events. Let's say the eurozone starts to break up and that leads to a general banking crisis and a sharp economic recession. The crisis of 2008/09 gives us some assistance in terms of benchmarks.

"If a disorderly default were to happen, a much more severe drop in the car market would be unavoidable," says Jonathan Poskitt of LMC Automotive. "But there's a big range of outcomes in terms of the immediate event, its knock-on impacts – for example on the banks and liquidity generally and the government policy responses that might follow."

Poskitt refers to the sharp drop in demand when the financial crisis and recession kicked in late 2008 and into 2009. *"We saw the West European car market suddenly collapse to a running rate of around 11 million units,"* he says. *"That gives us a guide to the kind of thing that*

might result if Europe's crisis takes a sudden turn for the worse. A disorderly default in the eurozone might produce something similar if its effects weren't contained and spread quickly into a broader regional financial crisis."

But the picture need not be as bleak as some of the worst scenarios suggest. A European economy bumping along but with the broader crisis for the euro currency being effectively managed would probably serve to gradually reassure the markets and bring about the conditions for a modest economic upturn in 2013. Interest rates will remain low. Inflationary pressures are generally subsiding (oil price key though) and cooled down wholesale banking markets will warm up again over time, the longer we go without a Lehman-style lurch and as confidence gradually returns. As the US experience shows, rising pent-up demand after dramatically reduced markets and put-off replacement will eventually turn into new vehicle sales.

"If a disorderly default were to happen, a much more severe drop in the car market would be unavoidable"

Jonathan Poskitt of LMC Automotive

Europe's automotive supply situation not as bad as 2008/2009

There's also some comfort to be derived from the lessons learned after the 2008/09 experience. Inventory is much more in line with demand. The resultant downturn for the industry will be much less severe than that of late 2008 and early 2009 because there is less of a surplus stock problem this time round. Back then production was running way over the suddenly sharply reduced market, forcing dramatic actions – such as plant furloughs – to reduce inventory.

LMC Automotive analyst Arthur Maher believes that the economic crisis in Europe will inevitably lead to lower car sales across the

region next year. *"The eurozone continues to struggle to manage the sovereign debt crisis,"* he points out. *"And governments are also moving pretty aggressively to tighten fiscal balances and for a number of EU states that could prove to be a vicious circle. It's a low growth economic environment and against that background we forecast that West European car sales will fall back by 5% in 2012."*

With the market down next year, Maher says there will be an accompanying adjustment for the region's vehicle manufacturing sector with a drop to Europe's light vehicle production total of 6.5% forecast (to 19.1m units in 2012). Within

that total, higher demand in Eastern Europe supports output there to produce a small gain (0.6% to 6.5 million units) while Western Europe's production is forecast to fall by 9.7% to 12.6 million units.

"That is serious, of course," Maher acknowledges. "But it's less severe than what we saw in the last big downturn of late 2008 and 2009 when the industry was burdened with around 2 million units of excess stock and we saw output contract by 20%. Without that stock problem, output then would have fallen by more like 10% - half of the collapse to production that occurred was therefore down to destocking.

"Currently, industry stockholdings are fairly well managed and, depending on the severity of the downturn to demand predicted for 2012, the industry is not starting with a major stock overhang."

Maher notes that Ford, PSA, Renault, Toyota and Opel have all announced plans to trim production and that some new model programmes are also slipping. And some premium OEMs are still working hard to meet strong orders from Asia, he says. "From an industry point of view, it's a very different situation from that which we were faced with in late 2008," he says. "We believe that the industry will continue

to work hard to avoid a repeat of the 2009 stock crisis. In general, we expect OEMs to remove individual lines and thus capacity as and when new models are introduced – politically this is much more achievable in Europe."



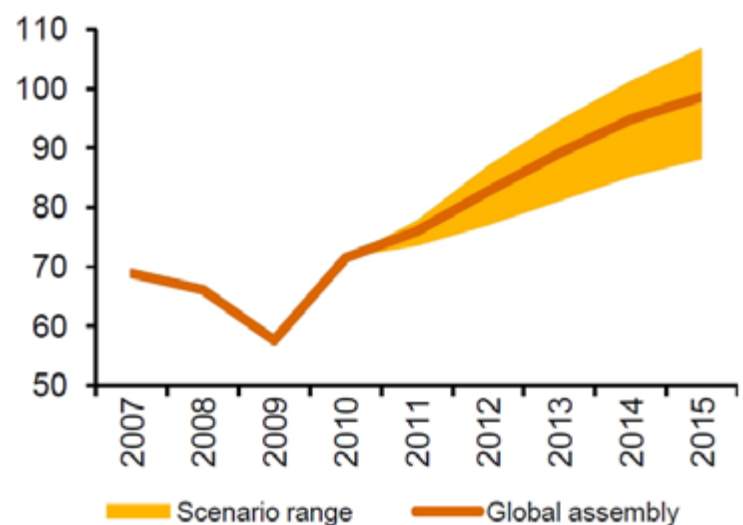
ABOVE: Honda in Swindon (UK) was among the vehicle manufacturers who had to sharply cut output in early 2009, with the plant furloughed for four months

German market to run out of steam?

What about the German powerhouse? Germany was the only major European car market registering any sort of gain for 2011 over 2010 – it was 9% up. That compares, for example, with 11% down in Italy. At almost 3.2 million units for 2011, the market is not far from levels achieved last decade (pre-recession). However, the second half of the year saw the German market weaken and analysts see it losing momentum as the German economy slows further in 2012. Consumer confidence surveys already reflect rising concerns over the implications of the eurozone crisis for the German economy.

"The German market is losing momentum," Poskitt maintains. "We're currently assuming a 2% drop."

Global: Baseline vs. Scenario Forecast 2007 – 2015 (millions)



Source: PwC Autofacts 2011 Q4 Release

Elsewhere in Europe, demand seems likely to be depressed with markets bumping along the bottom after big drops in 2011 to yield an overall drop for Western Europe of around 5%. The UK car market will likely turn out 1.8 -1.9 million depending on how severe the economic slowdown turns out. Fleet sales have been supporting the market in 2011, an indication that underlying demand cycles as well as how the economy tracks have a role to play.

A year ago, the French market was flying as buyers looked to take advantage of the remainder of the government scrappage incentive support, with last month's result certainly being put in the shade. The Spanish and French markets continue to reflect the very trying economic conditions in those countries.

Of the five major West European markets, the Spanish market is certainly struggling the most, with the December selling rate once again under 800,000 units/year, leaving the full year market down 18%. Any form of significant improvement in this market appears some time away. Italian registrations continue to be a cause of concern as well. The selling rate for the final quarter of 2011 stood at 1.7 million units/year and with the economy continuing to struggle, the market could slip further in 2012.

While the UK market was down by 4.4% last year, the revealing statistic is private retail sales, which was down by a staggering 14.1% and clearly highlights a retail driven recession. This retail slump is not just a concern for overall volumes but also for profit margins.

“While the UK market was down by 4.4% last year, the revealing statistic is private retail sales, which was down by a staggering 14.1%” Jonathan Poskitt of LMC Automotive

US market recovery set to continue off low base

By contrast, the position in the US is relatively upbeat. The market remains well down on the 16-17 million annual norms before 2008, but it is coming back. December was quite merry for automakers. US light vehicle sales rose 8.9% to an estimated 1.24 million units, producing a seasonally adjusted annualised rate (SAAR) of 13.56 million, down slightly from November's 13.63 million mark but still the second best reading of the year. Full year sales came in somewhat above 12.7 million, in line with just-auto estimates.

Forecasts for 2012 are split, but there is generally a view that another increase is coming, driven by strong retail: Morgan Stanley recently raised its projection to 14 million sales though most other analysts are looking for results in the mid-to-upper 13 million range. Recent sales have been robust but some worry the good results were driven by pent-up demand that may have been mostly satisfied. The US economy is recovering, albeit slowly, but there are still many factors that could throw a spanner into the works.

The US vehicle market, analyst Polk says, will experience single digit growth, primarily due to the relatively strong year for sales in 2011, and the effects of the weak economy that will continue to impact new vehicle demand through most of 2012. Light vehicle sales are expected to grow at a moderate pace, with a 7.3% increase to 13.7 million vehicles, according to Polk analysts, but they do not expect the US market to achieve pre-recession levels of greater than 16 million vehicles per year until 2015.

Other analysts are in the same ballpark. North American industry outlook remains positive although volumes are not expected to achieve prior peaks. Autofacts predicts an 860,000 year-over-year increase in North America production predicated on healthier inventory, export growth, and US light vehicle sales of 13.6 million units in 2012.

“The US region's automotive sector is poised for continued growth in 2012,” said Rick Hanna, global automotive leader, PwC. “Automotive



“The US region’s automotive sector is poised for continued growth in 2012” Rick Hanna, global automotive leader, PwC

companies have ramped up vehicle inventories and growth markets are easing monetary policy. Although uncertainty persists, we anticipate the global automotive industry will run on all cylinders toward another record year as long as Europe’s issues don’t spill over to other regions.”

