Loughborough University

World-class low carbon vehicle expertise

www.lboro.ac.uk

Loughborough University campus is home to an outstanding breadth of expertise and facilities, dedicated to advancing the low carbon transport agenda.

M1 (junction 23) one mile from University

1 Loughborough University Science and Enterprise Park
2 Potential for further development
3 Planning permission for major expansion
4 CENEX Centre for excellence for low carbon and fuel cell technologies
5 Intelligent Energy
6 Holywell Mechatronics Research Centre Energy Technologies Institute
7 Electric Vehicle Plug-in
8 Hydrogen Refuelling Station and site of Electrolyser Facility
9 Zero CO_2 Vehicles Laboratory
10 Rolls-Royce University Technology Centre
11 Automotive Simulation Laboratory
12 Advanced Powertrain Test Facility
13 Aeronautical and Automotive Engineering
Anechoic Chamber
Noise and Vibration Laboratory
Wind Tunnels
14 Chemical Engineering
15 Advanced Friction Materials Laboratory
Materials Characterisation Centre
16 Additive Manufacturing Laboratories
17 Innovative Electronics Manufacturing Research Centre
Sustainable Manufacturing Reuse/Recycling and Technologies Centre
Wolfson School of Mechanical, Electrical and Manufacturing Engineering
18 Optical Engineering Laboratories

Loughborough Design School Instrumented Car

World-class low carbon vehicle expertise

Loughborough University works in partnership with the automotive industry to develop new technologies to reduce carbon emissions and provide clean energy solutions.

Our world-leading expertise also spans more efficient and sustainable methods of manufacturing, pioneering new materials applications, transport infrastructure, vehicle ergonomics, safety, design and user acceptability.

Specialist on-site resources include a hydrogen refuelling station, an electrolyser facility, wind tunnels, chassis dynamometers and laboratories for zero CO_2 vehicles, fuel cells, thermofluids, vibration and additive manufacturing.

Our Science and Enterprise Park hosts the Government's £1 billion Energy Technologies Institute (ETI) which is accelerating the UK's transition to a low carbon economy.

We have well-established and mutually beneficial partnerships with global brands including Caterpillar, Ford, Jaguar Land Rover, Lotus Cars, Mahle Powertrain, Nissan, Renault and Rolls-Royce.

Organisations of all sizes can work with us in a number of ways to achieve their low carbon strategies and improve performance. Some of these schemes offer up to 66 per cent funding towards expert staffing, training and equipment costs. Details of these schemes are available later in this brochure (page 17).

By kind permission of CENEX

Low carbon technologies

Our Low Carbon Technologies Research Group is engaged with multiple partners in the automotive industry ranging from SMEs to Jaguar Land Rover and Lotus.

Our facilities include a 400m^2 fuel cell laboratory, a Powertrain Lab equipped with eight engine cells to pioneer more fuel efficient engine systems and two chassis dynamometers for vehicle evaluation.

These resources support our research across a range of areas, spanning:

- Electrochemical kinetics transportation
- Digital signal processing of AC impedance
- X-Ray image based lattice Boltzmann simulation
- Fault/durability diagnosis methods
- System optimisation of a hydrogen fuel cell vehicle
- Energy recovery methods for internal combustion engines
- Real-world duty cycle and impact on CO_2 emissions analysis of vehicles with combustion engines and other electric technologies
- Interaction of components and control systems for electric and hybrid electric vehicles
- Fuel cell system integration and thermal management.

We led the £3.5 million FUTURE Vehicles project (EPSRC, 2011-16) which examined the interaction of components and control systems for electric and hybrid electric vehicles (HEVs).

We are currently leading another EPSRC-funded project, ELEVATE, which is exploring ways to enhance the efficiency of low carbon vehicles – spanning hybrids, battery and fuel cell electric vehicles – via the development of optimised materials for energy storage devices.

This £3.3 million cross-disciplinary collaboration brings together academics from the universities of Loughborough, Oxford, Southampton, UCL and Warwick. An invaluable industry perspective is provided by eight leading UK companies, including Jaguar Land Rover, Johnson Matthey and Intelligent Energy - the power technology company founded on Loughborough research.

