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LC Super Hybrid premiere at Geneva Motor Show

The LC Super Hybrid has been conceived by Controlled Power Technologies (CPT) and the Advanced Lead-Acid Battery Consortium (ALABC) to show that significant CO₂ reduction can be achieved through electric hybridisation at low voltages (12-48 volts) using the latest lead-carbon batteries. The production-ready technology offers the potential of a mass market, petrol-powered, large family car with superb drivability, impressive performance and excellent 5.6 litres/100km (51mpg) fuel economy achieved at substantially lower cost than an equivalent diesel model. The low voltage technology enables aggressive yet near-term down-sizing and down-speeding of existing engine families.

The state of the art in substantial and affordable CO₂ reduction will be unveiled at the 2012 Geneva International Motor Show, where the LC Super Hybrid will make its world debut helping to define a whole new class of low cost low consumption lead-carbon hybrid vehicles. The low voltage (12 volts) 'micro-mild' technology demonstrator has been developed by UK-based Controlled Power Technologies in cooperation with the Advanced Lead-Acid Battery Consortium, an international research group based in the US. The vehicle includes production-ready technology recently sold by CPT to the leading French tier 1 supplier Valeo, thereby becoming the first global automotive component manufacturer to offer its OEM customers a range of electric superchargers. Other international companies involved are powertrain developer and systems integrator AVL Schrick based in Austria and Germany, springy materials specialist Mubea also from Germany, and Provector, a leading expert in battery management systems, based in the UK.

The LC Super Hybrid will be presented on the [Swiss association e'mobile](#) stand 5141, which takes centre stage at the international exhibition in Hall 5. The association works closely with Palexpo SA, which is mandated to organise the show on behalf of the Geneva Motor Show Foundation. Geneva has a long tradition of being in the vanguard of revealing technical breakthroughs and new design concepts ever since the inaugural event in 1905. The 2012 exhibition opens to the general public from 8th to 18th March following the two press days on 6th and 7th March when the LC Super Hybrid's innovative technology will come under the scrutiny of 11,000 media reporters.

VIP visitors also taking a look at the LC Super Hybrid include Switzerland's president Eveline Widmer-Schlumpf expected on 8th March during her official visit to the motor show. Daniel Büchel vice-director of the Swiss Federal Office of Energy and head of the program Swiss Energy is expected to visit on 14th March. They will be hosted by Swiss association e'mobile president, Yves Lehmann, and managing director Dr Susanne Wegmann.

Based on a series production 1.4-litre turbocharged VW Passat TSI model - generally considered an industry benchmark for fuel economy in this size of vehicle - the LC Super Hybrid will provide carmakers with real world validation of its pioneering technology. With a mass of approximately 1,530kg the demonstrator including its up-graded battery pack and on-board test equipment adds about 79kg to the kerb weight of the baseline vehicle. However, much of this additional mass including the test equipment would be eliminated in a production vehicle as well as the existing starter motor, which is made redundant by the belt-integrated starter generator. The additional payload further underscores the excellent performance and drivability of the LC Super Hybrid demonstrator.

The technologies comprise an electric supercharger, next generation belt-integrated starter generator with an advanced belt tensioning system, carbon enhanced valve regulated lead-acid (VRLA) batteries which avoid the need for super-capacitors, and higher gear ratios to reduce engine speed. Recalibration of the engine increases power from 122 to 142PS and torque from 200 to 275Nm. This power and torque is more comparable with VW's bigger 1.8-litre TSI gasoline engine, which delivers 160PS and 250Nm, and the engine output of the LC Super Hybrid is generally equivalent to vehicles in the 2-litre class. Despite the enhanced gasoline engine performance the vehicle achieves near diesel levels of fuel economy, but with substantially lower production costs.

The impressive performance and excellent fuel economy are underscored by the acceleration figures and results measured on the standard European drive cycle. The LC Super Hybrid delivers CO₂ emissions of less than 130g/km compared with 140g/km for the baseline Passat 1.4-litre TSI, which is already best in class, and an even more significant reduction when compared with 160g/km for the 1.8-litre TSI model. This represents a reduction in CO₂ emissions of 8 and 23 per cent respectively. Similarly, the excellent fuel economy of 5.6 litres/100km (51mpg) represents a significant 11 and 24 per cent improvement respectively when compared with 6.2 litres/100km (46mpg) for the 1.4-litre TSI and 6.9 litres/100km (41mpg) for the 1.8-litre TSI also measured over the standard European drive cycle.

This notable reduction in CO₂ emissions and fuel consumption has to be seen in the context of the impressive performance and driveability of the technology demonstrator. In 6th gear, which is taller even than the gearing in the baseline vehicle, the 80 to 120 km/h (50 to 75mph) top gear acceleration is reduced by 3.5 seconds from 16.0 to 12.5 seconds. Similarly, the 0-100 km/h (0-62 mph) time is reduced by 2.5 seconds from 11.1 to 8.7 seconds compared with the 1.4-litre TSI and achieves virtually the same acceleration (8.5 seconds) as the 1.8-litre TSI model.