The luxury segment in the U.S. market in 2012 is expected to be the fastest growing segment, with more than 14% growth, according to Polk.

“More affluent buyers are returning to the market for new vehicles, after three years of spending reductions,” said Anthony Pratt, director of forecasting for the Americas at Polk. “The luxury segment also offers a wide variety of product options for consumers across all segments, ranging from small cars to SUVs,” he said.

Polk says that leasing penetration will continue to be higher in the luxury segment in the US and will continue to lift transactions in all segments, as elevated residual values reduce the monthly lease payments, attracting consumers to showrooms who often make purchase decisions on the monthly payments that fit their budget.

An estimated 13.6 million new cars and trucks

will be sold in 2012, according to Edmunds.com. “With annual sales still far below the level achieved prior to the last recession, there’s plenty of indication that pent-up demand is far from spent,” says Edmunds Chief Economist Dr. Lacey Plache. “Improved selection and loosening credit conditions are helping to entice the millions of buyers that are waiting to jump back into the market.”

Next year won’t be without obstacles, though. Dr. Plache says that the continued slow pace of the economic recovery and uncertainty in the months leading up to the US Presidential election may constrain sales growth. Threats of a European recession and a Chinese economic slowdown will also pose a risk to growth in the auto market, and if these or other negative events shake the marketplace, new vehicle sales momentum could weaken.

ABOVE: Ford will be hoping that its new Fusion (Mondeo in Europe) will help it to hang on to recent share gains in North America.

Emerging markets to continue to grow, led by Asia

Elsewhere around the world, the 2012 picture is far from bleak – though much depends on stability being achieved in the global economy. Inflation has been a problem and prompted monetary tightening and other policy shifts in Brazil, India, and China caused slower growth in 2011. But, with inflationary fears in these markets subsiding (prompting correspondingly looser monetary policy), these markets could be poised for substantial growth once again, according to the analysts at Autofacts. There is clearly plenty of potential for further motorisation in places where car density remains low.

Polk maintains that growth in the other BRIC countries will outpace many mature markets over the next few years. As an example, Polk expects Brazil to surpass Germany as 2011 sales results are finalised, and new vehicle sales in India are expected to surpass those sold in Germany by 2014. Sales in Russia will outpace Germany by the year 2015, Polk believes.

Russia is also positioned for another year of strong local demand. BRIC growth is likely to reach double digits (12%) in 2012 following only five percent growth in 2011, Autofacts says.

The analysts there also say that potential exists for strong output recovery in Japan and Thailand as the auto sectors in both countries work to satisfy pent-up demand, clear product backlogs, and rebuild inventory in the wake of 2011's natural disasters. Thailand's eco-car program is also likely to provide assembly upside in 2012, Autofacts adds.

What about the chronic traffic congestion in major urban centres in China and India, I hear you ask? It's an issue, of course. But the automakers seem convinced that there is a 'cascading' effect as economic growth and rising real incomes spread out from initial hotspots. In China's case, it is spreading away from the hitherto high-growth and congested cities such as Shanghai and Beijing to inland population centres where manufacturing activity continues to be strong.

After two years of massive expansion, China's auto market is returning to a more subdued growth pattern. The cooling has been attributed to the termination of government tax incentives

and local government initiatives aimed at easing ever-worsening traffic congestion. This, some observers say, is expected to hit local car makers more than overseas players which have superior fuel-saving technologies.

Analysts looking at China are still generally upbeat about 2012. Growth is expected to come from solid demand in tier 2 and tier 3 cities, capacity expansion, easing monetary and fiscal policy and possible new investment programmes after the change in government leadership due in 2012. Industry observers expect market growth in 2012 to be between 5% and 10%.

Like China, the Indian car market is also being adversely impacted by rising interest rates, higher car prices and more expensive fuel. But again, the outlook remains positive for vehicle sales providing inflationary pressures are kept under control and economic growth maintained.

Author: Dave Leggett

RIGHT: General Motors and its joint ventures sold a record 2,547,171 vehicles in China in 2011 - The Chevrolet Malibu was among the many new model introductions. The company will be hoping that market demand holds up in 2012.

Ernst & Young's five key themes for 2012

Management consulting firm Ernst & Young says that five themes are likely to be critical for the auto sector in 2012:

1. The cooling of emerging markets growth is likely to be an area of concern for the industry in 2012. However, long-term outlook remains positive.
2. Developed automotive markets in Europe are likely to witness weak sales as a result of the sovereign debt crisis and the sales growth in the US is likely to remain uncertain. While these markets were forecast to recover to 2007 levels of production and sales by 2012, this is now likely to be delayed until the middle of the decade.
3. The intensifying competition for a market share among OEMs globally is likely to create pressures on the supply chain. Emerging economies, especially China, are becoming the largest markets for a number of global OEMs. As a result, these OEMs face the challenge of not only defending their share in their home markets, but also leveraging the growth in emerging markets. The competitive environment will place operational and financial pressures on suppliers.
4. The auto industry is expected to fully recover from the impact of the two natural disasters, the Japanese earthquake and the Thai floods, that caused severe vehicle and parts shortage in the past few months. These disasters led to a reduction in automotive inventories and offer companies a unique opportunity to evaluate production footprint and put in place processes to respond to future supply chain disruptions.
5. The uncertainty of raw material prices is likely to be a key concern for suppliers and they need to look at various options from structuring pricing contracts to joint sourcing strategies.



Battery systems

for hybrid and electric vehicles

There are many things that need careful consideration in the design and management of a battery pack for hybrid or electric vehicles

To the uneducated, what could be simpler than connecting some cells together and putting them in a box with a + and – marked on the outside? If only it was that easy.

Designing a battery starts with understanding the fundamental performance requirements of the vehicle. The key vehicle targets to start with are acceleration, top speed and range. Acceleration and top speed will give an indication of the power and torque requirements of the electric motor and factoring in any losses (efficiency etc) will give the levels of power and current the battery has to supply. Analysing the vehicle range will give what capacity the battery has to have – usually

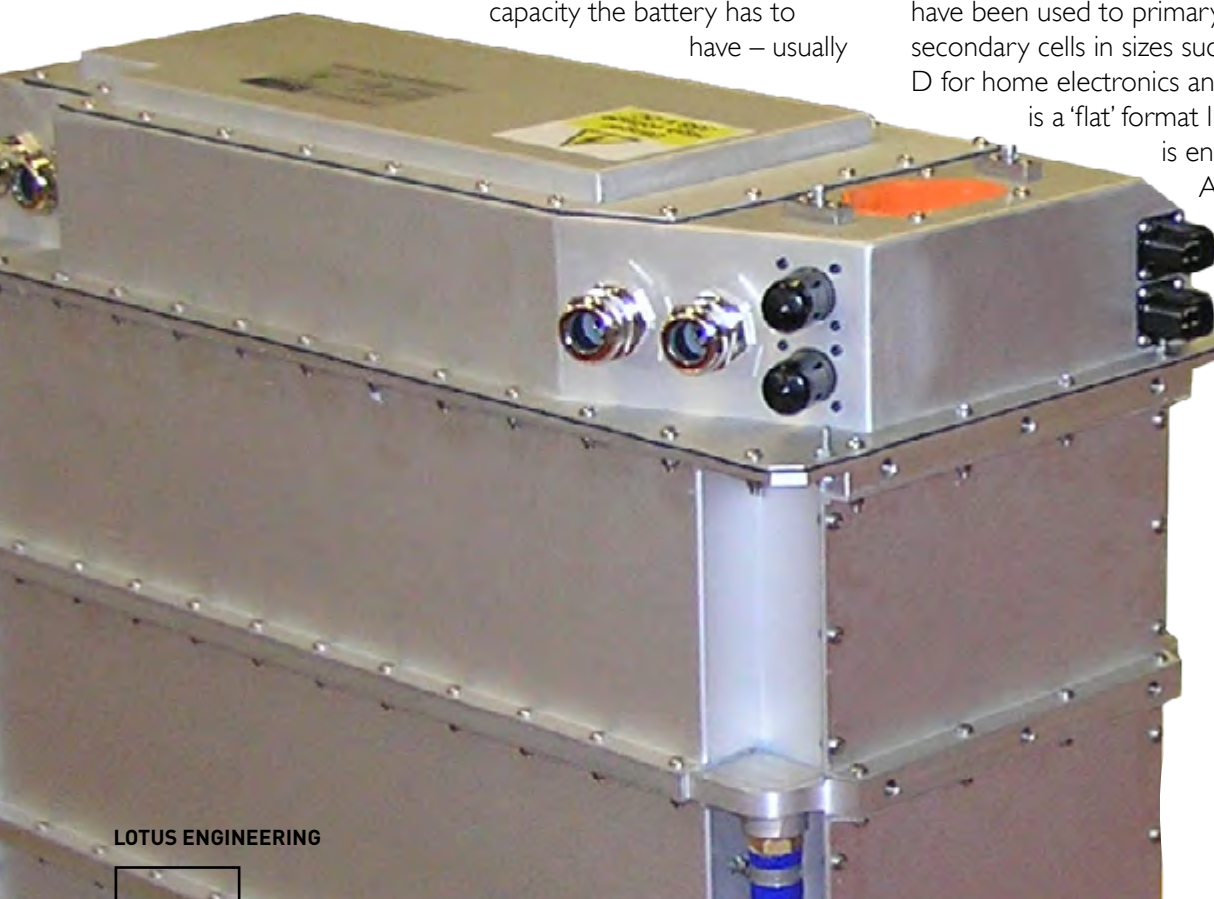
measured in kilowatt hours (kWh).