The project is addressing challenges in four key areas: hierarchical structured electrodes; diagnostics and correlative metrology; system-level integration and evaluation; and optimised design of high-rate grid interface.

The resulting new technologies undergo testing and validation in a hybrid vehicle, informing the design and innovation cycle, leading to improved materials and devices – and, ultimately, greener vehicles.

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Key facilities available to the Research Group include a 400m^2 fuel cell laboratory for the testing and development of more efficient propulsion systems.

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Vehicle aerodynamics

Improving vehicle aerodynamic performance is a key element of the drive to increase energy efficiency and reduce carbon emissions.

Our Vehicle Aerodynamics Research Group – one of the largest such university-based groups in the world – pursues both experimental and computational approaches, building on the broader Loughborough capabilities in applied aerodynamics.

Their work applies a broad range of techniques – spanning planar and tomographic PIV, pressure, balance, and DES / LES – to a range of vehicle geometries, including reference and generic test cases as well as real vehicles.

The Group's broad research interests include:

- Drag reduction – optimisation, wheel drag and unsteady contributions
- Wake topology, wake dynamics, bi-stability
- Flow control, using active methods to modifying the wake balance and reduce drag
- Real world aerodynamics, including the influence of the environment and other vehicles on vehicle drag and its optimisation
- Crosswind and straight line stability and the influence of real-world conditions on aero-acoustic performance
- Multi-phase flow applied to the measurement and modelling of surface water and dispersed phase surface contamination.

This work is supported by access to:

- high-quality wind tunnels and instrumentation
- HPC, and commercial and in-house CFD codes.

A particular strength is the complementary use of experimental and computational methods.

To ensure that it addresses current challenges, the Group works with a number of project partners including Ford and Jaguar Land Rover.

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Control and systems technology

Crucial to the successful and efficient functioning of low carbon power systems are the instrumentation and control methods used to automate and operate them.

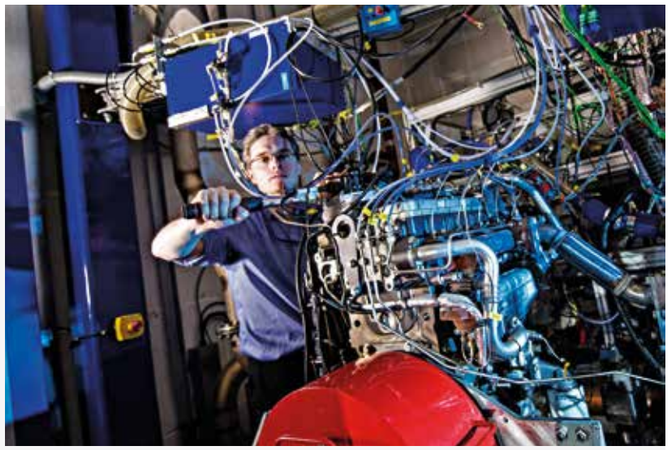
We work with Caterpillar, Infineon, National Instruments and a number of other industrial partners to investigate control solutions for fuel economy and low emissions. Our work around control methods for novel propulsion needs is funded by the EPSRC, Innovate UK, and directly by our industry partners.

Recent work has included world-leading developments in the control of range-extender engines for hybrid vehicles, and energy recovery systems designed to improve fuel economy by harnessing otherwise wasted energy.

Our research areas include:

- Investigation of methods to control diesel fuel injection to create the exhaust conditions needed for efficient operation of catalysts.
- Simulation and control of a thermo-electric generator system to recapture exhaust energy in a diesel engine.
- An evaluation of methods of controlling diesel engine combustion for low emissions and high fuel economy.
- The design and test of a light-weight hybrid power train.
- The development of virtual test methods that allow promising fuel economy technologies to be tested at the early concept stage.
- The control of an energy recovery device to improve the fuel economy of heavy duty engines used in freight transport and machinery.
- The development of the open source Electrified Vehicle Library for Simulation and Optimisation (ELVIO) with applications in teaching and research.