The LC Super Hybrid technology, which has taken years of research to develop, has achieved its technical breakthrough in the cost effective reduction of CO₂ emissions and fuel consumption without destroying the fun-to-drive factor and high energy density fuel tank range advantage of gasoline engines. The

demonstrator embraces low voltage switched reluctance (SR) motor-generators, which are not currently employed by the automotive industry in mass production. The motors are of simple robust construction using steel, aluminium and copper and avoid the use of increasingly expensive rare earth materials required for permanent magnet motors. The SR technology is licensed from Nidec Corporation of Japan, one of the world's leading suppliers of electric motors.

"We are confident we have met the challenge facing the automotive industry for cost efficient CO₂ reduction technology, compatible with legislative demands and at showroom prices that consumers are willing and able to afford," says Allan Cooper European projects coordinator at ALABC. "There is no huge upfront cost with this technology and therefore no need for expensive subsidies from the taxpayer."

Cooper will present full technical details of the LC Super Hybrid at the [5th International Advanced Mobility Forum \(IAMF\)](#), a scientific and public meeting focused on future vehicle technologies, which draws together motor industry engineers and scientific experts. The annual forum is held in collaboration with Bern University of Applied Sciences, the Swiss association e'mobile, and other organisations. The event is supported by the world body for automotive engineering FISITA - a global federation of engineering institutions also working to exchange technical knowledge on all aspects of vehicle design and manufacture. The forum is organised by Palexpo and takes place on 7th and 8th March during the show.

"Carmakers face progressively increased costs and diminishing returns as they try to further squeeze CO₂ emissions and fuel consumption," says Nick Pascoe chief executive at Controlled Power Technologies (CPT) who will attend the auto show. "Ideally, vehicle manufacturers would prefer to respond to this challenge using relatively familiar powertrain technology and to avoid the cost, complexity and cooling requirements of the high voltage power electronics, massive batteries and high torque motor-generators typified by full hybrid and electric vehicles. The evolutionary near-term technologies incorporated into the LC Super Hybrid avoid this expense by the smart use of modular hybrid products, and provide an as yet unfulfilled low voltage solution for the important high volume C/D market segment critical to the commercial success of global car makers."

"The electric supercharger boosts the performance of downsized turbocharged engines and finally eliminates turbo lag," says Mark Criddle R&D director for powertrain air charging at Valeo. "Electric supercharging provides the same swift acceleration and drivability of a much bigger naturally aspirated engine, which is a characteristic much preferred by drivers. It's powered by the battery and unlike mechanical superchargers and exhaust driven turbochargers is not driven by the engine. This vital disconnect means it can provide maximum boost even at very low engine speeds."

"At 12 volts our modular approach to hybridisation offers cost effective and outstanding levels of performance and the technology is production ready," adds Cooper. "At 48 volts the results get really exciting with significantly more opportunity for energy recuperation and torque assist at low engine speeds. This will push the current limits of powertrain down-speeding and down-sizing even further and help maximise the recycling of vehicle energy through a lead-carbon battery only slightly bigger than a

conventional 12 volt battery. We are planning a 48 volt demonstrator during the next 12 months, so we can further explore the performance and cost effectiveness of this new micro-mild hybrid technology. Moreover, this voltage is substantially less than that of a full hybrid and inherently safer.”

The improved lead-carbon battery design employed in the LC Super Hybrid allows for an excellent charge and discharge characteristic, while the carbon-enhanced negative plate formulations dramatically improve life under hybrid vehicle duty cycles. Further battery life improvements have been achieved by careful attention to battery management. These next generation batteries are already under test in pre-production vehicles. They also retain the long established end-of-life re-cycling benefits of lead-acid batteries, providing another advantage over high voltage lithium ion (Li-Ion) and nickel metal hydride (NiMH) batteries.

At 48 volts the low voltage LC Super Hybrid is expected to deliver more than the nominal 25 per cent improvement in CO₂ emissions and fuel economy already achieved when compared with typical 2-litre naturally aspirated saloons - and will more than match their performance and drivability.

The additional cost to the vehicle manufacturer is estimated between €750 and €1,500. By comparison, a high voltage hybrid typically delivers between 15 and 20 per cent CO₂ reduction, but incurs an additional manufacturing cost of between €3,000 and €5,000. And while a plug-in hybrid electric vehicle can deliver better than 20 per cent CO₂ reduction, the additional manufacturing cost increases significantly to between €6,000 and €10,000 - dominated by the high cost of Li-Ion and NiMH batteries - hence the need for government subsidies so these vehicles are affordable for early adopters of EV technology.