Fundamentally, cells can be divided into two kinds – primary cells (non-rechargeable) and secondary cells (rechargeable). For the purposes of this article, only secondary cells are considered. The current cell chemistry of choice will usually be something from the Lithium family of chemistries and identifying exactly which one can be a difficult task as there are so many variations in the cell chemistries, characteristics and technology maturity.

There are three main architectures for lithium cells: cylindrical, prismatic and pouch. Cylindrical is a familiar cell format – for many years we have been used to primary and more recently secondary cells in sizes such as AAA, AA, C and D for home electronics and toys. A prismatic cell is a 'flat' format like that of a book but

is enclosed in a hard casing.

A pouch cell is another 'flat' format cell that has a foil enclosure rather than a hard



LEFT: Battery pack assembly for the Lotus Evora 414E Hybrid



LEFT: Battery modules for the hydrogen fuel cell taxi. Each module contains 14 cylindrical lithium polymer cells

casing and while pouch cells may offer packaging benefits, careful mechanical design to hold or mount the cells will be needed.

A cell can be optimised for power density or energy density by altering the thickness of the active chemical layers on the electrodes. As hybrid vehicles typically have a reduced electric range, power density is more suited where the pack can be optimised in size and weight to produce power. For Pure EVs, capacity is the key for the vehicle driving range, therefore the pack can be optimised in size and weight to store energy.

A process of iteration and refinement is necessary, where managing trade-offs becomes a constant task to identify the most appropriate cells for the application from the large and growing supply base. The cell data sheets provided by the manufacturers are used to build a mathematical model of the cell so that the characteristics of the full battery pack can be understood. The choice of battery management system (BMS) is an important one as, firstly, some are better than others. Which BMS is chosen may lead to defining how many cells make up a module and how many modules make up a pack. A future proActive article will look at Battery Management Systems in more detail.

The electrical definition of the pack can be determined with respect to how many cells are connected in series and parallel to give the

overall battery pack specification for voltage, current and capacity. Simulations that include a basic control strategy will predict range and performance figures for the whole vehicle. Included in the 'performance' is battery lifetime and this is a large consideration from a customer point of view due to the cost of ownership and from an OEM point of view regarding warranty. Cell data produced by the cell manufacturers will include lifetime figures for the number of cycles a cell can be subject to before the cell performance starts to degrade. This is typically derived from empirical data from the supplier or a third party. There are other factors that affect lifetime such as temperature and storage. Testing has shown that temperature is the factor that has the largest effect on lifetime. This is true for both the operating temperature and the temperature cells may be stored at.

Cycle life can also be affected by the state of charge (SOC) the cells have when they are stored. If they're stored with a high SOC, it is shown that there will be a decrease in cycle life. It must be understood that when a cell reaches the end of its cycle lifetime, it doesn't cease to operate but it does start to degrade. The way the cell degrades is generally a capacity loss and the auto industry has defined the end of useful life as when the whole battery pack capacity has dropped to 80% of the capacity when new. What this means practically is that the vehicle range will decrease over lifetime – the vehicle is

still usable but the range will never be able to be restored.

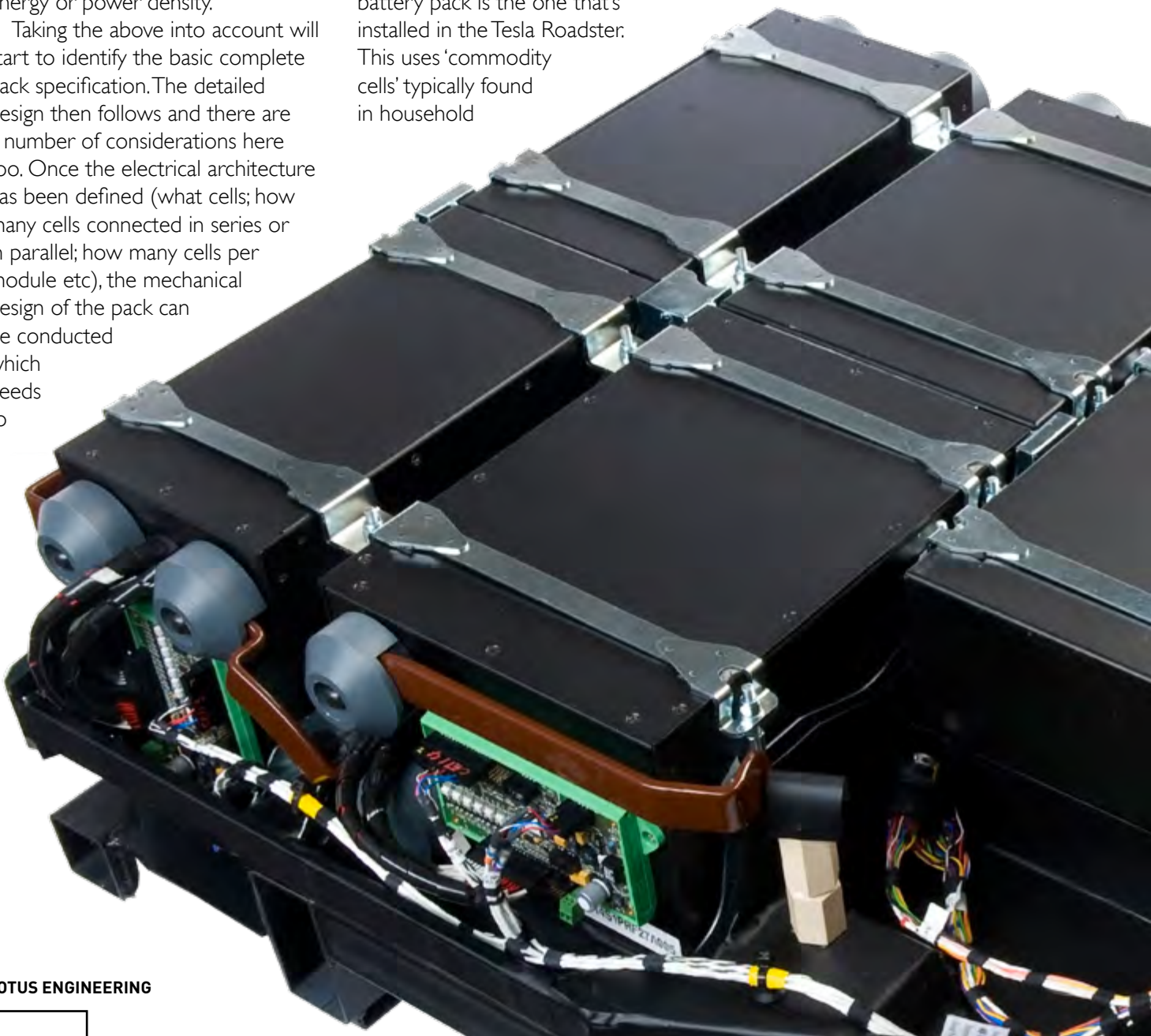
This degradation however can be mitigated in a number of ways. One method is to set a narrower band of usable voltage compared with the one stated in the cell data sheets. The result is that the cell can be taken through more cycles before the degradation occurs but the downside is that the pack will need more cells for the desired voltage, current and capacity. It's one of the many trade-offs that needs managing when designing battery packs. Choice of cell chemistry can also mitigate lifetime issues but the trade-off here may be specific energy or power density.

Taking the above into account will start to identify the basic complete pack specification. The detailed design then follows and there are a number of considerations here too. Once the electrical architecture has been defined (what cells; how many cells connected in series or in parallel; how many cells per module etc), the mechanical design of the pack can be conducted which needs to

take account of the vehicle dynamic forces. The structural integrity of the pack and the pack installation into the vehicle can be defined with the assistance of structural analysis tools. The pack and installation will need to be robust enough to withstand the forces subjected by normal road use as well as crash pulses set down in legislation and corporate test requirements. The vehicle environment is a very dynamic thing where loading and vibrations are present and changing all the time. Understanding this environment should lead to a pack that is fit for purpose.

An example of a production battery pack is the one that's installed in the Tesla Roadster. This uses 'commodity cells' typically found in household

electronics such as laptop computers. They are cylindrical cells, designated '18650' and are similar in size to a normal AA size cell. What makes the pack stand out is the large number of cells – there are 6,831 of them making the mechanical design and electrical connectivity a challenge. What's becoming more commonplace is the production of larger format cells which may be pouch or prismatic in their architecture. The benefits are that there should be fewer cells to assemble and connect – a pack equivalent to the Tesla pack may only need around 100 large format cells.