Our work with Infineon – supplier of semi-conductor products – involves the implementation and evaluation of advanced controls concepts for future solutions to powertrain requirements. The findings are helping Infineon to understand the requirements for semi-conductor products so that their designs can converge with new powertrain technologies.



— The Caterpillar Innovation and Research Centre builds on a strategic research partnership, forged over 20 years, in which our interdisciplinary research teams have explored pioneering technologies in collaboration with Caterpillar. —

Caterpillar supports our work on engine systems through the jointly managed Innovation and Research Centre. To facilitate this work, we operate a number of test cells where the practical implementation of control systems can be evaluated to:

- Improve efficiency and emissions performance through precise and consistent engine operation.
- Enable fuel economy concepts that would be impossible without electronic control.

Launched in 2009 and the first such agreement in Europe, the Innovation and Research Centre assists Caterpillar with research into the development of new low emissions and high efficiency techniques for internal combustion engines.

The tools and methods developed in the Centre demonstrate the global leadership that will enable the UK to pioneer crucial developments in low carbon transport technologies.

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Optical techniques

Our optical engineering expertise has been recognised by international SAE and IMechE prizes, a Queen's Anniversary Prize and EPSRC platform grants, denoting world-class quality and impact.

Over the years, we have earned an international reputation for pioneering techniques that are used worldwide – Laser Vibrometry, Particle Image Velocimetry (PIV) and TV Holography.

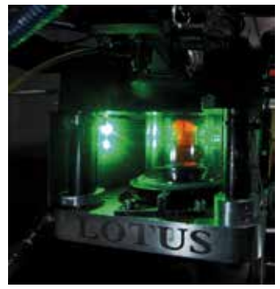
Optical techniques are used to study almost all parts of vehicle systems.

Internal combustion engines research is conducted in state-of-the-art engine test cells, including advanced transient dynamometers and emissions measurement equipment. Advanced optical diagnostic methods such as PIV, LIF, LDA, PDA and high-speed imaging are used and developed for the analysis and design of, for example, fuel injection system sprays and flows, engine combustion and emissions, exhaust after-treatment systems and vehicle aerodynamics.

Our optical engine research includes the award-winning HOTFIRE project conducted in collaboration with Lotus Engineering, Continental and UCL. This resulted in an advanced gasoline direct injection engine combustion system with variable valve timing that reduced emissions while delivering 15 per cent greater fuel efficiency. A new 1.5 litre three-cylinder turbocharged DISI downsized gasoline engine was developed by Lotus and Continental, and integrated into an advanced Opel Astra demonstrator vehicle.

Other multiple optical engine research projects have included studies into gasoline DISI in-cylinder cold-start combustion, advanced diesel optical in-cylinder flow and combustion and advanced exhaust after-treatment design.

Measurement systems using non-contact structured lighting techniques were pioneered in our Optical Engineering Research Group. The technology overcomes many of the shortcomings of the lasers often used in industrial measurement, such as the ability to provide 360° inspection at production line speeds of very large and complex objects, or objects with 'shiny' surfaces. The technology has the potential to greatly improve the performance and efficiency of engines, reduce the drag on vehicle panels and optimise manufacturing processes.



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Manufacturing

Manufacturing has been central to the University's endeavours since its origins in 1909, and remains a significant research activity to this day. Our work addresses a range of challenges spanning manufacturing processes and technologies, organisational management and sustainability.

Additive manufacturing

Widely regarded as one of the UK's leading centres in the field, our Additive Manufacturing Research Group focuses on techniques, materials and design systems to effectively 3D print components and assemblies directly from computer data without expensive tools or moulds.

Funded through the Centre for Power Electronics and in collaboration with the universities of Nottingham and Manchester, we are miniaturising magnetic components for the automotive industry.

All vehicles with electric motors or generators, including hybrid and fully electric cars, require power electronic converters. Currently, the largest element of these converters is the magnetic components – transformers and inductors.

Minimising power electronics results in a decrease in overall vehicle mass, leading to better fuel economy and reduced emissions – and, for fully electric vehicles, an extended range between charges.

New manufacturing techniques – such as the 3D integration of multiple components through materials deposition and printing – offer multiple benefits in addition to reduced component size:

- Complete design control not restricted by the limitations of traditional manual techniques
- Customised materials can overcome the thermal limit that often hampers correct function.

