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Redefining combustion process to substantially reduce heavy vehicle carbon emissions

In a feasibility study part-funded by the UK Technology Strategy Board as one of the winning submissions for the recent 'Disruptive technologies in low carbon vehicles' competition, Ricardo is to work with the University of Brighton to model and evaluate an advanced split-cycle combustion system aimed at substantially reducing the carbon emissions of heavy duty vehicles

Heavy duty vehicles such as long haul trucks represent a significant challenge in terms of the reduction of carbon dioxide emissions. An essential element of the transportation mix of modern industrialized society, heavy vehicles are inherently less amenable to the type of electrification and hybridization strategies that are already contributing to reduced carbon emissions and potential long-term sustainability for the light vehicle sector. A key global imperative is therefore the substantial improvement of heavy vehicle engine efficiency. Unlike many previous research projects that have focused on refining existing four-stroke engine technology, however, the CoolR project will examine a fundamentally new split cycle combustion concept based on a recuperated split-cycle with isothermal compression.

Ricardo has already successfully demonstrated a spilt-cycle isothermal compression engine in static form for power generation purposes. The so-called "IsoEngine" prototype demonstrated by the company for energy utility Innogy in the 1990s used water injection to achieve a thermal efficiency in excess of 60 percent in comparison with around 43 percent for a current state-of-the-art on-highway heavy duty diesel engine. While water injection would not be practical for a vehicular implementation, the CoolR concept aims to achieve the same thermodynamic benefits using liquid cryogen injection. Allowing for the energy costs of cryogen production, this would result in a thermal efficiency improvement of around 40 percent. This is significantly better than that of other promising technologies also currently being researched such as exhaust heat recovery concepts based on thermo-electric generation or the Organic Rankine Cycle which offer improvements of around 10-15 percent.

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In this one year feasibility project, the partners will carry out a concept study aimed at addressing the fundamental questions that industry will face if such a radically new technology were to be adopted. In doing so, it is intended that a road map be developed to identify the necessary work required to bring the CoolR concept from feasibility to systems prototype and beyond.

Commenting on the announcement of the CoolR project, Nick Owen, project director for research and collaboration at Ricardo UK, said:

> "The global imperative to reduce the carbon footprint of road transportation is now almost universally accepted. While electrification, hybridization and improvements of the existing internal combustion engine offer a pathway to sustainability for light vehicles, a major problem remains in the heavy duty sector. By fundamentally reviewing the underlying thermodynamics of the internal combustion engine in a manner unseen for many decades, we believe that the CoolR spilt cycle cryogenic injection combustion concept offers the prospect of very significant improvements in thermal efficiency and hence reduced carbon dioxide emissions in the economically crucial heavy vehicle sector."

CoolR is one of two projects to be led by Ricardo – out of a total of fifteen announced by the Technology Strategy Board as winners of its recent competition – selected to receive government support to carry out feasibility studies into the development of disruptive low carbon vehicle technology that will challenge current thinking. For further information see www.innovateuk.org.

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NOTES TO EDITORS:

Ricardo plc: With technical centres and offices in the UK, USA, Germany, the Czech Republic, France, Italy, Russia, China, Japan, India and Korea, Ricardo is a leading independent technology provider and strategic consultant to the world's transportation sector and clean energy industries. The company's engineering expertise ranges from vehicle systems integration, controls, electronics and software development, to the latest driveline and transmission systems and gasoline, diesel, hybrid and fuel cell powertrain technologies, as well as wind energy and tidal power systems. Ricardo is committed to excellence and industry leadership in people, technology and knowledge; approximately 70 percent of its employees are highly qualified multi-disciplined professional engineers and technicians. A public company, Ricardo plc posted sales of £162.8 million in financial year 2010 and is a constituent of the FTSE techMark 100 index – a group of innovative technology companies listed on the London Stock Exchange. For more information, visit www.ricardo.com.

The Technology Strategy Board is a business-led government body which works to create economic growth by ensuring that the UK is a global leader in innovation. Sponsored by the Department for Business, Innovation and Skills (BIS), the Technology Strategy Board brings together business, research and the public sector, supporting and accelerating the development of innovative products and services to meet market needs, tackle major societal challenges and help build the future economy. For more information please visit www.innovateuk.org.

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