



13 September 2016

Ricardo plc
Shoreham Technical Centre,
Old Shoreham Road,
Shoreham-by-Sea,
West Sussex,
BN43 5FG, UK

ADEPT CO₂ savings confirmed - affordable 48V hybrid car goes on first public ride & drives

- **Final testing confirms ADEPT key achievement of 10-12 percent reduction in fuel consumption – equivalent to sub-80g/km of CO₂ emissions**
- **Updated estimated cost of production implementation only €60 per g/km CO₂ reduction – very competitive with other fuel economy solutions such as full hybrids**
- **Full results of the project will be presented at the LCV2016 show tomorrow, where the ADEPT vehicle will be available for the first time for public ride and drives**

The automotive industry is facing the challenge of offering customers new vehicles that are able to deliver significantly improved fuel economy and reduced carbon dioxide emissions, while at the same time maintaining affordability, performance and achieving the latest regulated emissions limits. The three-year ADEPT (advanced diesel-electric powertrain) project set the target of developing and validating a range of advanced mild hybrid technologies with 48V 'intelligent electrification' utilizing an advanced lead carbon battery. These have been applied to a Ford Focus project demonstrator which tomorrow, for the first time, will be made available for public ride and drive evaluation by delegates at the Low Carbon Vehicle event (LCV2016), at Millbrook, UK.

Key achievements of the ADEPT project have been to show that the integration of hybrid and emissions control systems in the manner envisaged by the project, can deliver a Euro 6b compliant package offering up to a 10-12 percent reduction in fuel consumption, equivalent to sub-80g/km of CO₂ emissions (NEDC). It can also offer improved responsiveness and acceleration as a result of the increased full-load powertrain torque available through the hybrid systems. Moreover, according to the



The University of
Nottingham

UNITED KINGDOM · CHINA · MALAYSIA



latest updated analysis of the potential cost of production implementation of ADEPT – conducted independently by Ricardo – the system would represent an incremental cost of in the region of €60 per gram/km of CO₂ reduction. This is a result that makes the ADEPT powertrain architecture very competitive with other fuel economy solutions such as full hybridization, where costs of implementation can be significantly higher. The ADEPT powertrain concept is also equally applicable – with appropriate fine tuning of design and configuration – to gasoline or alternatively fuelled powertrains.

Ricardo plc
Shoreham Technical Centre,
Old Shoreham Road,
Shoreham-by-Sea,
West Sussex,
BN43 5FG, UK

Details of the configuration of the affordable ADEPT hybrid powertrain concept were revealed in late June together with the provisional results of vehicle testing. Today, these very positive results will be confirmed – and in the case of the Ricardo cost estimate for implementation, exceeded – in a presentation at the LCV2016 show, where delegates will be able to experience the performance of the ADEPT vehicle on the test track.

“The confirmation of the impressive results of the ADEPT project is a great achievement for the whole project team,” commented Ricardo Innovations MD Thomas Gutwald. “The concept of ‘intelligent electrification’ as exemplified in the ADEPT project is likely to enjoy mass-market appeal in the short to medium term, due to the fuel economy, performance and cost benefits that it brings. This concept – which is applicable with appropriate adaptation to gasoline, diesel or alternatively fuelled IC engine based powertrains – is thus a very attractive solution for both the consumer and automaker. It is also a fitting conclusion to the project that we are able to make the ADEPT vehicle available for a public ride and drive for the first time tomorrow at one of Europe’s major showcases for low carbon vehicle technology, LCV2016.”

For consortium partner and switched-reluctance motor-generator technology developer Controlled Power Technologies, 48V electrification is about harvesting and recycling kinetic and thermal energy, explains CPT’s founder and chief executive Nick Pascoe: “Our SpeedStart motor-generator, for example, which replaces the conventional alternator and starter-motor, can near instantaneously boost engine power and torque whenever required without having to feed additional fuel into the engine. So not only can we boost vehicle performance and fuel economy, but we can also improve air quality by reducing NOx and particulate emissions. And while SpeedStart also recovers kinetic energy, our turbine integrated exhaust gas energy recovery system known as



The University of
Nottingham

UNITED KINGDOM · CHINA · MALAYSIA



TIGERS simultaneously recovers thermal energy. Furthermore, 48V mild hybrid technology is equally applicable to trucks and buses, as well as off-road vehicles.”

Alistair Davidson, of ALABC, added: “The excellent results of the ADEPT project clearly demonstrate that advanced lead-carbon batteries in 48V automotive applications are the most cost efficient way of meeting stringent future CO2 emission targets, when measured by the relevant test procedures for HEV operation.”

The ADEPT project has been led by Ricardo in a research partnership that has included the Advanced Lead Acid Battery Consortium (ALABC), Controlled Power Technologies (CPT), Faurecia Emissions Control Technologies UK Ltd, Ford Motor Company and the University of Nottingham. The research project was jointly funded by the UK Government’s Office for Low Emission Vehicles (OLEV) implemented through the UK innovation agency, Innovate UK, with matching contributions from the participating partners.