Another aspect of the mechanical design is design for safe assembly. As the cells are supplied with typically 50% state of charge, it doesn't take many electrical connections before a 'high voltage' is present. The health and safety aspect for assembly must be accommodated in the mechanical design stage. A service disconnect must also be included so that the terminal voltage can be isolated by means of a mechanical, removable disconnect. This has advantages in the vehicle assembly process but also improves the safety of vehicle occupants and first responders to an incident such as a vehicle crash.

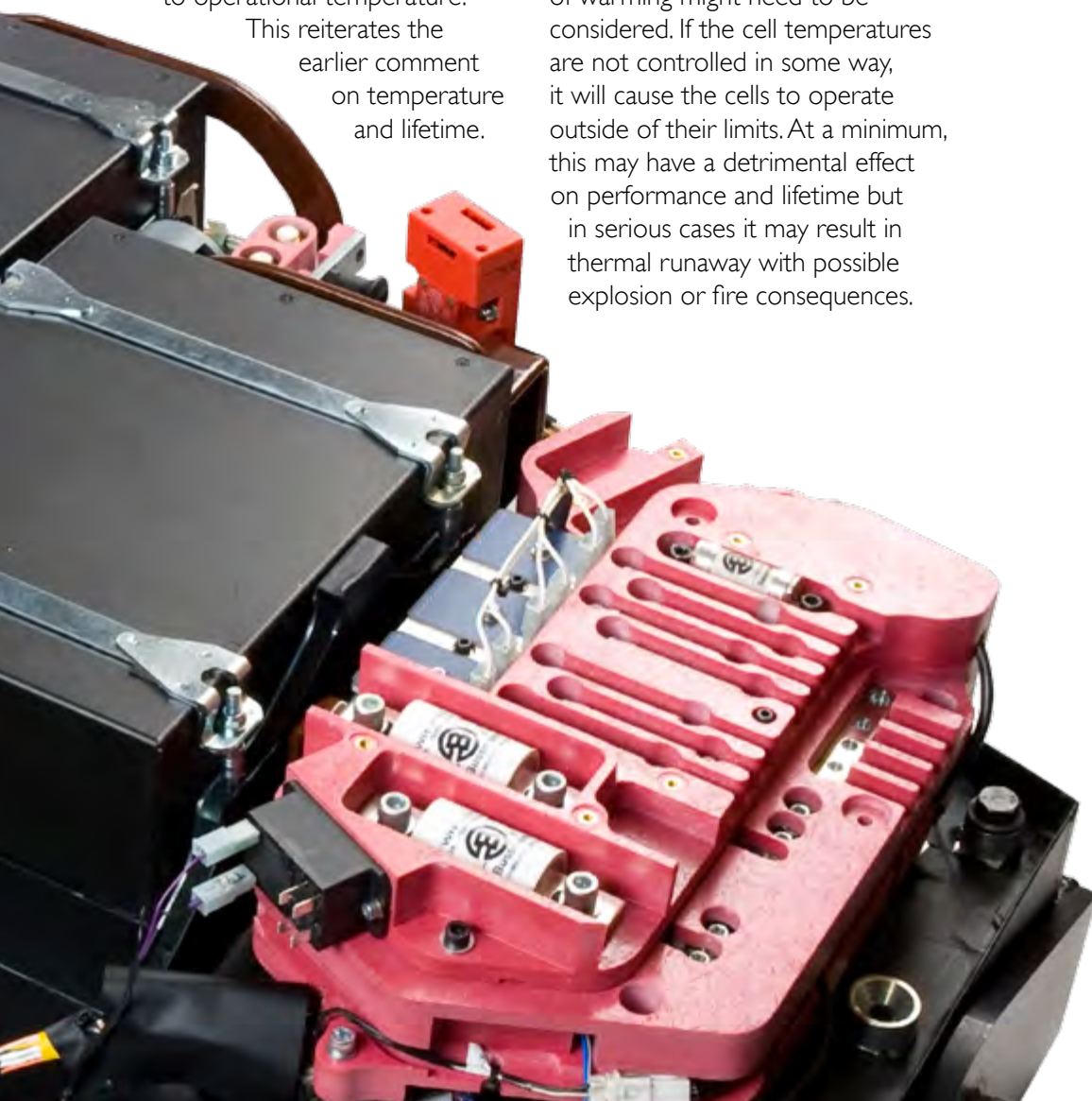
The thermal management of the battery needs to be consistent with the cell characteristics with respect to operational temperature.

This reiterates the earlier comment on temperature and lifetime.

Again, choice of cell chemistry will define the requirements for a thermal management system, which in some cases may be relatively straightforward but in other cases could be a sophisticated system with significant costs. The vehicle operational temperature is usually defined in OEM corporate standards and might be (for example) between -35 degrees C to +45 degrees C. However, what this doesn't account for is heat-soak where, for example, the rear storage compartment temperature may reach 80 degrees celsius or an engine bay temperature which may be higher still. It's not all about cooling though. Typically, damage will be caused if lithium cell chemistries are operated in temperatures approaching freezing so a method of warming might need to be considered. If the cell temperatures are not controlled in some way, it will cause the cells to operate outside of their limits. At a minimum, this may have a detrimental effect on performance and lifetime but in serious cases it may result in thermal runaway with possible explosion or fire consequences.

To sum up, the battery pack will probably be the single largest, most costly system that is installed in the vehicle and to design the most appropriate pack that meets all requirements for performance, durability and crashworthiness is a complex task. The use of analysis techniques is an important factor in battery design to make sure the end result is robust and fit for purpose.

Author: Phil Barker



LEFT: Battery pack assembly for the hydrogen fuel cell taxi. The taxi battery pack uses pouch cells.

Proton Campro 1.6 CFE

downsizing with the Campro engine

Lotus has recently completed its involvement in the development of Proton's first forced induction engine

The programme was born out of Proton's desire for a more powerful derivative of their new MPV that was in the latter stages of validation ahead of its early 2009 launch with a 1.6 litre engine. After much discussion and investigation, it was decided to use a turbocharged variant of the Campro engine family as a downsized alternative to a bought in 2.0 litre normally aspirated engine.

The first application is in the Proton Exora Bold newly launched in the Malaysian market, with further engine rollout into Euro 5 markets later in several platform variants. The engine is manufactured and assembled at Proton's Shah Alam facility outside Kuala Lumpur.

The new 103 kW 1.6 litre gasoline port fuel injection (PFI) engine, designated Charged Fuel

Efficiency (CFE), is based on the existing Proton Campro 76 mm bore normally aspirated engine family, developed by Proton and Lotus which has been in mass production at Proton since 2004 in 70 kW (1.3 litre), 82 kW (1.6 litre) and 93 kW (1.6 litre PFI) variants.

As well as the increase in performance over the existing engines, the engineering programme permitted the introduction of numerous improvements in quality and serviceability.

Taking the decision to develop their own engine provided Proton with a solution that was a lower overall cost and also gave them more flexibility for the future by owning the IPR of the engine. This was a bold step by Proton because at the time, downsizing was seen as popular in Europe but not in Japan which drives a lot of the direction of the Malaysian market. However, since the start of the project, using a smaller forced-induction engine is becoming more common in Malaysia with VW and PSA entering the market with their downsized engines. Gasoline direct injection (GDI) would seem an obvious choice for such an engine but this was ruled out due to durability concerns relating to fuel quality standards in some of their key export markets.

The overall objectives for the engine were clear, the performance and fuel economy were to match or better a state of the art 2.0 litre NA engine. Because of the nature of the target vehicle (the Exora has a gross vehicle weight of over 1,900 kg), there was to be a particular focus on good low speed torque rather than outright power.





The development programme

The engineering team comprising Proton and Lotus engineers started the design work at Lotus' UK Technical Centre outside Norwich, before migration of the project to the Proton technical center in Shah Alam, Malaysia.

This allowed for good continuity within the engineering team, as well as building strong interpersonal links. This method also allowed inexperienced engineers an unparalleled opportunity to be introduced onto a live project, being mentored by Lotus and Proton senior engineers. In total, around 30 Proton engineers spent time at the engineering centre at Lotus.

Web conferencing packages were used extensively to efficiently communicate between Lotus and Proton, as well as with vendor engineering teams in Asia and Europe. As well as utilizing Proton's existing supply base, many new technology suppliers were used for the CFE engine. Lotus Engineering Malaysia worked closely with the

Proton supplier quality assurance (SQA) team through the advanced product quality planning (APQP) process.

Lotus manufacturing engineers worked with Proton manufacturing engineers to define and plan out the changes needed to the existing manufacturing facility in terms of equipment and processes to accommodate the changes of the Campro CFE engine.

Engine dynamometer testing was carried out at both the Lotus UK and Proton Malaysian test facilities. Additionally engines and electrically driven rigs were run at vendor sites to validate key components.