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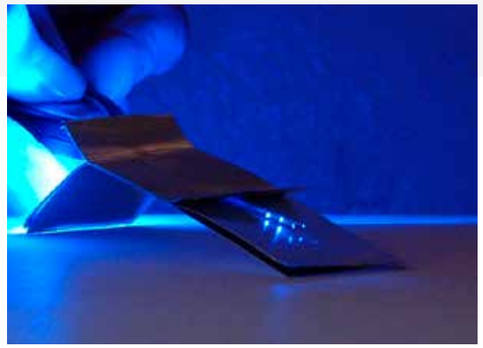

Electronics manufacturing

Host to the UK's Centre for Doctoral Training in Embedded Intelligence, we drive high value manufacturing by delivering pioneering new technologies of strategic value to the automotive industry.

Our research areas include:

- Intelligent tags for the automotive industry that offer complete monitoring and tracking of components, reducing product scrap rates, enabling the tailoring of process to product, and enhancing end-of-life recycling.
- New lightweight electronics technologies, saving the equivalent of a standard passenger (65kg) per car.
- Closed loop control techniques for high temperature manufacturing processes to reduce energy waste.
- New manufacturing techniques to consolidate multiple processes into single process steps –enhancing energy and resource efficiency.

As part of the two-year Innovate UK funded EV-Lite project, led by the Manufacturing Technology Centre, we have helped to facilitate the uptake of electric vehicle technology by reducing the mass of lithium-ion battery packs and their manufacturing costs.

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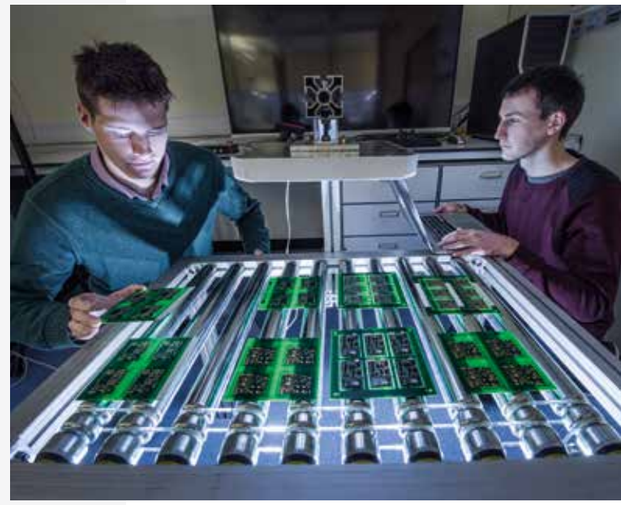

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Facilitating more efficient product assembly, condition monitoring and end-of-life recycling within the automotive industry.
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"The knowledge gained through the collaboration [with SMART] will continue to shape the design of our future products."

Leighton Jones – QHS&E
Rolls-Royce Fuel Cell Systems
—

Sustainable manufacturing

Our Centre for Sustainable Manufacturing and Recycling Technologies (SMART) is a leading UK-based R&D facility.

We develop strategies, tools and technologies to underpin sustainable growth in the manufacturing industry.

Our core expertise spans life cycle analysis, sustainable design, resource and energy efficient manufacturing, end-of-life processing, sustainable consumption and business models – all key enablers for transformational change.

Our research areas include:

- Design for a sustainable lifecycle in the automotive sector
- Resource efficiency in automotive manufacturing
- Vehicle remanufacturing and recycling technologies, in particular for alternative fuel vehicles
- Sustainable business models to support servicisation in the automotive sector.

We are currently involved in a number of national and European research programmes and also work with a range of industry partners, including Rolls-Royce Fuel Cell Systems and Toyota. These projects span clean, efficient power generation; more efficient production processes; and next generation recycling technologies.

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Advanced propulsion

Loughborough researchers – from a range of disciplines – have long worked to improve low carbon propulsion technologies.

