NEWS RELEASE

Lotus Engineering

06 March 2007

NEWS RELEASE

'EVE HYBRID' TECHNOLOGY DEMONSTRATOR SHOWCASES RETRO-INTEGRATION OF HYBRID SOLUTIONS

An Innovative R & D project by Lotus Engineering and Proton Holdings Bhd features hybrid solutions that deliver up to 22% CO_2 reduction and are advancing towards readiness for integration into current models.

Lotus Engineering will unveil the 'EVE Hybrid' (Efficient, Viable, Environmental) technology demonstrator at the 77th Geneva International Motor Show. Developed for, and in close R & D Engineering cooperation with, our shareholder, Proton Holdings Bhd, it showcases how OEMs can introduce lower emissions variants to existing model ranges that currently only offer conventional gasoline and diesel powertrains.

Lotus Engineering believes the application of hybrid technology is a key route for CO_2 emissions reduction and that for the next five years it may remain more viable to integrate hybrid technologies into existing model ranges than to develop expensive new dedicated hybrid platforms. Solutions that Lotus Engineering can provide to its OEM clients will help them keep price premiums for hybrid variants at a minimum, thanks to lower development costs, and are available immediately for introduction within current and next generation model lifecycles.

The EVE Hybrid programme is focussed on establishing the processes for integrating hybrid technology with minimal development time and cost, overcoming many of the challenges associated with integrating hybrid technology into existing platforms through intelligent, compact and discreet packaging of additional systems.

Ultimately, Lotus Engineering's solutions aim to provide strong, viable business case propositions for our OEM clients to offer a hybrid variant of a medium-high volume production car.

Lotus Engineering

The research and development programme was undertaken by a cross-functional team of Lotus and Proton engineers working seamlessly together at Lotus Engineering's Hethel headquarters and Shah Alam, Kuala Lumpur. The resulting EVE Hybrid demonstrator, based on a Proton Gen.2 compact midsize car with a 1.6litre gasoline engine, showcases a trio of production-representative technologies:

(1) a 'micro-hybrid' start-stop system

(2) a full parallel hybrid drive

(3) Continuously Variable Transmission

Compared to the baseline Proton Gen.2, tailpipe emissions are reduced from a competitive 172g/km to just 134g/km, a reduction of 22%, while fuel economy improves from 39.2mpg to 50.2mpg, a 28% improvement.

Mike Kimberley, Chief Executive Officer of Group Lotus plc, said: "The technologies and know-how showcased in the EVE Hybrid are the latest addition to our suite of efficient performance solutions for the industry. As an automotive consultancy and Global OEM, Lotus is able to manage all elements of a hybrid integration project under one roof, with extensive drivetrain, vehicle, electrical and control systems expertise from design and development through to production. Our technologies and world-class engineering capabilities mean we are in a great position to help OEMs apply advanced hybrid technology to their products in order to reduce average CO_2 emissions."

Mr Kimberley continued: "This project is yet another example of how the Proton / Lotus family continues to successfully deliver exceptional projects and products and the EVE Hybrid technology we have developed further reinforces the Group's position as creative technology leaders in 'green' automotive engineering. The addition of the EVE Hybrid solutions to Lotus Engineering's extensive capabilities, together with the experience of developing our Bio Ethanol flex-fuel Lotus Exige 265E means that Lotus Engineering is an ideally placed high Technology organisation suited to helping the global industry to find a solution for future low emission personal transport needs."

Technologies in the EVE Hybrid technology demonstrator

A number of the technologies featured in the EVE Hybrid are production-ready, employing systems deliberately sourced from established tier one suppliers in order to demonstrate the availability of components, the minimisation of development costs and to maximise business case viability.

The EVE Hybrid features three key technologies:

(1) 'Micro-hybrid' stop-start system:

A starter-alternator system was integrated that switches the engine off when the vehicle stops, during town driving for example. The engine restarts automatically when the brake pedal is released.

As a result, noise, emissions and fuel consumption are reduced. The unit runs on the standard vehicle 12volt electrical system and combines both starter motor and alternator functionality. Fuel savings of 5% have been demonstrated with a 5% reduction in CO_2 emissions.

(2) Full parallel hybrid technology:

A bespoke 30kW, 144V motor is packaged between the engine and transmission. It delivers electric drive or regenerative braking via an additional clutch linking the motor to the drivetrain.

The motor provides the same start-stop functionality as the micro-hybrid with the additional benefit of electrical drive or drive assist, either boosting the drivetrain performance or providing economy and emissions benefits by operating as an electric vehicle. The motor is powered by a 144 volt battery located in the boot.

Testing has confirmed simulation predictions of 28% fuel efficiency improvement and 22% CO_2 emissions reduction.

(3) Continuously Variable Transmission (CVT)

The CVT is a transmission in which the ratio between the input and output shaft can be varied continuously within a given range, providing an infinite number of possible ratios. The integration of a CVT gives benefits in fuel consumption and emissions control. In addition, its compact package assisted in the application of a hybrid electric drive and it provides smooth acceleration and low transmission noise.