The first prototype engines were available for test 7 months after kick-off, with the initial design verification (DV) phase engines built at Lotus using prototype suppliers. Later DV phase engines would be built offline at Proton using soft tooled parts from production suppliers, before final process validation engine built on a new final assembly line in the

Shah Alam facility.

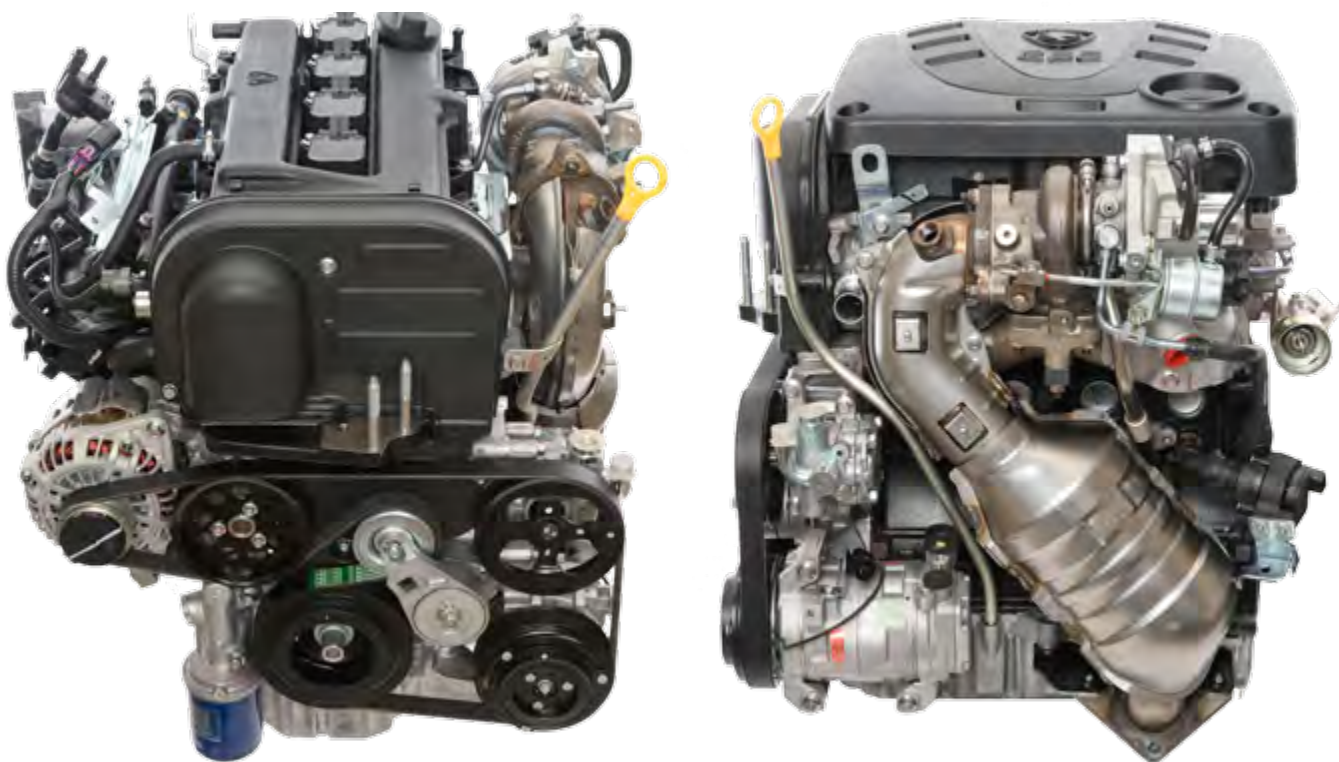
The engineering programme included application of a new torque based engine management system (EMS) as well as the base engine changes required for the higher performance of the force induction system's application. The new system would allow for seamless integration with a new continuously variable transmission, as well as permitting the vehicle to be upgraded to the latest levels of electronic stability program (ESP).

Calibration of the EMS was carried out by Lotus and Proton engineers, working closely with the transmission supplier (Punch Powertrain) and also the EMS software and hardware supplier (Continental SA).

In line with the product plan, the engine management calibration was proven at low temperature in Sweden, as well as high temperature/high altitude in Spain and Malaysia.



The engine management calibration was proven at low temperature in Sweden, as well as high temperature and high altitude in Spain and Malaysia



Technical

Although based on the existing engine family, retaining many of the key features like bore size, block height, cam positions etc, the vast majority of the components were replaced or modified in some way.

One fundamental change was a reduction in stroke from 88 mm to 86 mm. With the retained 76 mm bore, the swept volume reduced from 1,597 cc to 1,561 cc. This was brought about by the very compact height of the existing iron cylinder block which did not provide enough space to increase the required piston strength or lower the piston crown to achieve the desired compression ratio.

The compression ratio was set at 8.9:1, which although relatively low for a modern downsized engine, allows the same hardware to be used for all the target markets including those with 88 RON fuel and very hot climates without excessive retardation.

The cylinder block was based on the original Campro cast iron block.

Extensive finite element analysis (FEA) showed no requirement to strengthen the casting to withstand the increased cylinder pressures. Small changes to the block were made to incorporate piston cooling jets into the oil gallery, and computational fluid dynamics (CFD) driven flow improvements into the water jacket to improve the engine cooling required for the performance increase.

A forged steel crankshaft replaced the original cast iron unit in the engine. FEA indicated that it would be possible to maintain the existing main bearing and rod bearing dimensions; however it was necessary to improve the bearing material to withstand the projected loadings.

A new piston design with a 19 mm floating piston pin to withstand the higher cylinder pressures was implemented. The cast piston incorporated an anodised top ring groove to prevent micro-welding damage with the

expected high temperatures, and a scuff resistant coating applied to the piston skirts.

The changes to the piston and the increased gas pressure loading necessitated a change in connecting rod and connecting rod length. A new forged steel fracture cap design replaced the original powder metal design.

The aluminium 4 valve per cylinder DOHC Campro cylinder head was re-engineered to accept an intake cam phaser for the CFE application. This was achieved maintaining the existing cambelt location and now permits 40 crank degrees of intake cam phasing for improved performance, fuel economy and emissions. An improved cambelt material was implemented along with an auto-tensioner for improved serviceability.

During the cylinder head redesign, the spark plug was changed to a narrow thread, long reach design so that the spark plug boss would



allow better cooling as well as a lower coolant back pressure in the cylinder head water jacket. In the same way as the cylinder block, the water jacket design actions were led by extensive up-front CFD analysis. Through the reductions in coolant restriction developed through CFD, only a modest increase in water pump flow rate was required.

A new multiple layers steel (MLS) cylinder head gasket was developed to withstand the higher cylinder pressures.

To withstand the expected higher exhaust gas temperatures, sodium filled exhaust valves maintaining the original 5 mm stem diameter were selected.

An upgraded oil pump was also implemented to compensate for the higher demand of piston cooling jets, turbocharger bearing oil supply, and to maintain good oil pressure at low engine speed so that the intake variable valve timing (VVT) system could be operated. A water-cooled oil cooler is fitted as standard.

A Borg Warner turbocharger's compressor and turbine were

selected for maximum low speed performance. It uses a pressure regulated wastegate to control plenum pressure, and incorporated an electric integrated compressor bypass. Air from the compressor is ducted to an air to air charge-cooler mounted in the front left hand side bumper aperture. An electrical pump which is actuated on key-off to provide coolant to the turbocharger bearing housing after engine shutdown. This pump also circulates coolant around the rest of the coolant circuit to prevent boiling, an important feature in the high ambient temperature of Malaysia and Proton's export markets.

In line with the original Campro philosophy, the CFE engine uses a single close-coupled catalyst as sole exhaust gas after-treatment as a cost effective fast light off package. Variations in platinum group metals (PGM) loading and substrate density will cover Euro III to Euro V emissions markets.

The existing two-mode variable length plastic manifold was replaced with a compact fixed length plastic

manifold for the CFE. The fuel rail was re-engineered to a return-less design to reduce fuel heating effects, and higher flow fuel injectors fitted to satisfy the increased performance level.

As well as improvements to produce and withstand the increased performance, several other changes were made to reduce the friction of the base engine.

These changes included replacing the original engine's direct acting hydraulic tappets with lower friction mechanical graded tappets that are machine selected on the engine assembly line.

Piston ring heights were reduced allowing lower tangential loads and the piston skirts now include a low friction coating.

A windage tray was also added to the oil pan that has been shown to reduce parasitic losses by up to 1.5 kW. A higher specification lower viscosity mineral oil was specified to allow extended service intervals along with reduced friction.