Over the years, their research has delivered significant improvements to fuel efficiency, emission reductions and enhanced driver experience. They have collaborated with a variety of industry partners to address real-world challenges, including a 15-year project with the Ford Motor Company that has positively impacted Ford's production costs, engine performance and fuel efficiency.

In the off-highway sector, the Group hosts the Caterpillar Innovation and Research Centre – a long-term partnership in advanced engine research and innovation – covering areas such as control systems, emissions, materials, tribology, flow and combustion.

A current project in partnership with Ford, Ricardo, AVL and Mathworks – the Validation Platform for Engine Calibration (VPEC) programme – is developing a new approach to engine calibration validation. The current ECU validation process is costly and typically takes 11 weeks.

The new automated approach, making use of a test cell computer, will take just 14 days and be far more cost effective. The novel process controller has been developed in a purpose-built flexible modelling environment that will support future powertrain calibration and simulation studies.

The University's advanced propulsion work is supported by industry standard facilities and advanced equipment including a tribodynamics laboratory, advanced transient engine test cells, hardware-in-the-loop capabilities, model-based design, an advanced optical diagnostics laboratory, and precision emissions measurements.

The Group's research has been cited or adopted globally by many automotive companies across Europe, Japan and the USA.

ACTIVE

Advanced Combustion Turbocharged Inline Variable-valvetrain Engine (ACTIVE) was a 30-month, £26 million APC collaboration led by Ford to advance next-generation low carbon technologies. Central to the project was further improving the efficiency of Ford's EcoBoost engine, ensuring it exceeds 2020 emission regulations. Loughborough provided expertise in engine modelling, control, thermodynamic design and optical measurement techniques to improve combustion processes.

Advanced powertrain dynamic control and calibration test facility

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Sustainable transport

The long-term sustainability of transport is a crucial aspect of the global strategy to reduce carbon emissions.

Our research areas include:

- Automated transport systems and carbon emissions
- Low carbon city transport systems
- The acceptability of and behavioural response to personal carbon trading
- Improving the environmental performance of airport surface access
- Carbon emission reduction through air traffic management and airspace charging regimes
- Sustainable transport for the urban poor
- Markets for Alternatively Fuelled Vehicles
- Evaluation of Local Sustainable Transport Fund (LSTF) measures.

The £4 million Leicestershire County Council LSTF project Smarter Travel for Business – funded by the Department for Transport – sought to improve the local environment, reduce carbon emissions and bring benefits to both businesses and individuals in Loughborough and Coalville.

The LSTF has three complementary themes:

- Getting to work and training
- Information and behaviour change
- Smarter travel infrastructure.

We worked with Leicestershire County Council to evaluate transport impacts in Coalville against the control town of Hinckley.

Electric vehicle owned by CENEX at the charging point on the University campus.

We have also undertaken research to identify and develop markets for alternatively fuelled vehicles (AFVs). AFVs are not just about technology, but also public acceptability and market development. Our research has examined the:

- Identification of potential early adopters for AFVs in the UK car market
- Barriers to market development for Compressed Natural Gas (CNG) vans in the UK
- Potential for CNG vehicles in Nigeria.

A new project examining the impact of smart motorways on the environment is due to commence, exploring the question – is smart the new green?

Our researchers collaborated with the Department for Transport and UK local authorities to evaluate the design and development of EPSRC-funded Demand Responsive Transport (DRT) systems in the UK. The project gathered, for the first time, invaluable data on publicly funded DRT schemes in England and Wales and developed a way of analysing DRT evaluation data that could be useful to policy makers and practitioners to enable future initiatives to be sustainable and effective.

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Materials

Our materials research combines multidisciplinary activity from a number of schools and departments across the University. Expertise is principally drawn from the School of Aeronautical, Automotive, Chemical and Materials Engineering and The Wolfson School of Mechanical, Electrical and Manufacturing Engineering.

Advanced materials

We have an excellent range of state-of-the-art experimental facilities for materials research, including advanced techniques for materials characterisation.