Performance benefits of EVE Hybrid technologies

Extensive performance and drive cycle modelling of a production hybrid variant using the technologies on the EVE Hybrid indicate the following comparative vehicle performance figures:

(1) EVE Hybrid in micro-hybrid mode with start-stop system:

MPG:	41 (5% increase from baseline)
Max torque:	148Nm @ 4000rpm
Max power:	82kW / 110hp @ 6000rpm
0-62 mph (0-100kph):	12.6 sec
Top speed:	118mph
CO_2:	164g/km (5% reduction from baseline)

(2) EVE Hybrid with full parallel hybrid configuration:

MPG:	50.2 (28% increase from baseline)
Max torque:	233Nm (limited to180Nm continuous) @ 1500rpm

Max power:	105kW / 141hp @ 5500rpm
0-62 mph:	9 sec
Top speed:	118mph
CO_2:	134g/km (22% reduction from baseline)

(3) Continuously Variable Transmission configuration

MPG (EU combined cycle):	41 (5% increase from baseline)
Max torque:	148Nm @ 4000rpm
Max power:	82kW / 110hp @ 6000rpm
0-62 mph (0-100kph):	12.6 sec
Top speed:	118mph
CO_2 (combined cycle):	164g/km (5% reduction from baseline)

Proton Gen.2 1.6litre 4-cyl gasoline (manual transmission) baseline for comparison:

MPG (EU combined cycle):	39.2
Max torque:	148Nm @ 4000rpm
Max power:	82kW / 110hp @ 6000rpm
0-62 mph (0-100kph):	12.6 sec
Top speed:	118mph
CO_2 (combined cycle):	172g/km

Technical details of EVE Hybrid technology demonstrator

Engine

Various changes have been made to the Proton gasoline 1597cc CamPro engine. The main modification is the redesign of the front end accessory drive (FEAD). This was done to accommodate a Valeo 'StARS' starter/alternator, which drives the micro hybrid start-stop system.

The redesigned FEAD also accommodates a Sanden hybrid Heating Ventilation and Air Conditioning (HVAC) compressor that operates by conventional belt drive and has an additional electrically driven capability which enables continued air conditioning operation when the engine is stopped.

During the FEAD redesign the opportunity was also taken to replace the belt driven Power Assisted Steering (PAS) and water pumps with electric units to enable the investigation into the economy benefits of such units.

To accommodate the additional hybrid functionalities the Engine Management System (EMS) was updated to a Siemens VDO torque-based unit and re-calibrated by Lotus Engineering.

Motor/Generator

Due to tight packaging constraints and to minimise any loss in overall vehicle performance, bespoke electric motor and power electronics were developed in conjunction with specialist suppliers ElektroMagnetix and Turbopower Systems. The motor/generator and power electronics are water-cooled and include an auxiliary power unit to support the vehicle's 12volt systems.

An additional clutch supplied by AP Racing is packaged inside the motor and connects the IC engine to the traction motor. This enables the engine to be switched off for electric drive only use.

Gearbox

A Punch Continuously Variable Transmission (CVT) has replaced the conventional transmission and a modified bell housing accommodates the electric traction motor.

Battery Pack

The EVE Hybrid uses a Cobasys Series 1000, NiMH, 30kW 144V module that incorporates an integrated cooling system. This traction battery pack is securely mounted on the boot floor, displacing approx 47 litres of luggage space.

Control System

A sophisticated bespoke Lotus Engineering control system was developed to implement the energy management function by monitoring and controlling all sub-control systems including the engine management, motor/generator, transmission, HVAC, additional clutch, starter/alternator and battery pack.

Brake System

To maintain the integrity of the braking circuit when the petrol engine is off, a Mes-Dea electric vacuum pump maintains the vacuum assist for the brakes.

Steering System

An off-the-shelf TRW electro-hydraulic power assisted steering pump has been fitted, which allowed the retention of the existing steering column and hydraulic steering gear. This pump also provides hydraulic pressure for the additional clutch that engages the hybrid motor.

Interior

The instrument panel incorporates an additional LCD display developed by Lotus Engineering to show battery charge, power split between engine and motor, fuel economy and charge/discharge rate, and incorporates associated warning indicators where appropriate. Also fitted to the dash are new switches to select the car's operating mode - micro hybrid, full hybrid or electric vehicle.

- ends -

Notes to editors
The following high resolution images are available:
- diagram showing the technical configuration of the Full Parallel Hybrid Drive
- photograph of the EVE Hybrid technology demonstrator engine bay
- photograph of the EVE Hybrid technology demonstrator interior
- photograph of the EVE Hybrid technology demonstrator exterior

Senior Lotus Engineering spokespeople are available in advance of the Geneva International Motor Show and will also be available at the show for comment or interview. To arrange an interview or to access the images or for further information, please contact:

Mike Stainton or Patrick Peal at Band & Brown Communications:
+44 (0) 1603 417722 / mike.stainton@bbpr.com / patrick@bbpr.com
or
Alastair Florance, PR Manager, Group Lotus:
+44 (0) 1953 608462 / aflorance@lotuscars.co.uk

About Lotus Engineering
Lotus Engineering provides comprehensive and versatile automotive consultancy services to many of the world's OEMs and Tier 1 suppliers, offering a full engineering service from initial concept and project design through development to full production prototype build. This includes third party "niche vehicle" engineering and manufacture.