Performance

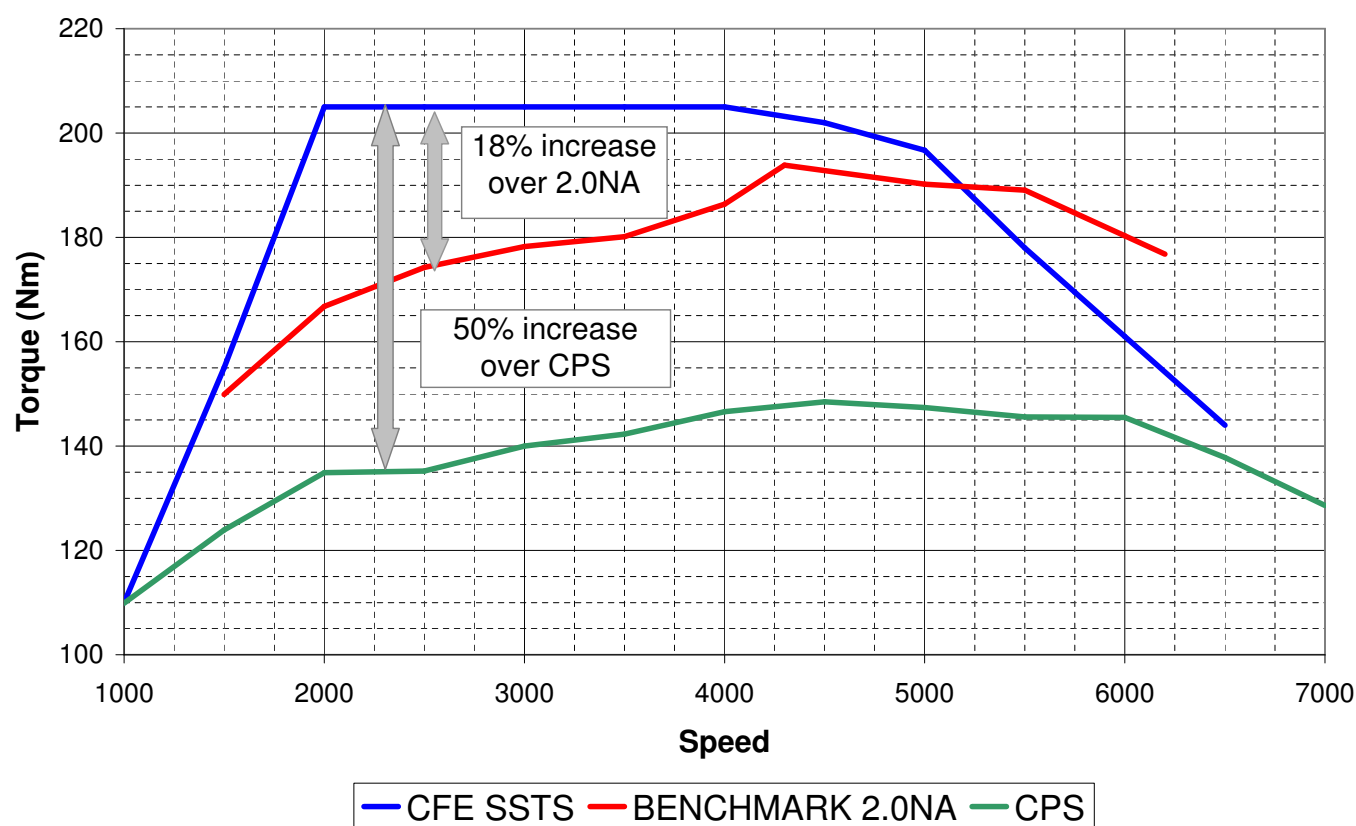
The main focus for the CFE engine was as a downsized engine to power a large MPV, instead of a potential 2.0–2.2 litre NA engine. It was specified to deliver better full load performance and part load fuel economy than a 2.0 litre NA.

The resulting torque curve, shown as Figure 3, peaks at 205 Nm

from 2,000-4,000 rpm to stay within the limits of the CVT transmission, this is achieved with a boost pressure of between 0.6 and 0.8 bar. Sufficient boost is achieved by 1500 rpm to exceed the torque of a 2.0 litre NA engine and to produce more than the peak torque of the Campro 1.6 CPS engine currently

used in the Exora. The engine achieved a part load BSFC over 4% better than the state of the art 2.0-litre NA engine benchmarked at the start of the project.

BELOW: Graph showing torque of new Campro CFE engine against benchmark engine and base Campro CPS



Summary

The 1.6 litre CFE engine represents Proton's first mass production downsized engine technology, with initial launch in the 2012 Proton Exora Bold vehicle.

The engineering programme from clean sheet to mass production was achieved inside 3 years with a relatively small team of Lotus and Proton engineers, and continues the track record of successful joint

engineering programmes carried out over the last 15 years and demonstrates Lotus' continuing powertrain capability from concept through to production.

Authors: John Birkmyre, Richard Jackson and Lee Jeffcoat

Vehicle mass emissions targets

is it time for us to consider an alternative in Europe?

Reducing vehicle mass is a clear route to reducing fuel consumption and therefore CO₂ emissions – the benefits depend on the road load experienced by the vehicle during the drive cycle in question.

From 2012 vehicle manufacturers will face fiscal penalties if the average CO₂ emissions on the new European drive cycle (NEDC) of the new vehicles which they sell exceed target levels set by the EU (see inset 1). Therefore cost-effective vehicle mass reduction might be expected to give unequivocal benefits to manufacturers.

Vehicle mass influences directly almost two thirds of the 19% of the fuel energy which makes it into supplying propulsive effort to the vehicle.

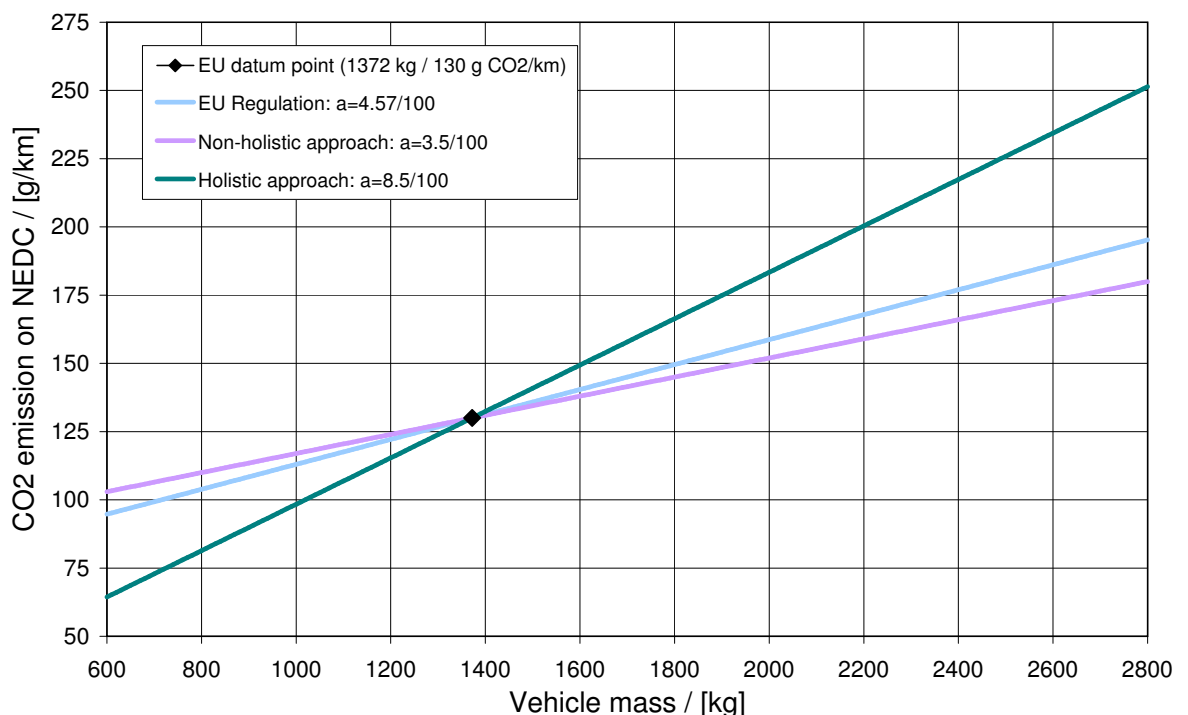
About a third of this propulsive energy is imparted to the vehicle in the form of kinetic

energy or energy used in overcoming the vehicle inertia during the acceleration events which is, in this case, not recovered. Close to another third is dissipated by the vehicle rolling resistance which is related to its mass via its influence on the friction between the moving interface between the tyre and the road. Only the energy dissipated in overcoming the aerodynamic drag of the vehicle is not directly related to the vehicle mass.

The NEDC does not include any gradients but energy required to overcome these in real world driving cycles is also directly proportional to the vehicle mass.

Clearly if manufacturer A's average vehicle mass is 1372 kg in 2012 its CO₂ target for new car sales would be 130 g/km. If the manufacturer reduces its average vehicle mass by 100 kg its CO₂ target becomes 125.4 g/km – a more

FIGURE 1:
The utilisation of energy supplied to a B-class vehicle with a 1.4 litre spark ignition engine driven over the NEDC



The target is higher for manufacturers of heavier vehicles and lower for manufacturers of lighter vehicles

difficult target by 4.6 g CO₂/km as a reward for its mass reduction efforts. From 2015, the reference mass used in equation 1 (p50) will be based on the industry average mass. Thus if, after this point, other manufacturers of less svelte vehicles cause the industry-average mass to increase by 100 kg, manufacturer A's new target would be 120.9 g CO₂/km, i.e. manufacturer A's target would have become more severe because other manufacturers had caused the industry-average mass to increase.