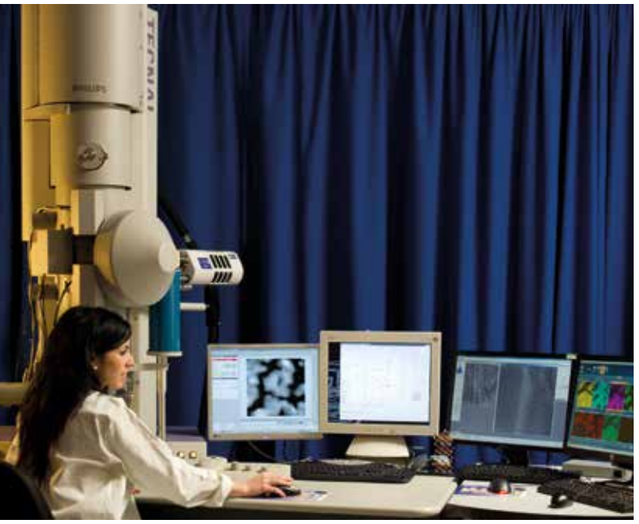
Our wide-ranging research is conducted in collaboration with international academic institutions, research organisations and companies.

Our research areas include:

- The development of materials for use within both solid oxide and polymer fuel cells
- Exploration into the photoelectrolysis of water using solar energy – one of the most promising means of producing hydrogen
- Investigation of nanomaterials for battery applications
- Development of electroceramic sensors for intelligent transportation
- Making 'green' tyres and recyclable brake components for automotive applications
- Advanced dismantleable adhesive systems
- Development of new conductive corrosion resistant coatings for aluminium alloys.

Work in our Advanced Friction Materials Laboratory includes projects with a number of industrial partners on the development of lightweight carbon ceramic composite disc braking systems.

Another key area is the development of new manufacturing techniques, utilising recycled materials to enhance braking performance and unit costs.



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Transmission Electron Microscope in the Loughborough Materials Characterisation Centre showing the chemical composition and structure of a lightweight alloy sample.

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The Loughborough Materials Characterisation Centre

The Loughborough Materials Characterisation Centre (LMCC) is our £6 million facility, home to state-of-the-art analytical instruments.

It provides a range of analytical services to businesses, tailored to each client's requirements.

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Lightweight materials

Advanced lightweight materials are a significant factor in reducing carbon emissions and improving fuel economy in the transport sector.

To meet current emission reduction targets, as well as adopting cutting-edge engine technology, vehicles will need to shed about 25 percent of their present mass.

However, the expense of developing and implementing the move to lightweight materials is currently a barrier to industry-wide take up.

©Image: Far-UK Ltd

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"In collaboration with Loughborough University we will develop a breakthrough cost-effective manufacturing process to create the most efficient structures that enable low-carbon vehicles."

Dr Kevin Lindsey
Technical Director, Far-UK Ltd

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Experts in our Multifunctional Materials Manufacturing Laboratory are developing new products and manufacturing protocols to design and manufacture engineered-porosity structures that combine high-spec mechanical properties and low weight.

A four-year EPSRC / Innovate UK part-funded partnership with Nottingham-based Far-UK Ltd – a leading innovator in the design and manufacture of lightweight structural composite components – is developing both the materials and manufacturing processes that address the need for robust, sustainable lightweight vehicles.

The resultant novel manufacturing technology is applicable across the transport sector, spanning heavy goods vehicles and rail, and presents a new avenue for high value manufacturing which will support the UK knowledge base, economy and jobs.

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Composite material testing

A novel test method developed at the University could revolutionise the interlaminar shear (ILS) testing of the composites used to build aircraft, ships and road vehicles – making them lighter, stronger and more fuel efficient without compromising safety or endurance.

The Double Beam Shear (DBS) testing technology has the potential to measure the ILS properties of composite materials with far greater accuracy and reliability than existing methods.

Using the DBS method, vehicles could be lighter and more efficient in terms of fuel consumption and CO_2 emissions.

The DBS test has been developed with collaborating partners including material manufacturers, material testing equipment (Instron) and services (National Physical Laboratory) as well as aerospace designers and manufacturers (GKN Aerospace).

The technology has successfully undergone independent round robin exercises, and we are now able to offer a wide range of consultancy services, full details of which are available on the DBS website.