Ends

Ricardo plc
Shoreham Technical Centre,
Old Shoreham Road,
Shoreham-by-Sea,
West Sussex,
BN43 5FG, UK



Media contacts:

Ricardo: Anthony Smith
Ricardo Media Office
Tel: +44 (0)1273 382710
E-mail: media@ricardo.com

CPT: Rob Palmer
Palmer PR
Tel: +44 (0) 1582 763255 / +44 (0)7768 242761
E-mail: rpalmer@palmerpr.com

ALABC: Bob Tolliday
International Lead Association
Tel: +44 (0)20 7833 8090
E-mail: tolliday@ila-lead.org

Ricardo plc
Shoreham Technical Centre,
Old Shoreham Road,
Shoreham-by-Sea,
West Sussex,
BN43 5FG, UK

NOTES TO EDITORS

Previously released details of the ADEPT powertrain architecture:

The baseline vehicle for the ADEPT research and development programme is based on an already downsized and competitively fuel-efficient diesel Ford Focus ECONetic 1.5TDCi, homologated with carbon dioxide emissions of 88g/km.

Key features of the vehicle systems include CPT's water-cooled SpeedStart switched reluctance belt starter generator (BSG), capable of delivering in excess of 12kW of regenerative braking, as well as near instantaneous and near continuous torque assist levels of over 7kW – sufficient to enable significant engine down-speeding in addition to a highly capable start-stop functionality.

Further energy recovery is achieved from CPT's exhaust mounted 48V turbine integrated exhaust gas energy recovery system known as TIGERS. Rated at 2.4kW, TIGERS is capable of providing further power recuperated from the exhaust downstream of the turbocharger. The exhaust gas is diverted to the TIGERS unit via two bespoke emissions control valves developed by Faurecia Emissions Controls technologies for the ADEPT project. Again, the recovered energy is stored in the advanced lead-carbon battery pack, providing a high power, high endurance, easily recyclable, lithium-free energy storage solution at a competitive cost.

The ADEPT powertrain includes a range of electrical ancillaries powered from the 48V system rather than directly from the engine, including for example, the vehicle air conditioning compressor. In addition to powering these ancillaries and facilitating a significantly improved start-stop functionality, ADEPT's 48V architecture also provides significant levels of torque assist from the BSG to offset fuelling to the engine for improved fuel economy, and to increase overall powertrain torque capability for enhanced vehicle performance.

The control strategies deployed have been developed based on extensive vehicle systems simulation work. This has enabled the core powertrain and aftertreatment system, as well as the 48V BSG, ancillaries, battery pack and exhaust energy recovery system, to be operated in a seamless manner, while also providing a valuable computer-aided engineering (CAE) capability to explore further potential avenues of development and optimization opened up through intelligent 48V electrification.



The ADEPT project partners:

Ricardo plc is a global, world-class, multi-industry consultancy for engineering, technology, project innovation and strategy. Our people are committed to providing outstanding value through quality engineering solutions focused on high efficiency, low emission, class-leading product innovation and robust strategic implementation. With a century of delivering excellence and value through technology, our client list includes the world's major transportation original equipment manufacturers, supply chain organizations, energy companies, financial institutions and governments. Guided by our corporate values of respect, integrity, creativity & innovation and passion, we enable our customers to achieve sustainable growth and commercial success. Ricardo is listed in the FTSE4Good Index, which identifies global companies that demonstrate strong environmental, social and governance (ESG) practices. For more information, visit www.ricardo.com.

Ricardo plc
Shoreham Technical Centre,
Old Shoreham Road,
Shoreham-by-Sea,
West Sussex,
BN43 5FG, UK

Controlled Power Technologies is an independent, clean-tech, company, based at Laindon in Essex and in Coventry in the West Midlands with subsidiaries in Germany and the USA, which specialises in the development of cost-effective CO2 reduction measures for the global automotive industry. Its core competencies include low voltage power electronics, advanced control software and the application of safe low voltage switched-reluctance machines (SRMs) to a vehicle powertrain and driveline, providing intelligent electrification of the propulsion system with near full hybrid vehicle capability. CPT is at the forefront of practical exploitation of SRM technology in vehicle applications and has already issued a number of patents in machine design and construction in the UK, Europe, USA, India, Korea and Japan. For more information, visit www.cpower.com.

Advanced Lead Acid Battery Consortium (ALABC) is an international research body comprised of lead producers, battery manufacturers, equipment suppliers, application developers, and research facilities organised to enhance the performance of lead batteries for a variety of markets, including hybrid electric vehicle (HEV) applications. A program of the International Lead Association, ALABC pools the resources of its global membership in order to perform specific research on advanced lead batteries that otherwise would not be possible by any single entity. For more information about the ALABC visit www.alabc.org

The University of Nottingham has 43,000 students and is 'the nearest Britain has to a truly global university, with a "distinct" approach to internationalisation, which rests on those full-scale campuses in China and Malaysia, as well as a large presence in its home city.' (Times Good University Guide 2016). It is also one of the most popular universities in the UK among graduate employers and the winner of 'Outstanding Support for Early Career Researchers' at the Times Higher Education Awards 2015. It is ranked in the world's top 75 by the QS World University Rankings 2015/16. More than 97% of research at The University of Nottingham is recognised internationally and it is 8th in the UK by research power according to the Research Excellence Framework 2014. It has been voted the world's greenest campus for four years running, according to Greenmetrics Ranking of World Universities.

Faurecia Emissions Control Technologies (FECT) is one of the four divisions that comprise the Faurecia organisation, and is the global market leader in the supply of emissions control systems to the automotive industry. With total sales of €7.4bn, FECT employs over 21,000 people in 25 countries including 1,900 engineers and technicians at its 7 global R&D facilities.

Innovate UK is the UK's innovation agency. We are business focused and drive disruptive innovation right across the UK economy, funding and connecting pioneering businesses so they can create the products, processes and industries of the future. It is our mission to boost productivity, increase exports and help the UK economy grow head and shoulders above other nations. For further information, visit www.gov.uk/innovateuk