There is a further disincentive for a manufacturer inclined to produce lightweight vehicles by reducing only structural mass since this course of action does not give CO₂ benefits which keep pace with the reduction of the legislative limit value curve. Thus, in the case of a manufacturer reducing its fleet-averaged mass, the fleet-average CO₂ target is reduced by a larger amount than the reduction in CO₂ found in the performance of the vehicle on the NEDC resulting from this reduction in structural mass. Therefore simple mass reduction strategies could result in a situation where fiscal penalties for manufacturers are increased rather than

reduced.

To avoid this scenario a holistic approach, where more efficient engines are used together with reduced mass structures, is required in order to give benefits. The value of parameter α in equation 1, found in practice when a non-holistic approach to mass reduction is adopted, i.e. only the structural mass of the vehicle is reduced in isolation to the use of other technologies, is about 3.5 g CO₂/km per 100 kg mass change for a C-class vehicle on the NEDC (represented by the pink line in Figure 1).

It is clear that, not only are lightweight vehicles effectively penalised by having to meet a more stringent CO₂ target, the reductions in tailpipe CO₂ from the simple non-holistic approach to mass reduction may be insufficient to produce a net CO₂ benefit large enough to reduce the fiscal penalties to which manufacturers are liable – rather it would increase them.

If manufacturer A makes a single model and reduces the mass of this vehicle by 100 kg it will reduce its fleet-averaged CO₂ emissions by about 3.5 g/km whilst the target will be reduced by almost 4.6 g/CO₂. Thus there will be a fiscal

EU emissions targets (inset 1)

In 2012 65% of each manufacturer's new cars must comply on average with the limit value curve, rising to 75% in 2013, 80% in 2014, and 100% from 2015 onwards. From 2012 excess emissions premiums for each car registered are €5 for first g/km, €15 for second g/km, €25 for third g/km, and €95 for each subsequent g/km. From 2019 the premium will be €95 for every g/km above the limit value curve.

The CO₂ target specific to individual manufacturers is dependent on the average mass of the new vehicles it sells. Figure 2 shows that at the reference vehicle mass, which is taken as the industry-average mass of 1372 kg, the fleet-averaged CO₂ target to avoid fiscal penalties is 130 g CO₂/km. The limit value curve, shown by the blue line in the graph, varies so that the target is higher for manufacturers of heavier vehicles and lower for manufacturers of lighter vehicles (although the required percentage reduction to meet the new target for vehicles well above the reference mass is larger than those required by lower mass vehicles).

The target varies with vehicle mass according to equation 1.

penalty on 1.1 g CO₂/km which at an eventual penalty of €95 per gram of CO₂, amounts to €104 per vehicle sold by the manufacturer.

Significant reductions in CO₂ levels below the limit value curve are only possible by adopting a holistic approach to new vehicle design and specification, where the reduction in mass is leveraged to enable similar vehicle acceleration performance to be achieved with a smaller, less powerful, but more economical engine and/or the use of modified gear ratios, enabled by the vehicle mass reduction.

This holistic approach is represented by the green curve in the graph (the value of 8.5 g CO₂/km per 100 kg was used by Goede et al. in this scenario ^[1]). Clearly, further reductions in CO₂ are possible via additional engine downsizing, to retain performance for example.

Of course the benefits of structural mass reduction to the fuel economy and, importantly, performance of individual vehicle models, in terms of their market appeal, and strategic positioning against competitors may be the over-riding motivation.

An alternative is to use vehicle 'footprint' as the parameter on which to base a variable CO₂ target ^[2]. Of the parameters defining the vehicle footprint, only the width, which is capped by road lane

width and other practicalities, has a significant impact on vehicle energy consumption over a drive cycle via its influence on aerodynamic drag.

The possibilities for improving the efficiency of a wide car are greater than those for improving the energy efficiency of a heavy car ^[2]. High mass is perceived negatively by the consumer whereas interior space, which is directly proportional to footprint, is a positive consumer attribute ^[2] and is also directly related to the ability to carry more passengers giving greater potential to reduce per capita CO₂ emissions.

Whereas average vehicle mass in the EU increased by 21.7% between 1995 and 2006, average surface area (proportional to footprint) increased by only 7.7% over the same period, thus a standard based on vehicle footprint would be a more stable controlling parameter. Vehicle footprint is also positively correlated with transport safety, contrary to vehicle mass ^[2] and this has heavily influenced the US to switch to a vehicle footprint-based CO₂ and fuel consumption standard ^[3]. Is it time for us to consider an alternative approach in Europe?

Author: Dr Richard Pearson

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Equation 1

Where M_0 is the industry-average mass, M_v is the manufacturers fleet-averaged vehicle mass in kg, and a is the mass sensitivity parameter

[g CO₂/kg]. The value of a is 0.0457 g CO₂/kg or a change in the target of 4.57 g CO₂/km for every 100 kg by which the manufacturers fleet averaged-mass changes, as shown by the blue line in the graph.

$$m_{\text{CO}_2} = 130 + a(M_v - M_0)$$



Inside Lotus with Mark James

interview by just-auto's Simon Warburton

Mark James is director for Lotus Engineering's worldwide operations, a position he took up in June of this year having a wealth of experience from both the automotive industry and engineering services sector.

At Lotus, Mark is leading the expansion of Lotus Engineering's third party consultancy work and developing its position of technology leadership in lightweight architectures, efficient performance,

electrical and electronic integration and driving dynamics. Mark has full responsibility for Lotus Engineering worldwide,

Mark has held a number of positions with Lotus Engineering during his 25 years with the company, including head of European operations, head of strategy and head of the engines business unit.

Mark holds an honours degree in mechanical engineering from the University of Reading in the UK.

What are the key challenges facing Lotus Engineering at the moment and are you affected by the current global uncertainty?

The biggest challenge for us working day to day is demand. The engineering services industry has bounced back with a vengeance after the recession and there is so much change currently because of legislation, the green agenda and to some extent, what the market is demanding in terms of new products.

The market is unsettled in terms of industry direction on ultra low CO₂ solutions which is driving a lot of interest in new technologies for powertrains and vehicles. There hasn't been so much change in the industry probably since its inception.

Lotus values have always been about lightweight, efficient, innovative vehicles, so for us this is a really exciting time for Lotus Engineering. There is demand from the US, China and Europe for these new technologies and everybody wants to understand what ultra low CO₂ and light-weighting means in the context of the market.

How has the current global economic uncertainty, particularly in developed, Western economies affected your business?

It has not really affected the ESP's (Engineering Services Providers) to a great extent. The market is huge, we can safely say the global outsourced market for engineering services is between £5bn-10bn. Not only is the market enormous, but the majority is where Lotus Engineering is strongest in terms of our core competencies.

How do you find recruiting skilled engineers at the moment, can the UK government do more?

Our potential opportunities have quadrupled since April to more than £400m, this is wonderful but

unfortunately it has come at a time when the availability of skilled people has declined. Getting new people therefore has become the challenge.

Many companies are competing to recruit from the same pool of engineers and this will constrict the services industry growth to a degree. Companies are looking at off-shoring to China and India. China is not ideal because it has a shortage of experienced labour itself, it also has a high attrition rate and labour costs are increasing at 15% per year.

Thankfully the Lotus brand name attracts people. We make excellent products that entice employees however when you think you need around 150 people to man a typically sized vehicle programme, trying to find them locally is impossible. Therefore attracting new staff is currently a big challenge for our business. Two years ago, it was easier, but with increased demand in the Midlands, from companies such as Jaguar Land Rover, this is now more difficult.

Are there any particular types of graduates you would like to encourage to join the business and could the UK government do more to help?

Lotus has a lot to offer new graduates - not too small to be dull and not too large to have only a small area of responsibility. Lotus is recognised as having a world class graduate scheme, accredited by the IMechE, taking on about ten graduates a year. Any support the government could give to encourage engineering, especially more female, graduates would be good.

There is a higher cost in getting graduates from abroad, visa restrictions have also become much tighter under the current government. However, Lotus is a global player, so we want people who can speak different languages

and who understand the different cultures of the markets we are engaged in. Customer empathy is an important factor in good client relationships.

What will the key innovations be in the industry in the foreseeable future?

Legislation is being influenced by public opinion, the problem for manufacturers is that there are no cheap, ultra low CO₂ powertrain solutions currently. A full-electric car, like the Nissan Leaf for example, retails for around £31,000 - almost double the price of conventional gasoline vehicles in the same segment. I suspect therefore that none of the OEMs are making money out of small full-electric vehicles given the high cost of batteries. This is not sustainable.

This and infrastructure issues are also constraining the volume growth of hybrid and electric vehicles. This means the industry will not be able to scale up to higher volumes with ultra low CO₂ cars. It will be interesting to see what happens within the electric vehicle market.