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ACCT – emissions technology for cleaner diesel engines

Working at the forefront of nitrogen oxides (NOx) reduction technology since 2010, our experts have developed a novel system that dramatically reduces vehicle emissions.

As legislation imposes ever lower emission targets, alongside stringent penalties for compliance failure, pressure on vehicle manufacturers is mounting.

NOx reduction targets for on-highway and heavy-duty diesel vehicles are now so low they are almost impossible to meet, despite the adoption of Selective Catalytic Reduction (SCR) systems.

Current SCR systems use AdBlue™ to provide the ammonia required to reduce NOx emissions into nitrogen and water.

Because AdBlue™ only produces ammonia effectively at high temperatures, SCR systems struggle to operate at exhaust temperatures below 250°C. What's more, at lower exhaust temperatures, use of AdBlue™ can result in exhaust blockages and subsequent engine damage.

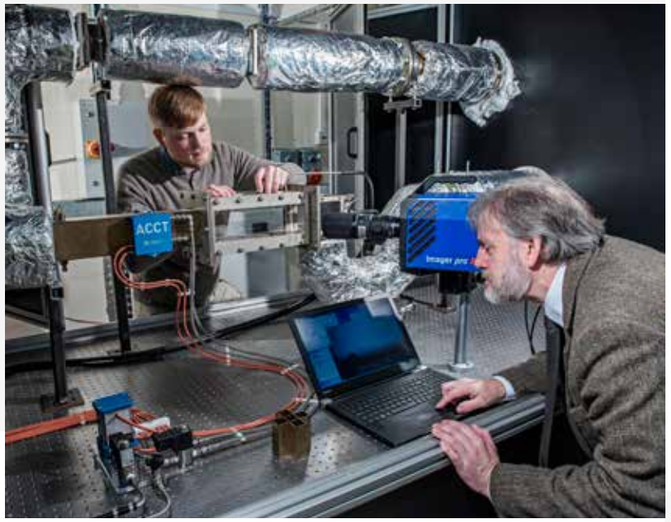
Our researchers have developed an innovative AdBlue™ conversion technology that transforms AdBlue™ into a new soloution that can produce ammonia at very low exhaust temperatures. By extending the temperature range at which SCR systems can operate much greater NOx reduction can be acheived.

The new technology will easily integrate with existing SCR systems, requiring minimal re-design, and will:

- dramatically lower total NOx output
- improve engine and fuel efficiency
- help to reduce CO_2 and particulate matter emissions.

To date, no other technology exists that functions at low temperatures and uses the readily available, industry-standard AdBlue™.

Our research has reached an exciting milestone, and we are keen to work with partners in developing the technology for licence across the board – to make diesel engines cleaner and greener.



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"The ACCT technology has the potential to reduce NOx emissions. We believe that the technology should be further developed to help address the emissions challenge."

Chris Thorne
Chief Technology Officer for Heavy Duty Vehicles
Energy Technologies Institute (ETI)

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Digital Engineering and Test Centre

The DETC is a unique collaboration, comprising industrial and academic experts whose unrivalled skills and knowledge are supported by world-class research facilities.

Hosted by Loughborough University in London, and delivered in partnership with the High Speed Sustainable Manufacturing Initiative (HSSMI), the DETC is an Advanced Propulsion Centre (APC) spoke. Its remit is to halve the time and cost of the development and test of next generation powertrain systems and vehicles.

An industry-led UK centre of excellence, DETC facilitates collaborative work to drive innovations in automotive product development, using advanced digital engineering tools and techniques.

As well as supporting innovative industry-focused R&D partnerships between SMEs, vehicle manufacturers and their suppliers, the Centre also offers a range of knowledge transfer, leadership and training programmes as well as sponsored PhDs, including the Virtually Connected Hybrid Vehicle (VCHV) project, a three-year programme supporting several PhDs.

Specialist activities and core competencies

Hybrid reality simulation centre
Paradigm shifting hybrid-reality simulation using numerical methods which concurrently run simulation and test in real-time to significantly reduce data collection costs whilst maximising the information obtained. Advanced experimental methods are used to develop numerical models of complex subsystems and describe their interactions for full system simulation. This ensures optimality throughout the design and manufacturing stages and beyond.