The micro-mild hybrid technology builds on previous work by CPT carried out with AVL, who were commissioned to build the LC Super Hybrid and handled the systems integration. The demonstrator develops AVL's efficient low carbon ELC concept by incorporating CPT's next generation SpeedStart stop-start system, which includes intelligent torque and current control with enhanced stop-start capabilities. The SpeedStart system is the world's most powerful belt-integrated starter generator (B-ISG) to operate at 12 volts, and the first and only system based on the highly controllable switched reluctance motor-generator technology, which resolves all stop-start issues including the notorious driver 'change of mind' problem. The Mubea belt tensioner system facilitates rapid reversals of the motor-generator and virtually halves the belt loads, reducing friction of the front end accessory drive system while significantly improving belt durability. And the carbon-enhanced lead-acid battery design (supplied by Exide Technologies) helps to maximise energy recuperation (regenerative braking) during deceleration, fully realising SpeedStart's potential for high power generation, torque smoothing and electrical energy recovery.

Note to editors – Geneva press conference details and company profiles

Allan Cooper will summarise the LC Super Hybrid project during the association e'mobile press conference being held from 15:45 to 16:00 on stand 5141 in Hall 5 on Tuesday afternoon 6 March. Allan Cooper, Nick Pascoe and Mark Criddle will all be available for interviews on both press days.

Controlled Power Technologies (CPT) is an independent, award winning, clean-tech company specialising in the development of cost-effective CO₂ reduction measures for the global automotive industry that avoid major redesign of the powertrain or vehicle electrical system. Its core competencies include low voltage power electronics, advanced control software and the application of low voltage electrical machines to vehicle powertrains. The company is a spin-off from the advanced powertrain development team established in the UK more than 10 years ago by Visteon, a spin out from Ford, when electric supercharging and switched reluctance motor technology was first mooted, and its technology development partner Emerson Corporation, whose motor business has since been acquired by Nidec. CPT was established in 2007 as a management buy-in funded by venture capital to acquire this advanced powertrain business. The company comes with a highly experienced team of automotive engineers and is backed by a number of prominent investors specialising in the energy and environmental sectors. Further information on CPT is available at www.cpowert.com.

The Advanced Lead-Acid Battery Consortium (ALABC) is an international research consortium formed in 1992 to advance the capabilities of the valve-regulated lead-acid battery in order to help electric and hybrid electric vehicles become a reality. The research resources of the world-wide membership of ALABC are pooled to carry out a large program of research and development that would otherwise not be possible. The ALABC is managed by the International Lead Zinc Research Organization based in North Carolina. ALABC membership currently stands at 69 organisations. Further information is available at www.alabc.org.

Valeo develops innovative solutions for reducing fuel consumption and CO₂ emissions. Valeo is an independent industrial group fully focused on the design, production and sale of components, integrated systems and modules for the automotive industry, mainly for CO₂ emissions reduction. Valeo ranks among the world's top automotive suppliers. The group has 124 plants, 21 research centres, 40 development centres, 12 distribution platforms and employs 68,000 people in 28 countries worldwide. Further information on Valeo is available at www.valeo.com.

AVL is the world's largest privately owned and independent company for the development of powertrain systems with internal combustion engines as well as instrumentation and test systems. The AVL ELC hybrid engine boosting concept with energy recuperation was first presented at the 22nd International AVL "Engine & Environment" conference held in September 2010 at Graz in Austria. A technical paper was presented at the conference jointly authored by CPT and AVL. Further information on AVL is available at www.avl.com

Provector, which is based near Cambridge in the UK, specialises in power-electronics, control and battery systems for hybrid and electric vehicles. Its expertise in battery management systems has helped to improve the durability of lead carbon batteries when operated under the complex duty cycles of hybrid electric vehicles. Further information on Provector is available at www.provector.com.

Mubea is focused on the development of "springy materials". This positioning has been a successful move for the German company, which sees itself as a global partner for the automotive industry and an innovative lightweight design specialist providing heavy duty spring components and related products -

such as the advanced belt tensioner system deployed in the LC Super Hybrid. Further information on Mubea is available at www.mubea.com

Ends

Media reporters wanting to register their interest in a test drive of the LC Super Hybrid or to request an interview, please contact Rob Palmer on +44 7768 242761 or email: rpalmer@palmerpr.com as the media contact at CPT/ALABC for this project. This press release and thumbnail images below as well as previous announcements can be downloaded at www.newspress.co.uk.



LC Super Hybrid technology demonstrator is based on a VW Passat 1.4-litre TSI model



LC Super Hybrid features a Valeo electric supercharger which boosts the existing turbocharger



LC Super Hybrid features CPT SpeedStart stop-start technology (top right) and Mubea belt tensioner



LC Super Hybrid lead-carbon battery installation and test equipment



LC Super Hybrid stop-start appraisal at Millbrook proving ground



LC Super Hybrid stop-start assessment on Millbrook city course



LC Super Hybrid drivability assessment on Millbrook hill route



LC Super Hybrid performance assessment on Millbrook high speed circuit