The European legislation is driving the industry towards these very high-cost solutions and local governments are having to offer grants to the buying public to subsidise their purchase. It is not a sustainable solution in my view.

Until someone develops a radical solution that reduces battery prices, which are currently prohibitive, then the industry will continue to struggle to provide competitively priced electric and hybrid vehicles and consequently not achieve sustainable volumes. The industry, under these conditions, is reverting to improving the internal combustion engine through aggressively downsized engines and other established engine technologies such as cylinder deactivation and through the use of alternative fuels. Aggressive

downsizing can achieve CO₂ reductions of 35% so there is life in the old dog yet. This doesn't mean electric vehicles will decline but their growth will be constrained for several years.

How has Lotus dealt with the legislation in Europe?

From a Lotus Cars perspective we helped form a group called the European Small Car Association (ESCA) in association with Burson Marsteller, an international lobbyist, and we invited all the European small car manufacturers to join. There were around a dozen of us eventually. For Lotus, as the

legislation stood, if we couldn't obtain a derogation under the legislation, we would have payed significant fines based on the product plan we had then.

We lobbied MEPs and government officials and put forward strong arguments for the amendments we needed as a group, mainly from Aston Martin, McLaren and ourselves. We were surprised at how supportive MEPs were of our concerns, and that they supported all of the amendments we tabled.

The way the legislation process works is, in itself, interesting. Politicians look for a broad

compromise - not necessarily a utopian solution. The current EU CO₂ legislation is therefore flawed in some ways. It penalises light weight and only considers tank-to-wheel, it does not consider well-to-wheel. Overall the legislation has been positive as the industry needed to change but I think there will be changes going forward.

How does Lotus Engineering view the next five years?

Because demand in the industry is so high for our four core competencies (lightweight architectures, efficient performance, electrical and electronic integration and driving dynamics) we expect our market share to continue to increase. We have a five-year plan to double our revenues and increase our profitability, even our conservative growth plan represents a 20% compound annual growth. This does not mean that I want Lotus Engineering to be the biggest ESP globally. I want us to remain specialists in advanced automotive technologies and processes and I don't want size to compromise this.

What are the key attractions for customers when it comes to Lotus Engineering?

Firstly our brand name and our association with Lotus Cars and Lotus Racing has enormous benefits in the market, people see the products we engineer on the road and on the track on a day-to-day basis. And, importantly, being an OEM ourselves means we understand how to develop vehicles and technologies



for production, not just in steel and aluminium and at high volume.

We are unique in the industry in that our cars advertise our engineering expertise. Conversely, our leading edge 3rd party projects and R&D programmes generate know how and technologies that benefit the development of our cars. No other automotive company currently has these synergies.

Our driving dynamics and hybrid vehicle capabilities are particularly well regarded in the industry. Combined with our expertise in lightweight architectures and efficient powertrains, we can provide all of the skills and know-how that manufacturers are currently looking for.

Will Lotus Engineering look to shift work abroad?

We are looking to increase our employee base in the UK, but we are also investigating hiring experienced and knowledgeable engineers from elsewhere. We think that over the next few years, 20% - 40% of our projects could be delivered outside of the UK, including work from our existing teams in America and China which will also continue to expand.

How do you view the competition?

We have a very good relationship with our competitors and talk to them on a fairly regular basis. We are competing but the relationship is not adversarial, there is much more dialogue than you might expect and I am not adverse to working with my competitors if it improves my ability to deliver to my clients.

How would you characterise Lotus Engineering's industrial relations?

We are not unionised here, we have a Lotus Engineering staff council and management representatives. My previous role was looking after UK operations. I have a good relationship with both groups. There are no topics that are off the table, we have a very open relationship and, whilst the responsibility for this has now passed to my UK operations head, I still have one-to-ones with the council chairman and the management reps as does the CEO.

We negotiate on a yearly basis for pay rises and terms of conditions, they do a good job representing staff concerns, not an altogether easy task. Lotus is quite an open company in terms of management style. It is one of the things I noticed, and subsequently admired, when I left the company several years ago.

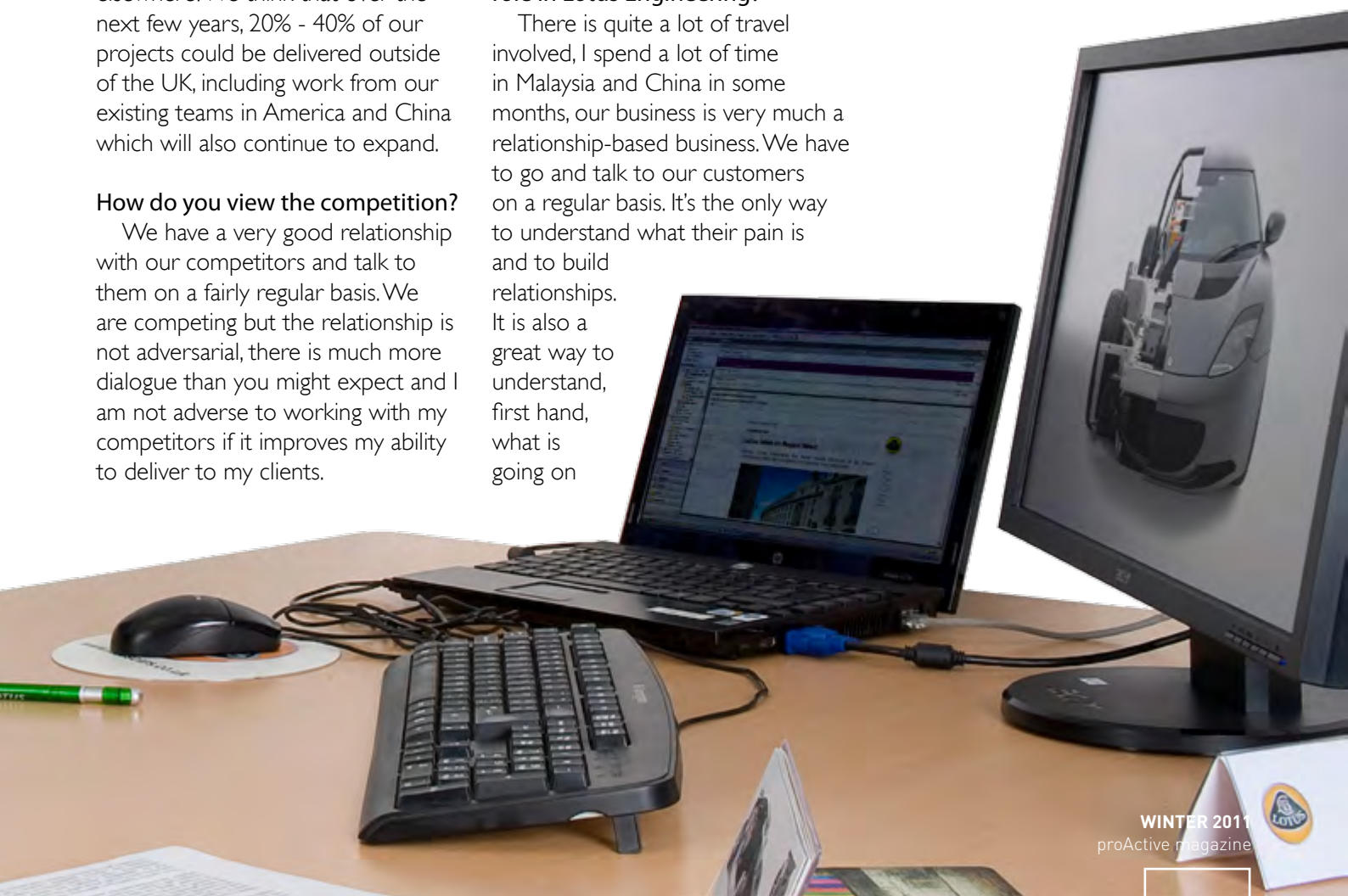
Are you away a fair amount in your role in Lotus Engineering?

There is quite a lot of travel involved, I spend a lot of time in Malaysia and China in some months, our business is very much a relationship-based business. We have to go and talk to our customers on a regular basis. It's the only way to understand what their pain is and to build relationships. It is also a great way to understand, first hand, what is going on

in the industry.

How does a typical day look for you at Lotus Engineering?

A day in the office is typically filled with meetings from financial and forecasting to client meetings and one-to-ones with staff. I am probably travelling up to half of my time which is to be expected when directing global operations. I have weekly meetings with the CEO and other directors. The wonders of modern technology mean you are available 24 hours a day. You are therefore never out of the office, the office goes with you. This is sometimes a mixed bag in terms of positive and negative, especially when the CEO calls you at 03:00! But I consider myself lucky, I love my job and I'm proud of what we have achieved, and continue to achieve at Lotus.





ENGINEERING

LIGHTWEIGHT ARCHITECTURES
EFFICIENT PERFORMANCE
ELECTRICAL AND ELECTRONIC INTEGRATION
DRIVING DYNAMICS



FOCUSED ON **TESTING EXCELLENCE**

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.

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