Rapid technology evaluation
The DETC is establishing methodology for rapid, no-prototype testing that minimises the time between conceptualisation and evaluation using simulation technology. With a target of 24 hours from idea to test, rapid parameterisation encourages innovation by supporting early stage technology selection.

Augmented reality for product development and manufacturing
The Centre's virtual and augmented reality hardware and methodologies support state-of-the-art graphics which facilitate immersive visualisation in product development and test, manufacturing planning and maintenance. This technology provides additional augmented insight and ensures that manufacturing method and facility are planned and implemented optimally – the first time.

High performance computing
With strategic links to several national high performance computing centres, DETC seeks to integrate modern performance computing to support product design and manufacturing activities.

Distributed development and test
Located within metres of one of the UK's main internet pipelines, DETC is fully connected to distributed global domain expertise and specialist test facilities at various research institutions. Multi-actor collaborative development and test is being pioneered at the Centre to significantly reduce development time through process parallelisation, using meta-models as a repository of organisational knowledge.

About the Advanced Propulsion Centre

The APC plays a key role in the Automotive Council's Industrial Strategy to position the UK as a global centre of excellence for low carbon powertrain development and production.

Loughborough is one of six universities that host an APC spoke responsible for a key strategic area, providing open access to UK expertise and research – facilitating partnerships to develop innovative low carbon propulsion technologies.

In March 2017, APC launched the Multi User Systems Testing Environment for Research programme, (MUSTER) which provides UK industry access to an advanced distributed simulation and test environment, comprising state-of-the-art research facilities and expertise.

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Design

Vehicle related expertise in Loughborough Design School spans design, vehicle and environmental ergonomics, technology acceptance and usability, sustainability and safety.

We have established expertise related to evaluating the acceptability of new and emerging technologies and the design of vehicle interiors and seating. We have worked with both users and partner manufacturers including Jaguar Landrover, Renault and Nissan as well as technology providers such as voice recognition leader Nuance and service organisations such as the RAC.

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An innovative design for driver interaction with in-vehicle information systems. This specific system relies on tactile controls to reduce driver distraction.
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Driver support systems

Researchers within Loughborough Design School provide a multi-disciplinary approach to all aspects of road and vehicle safety and the impact of intelligent mobility systems on road user behaviour.

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We have our own highly instrumented car to capture driver behaviour information and details of the vehicle system from GPS and the CANBUS.
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We conduct research on behalf of Government and industry and our work impacts directly on road and vehicle safety policies as well as the performance requirements of new vehicles and transport systems.

Our research areas include:

- Autonomous driving trials
- Accident analysis and safety policy support
- Naturalistic methods to observe driver behaviour to examine risks in normal driving and the functionality and impact of driver support systems
- Evaluation of impact and user acceptance of new intelligent transport technologies and vehicle propulsion systems.

Working with international partners, we can access a wide range of experimental resources including an instrumented proving ground and driving simulators.

Recent research projects include UDrive, a £7 million project funded by the European Commission to examine driving behaviour under normal traffic conditions.

Contact
Professor Pete Thomas
T: +44 (0)1509 226931
E: P.D.Thomas@lboro.ac.uk

www.lboro.ac.uk/lds/transport-safety

Part-time and short course programmes

The University offers a range of part-time and short course programmes that can help you to increase your skills and knowledge in low carbon vehicle technologies – whilst providing you with access to our facilities and expertise.

Our Masters programmes can be pursued part-time should you wish to pursue a postgraduate qualification.

Aeronautical and Automotive

Each short course is a module from the MSc Automotive Systems which is accredited by the IMechE.

Modules span a variety of key low carbon issues such as Powertrain Calibration and Optimisation, Sustainable Vehicle Powertrains, and Vehicle and Powertrain Functional Performance.

Contact
T: +44 (0)1509 223 340
E: aaepgadmissions@lboro.ac.uk

Civil and Building Engineering

The School offers two CIBSE-accredited Masters programmes which can be pursued part-time as well as a range of distance learning options.

Contact
T: +44 (0)1509 222637
E: Civ.Eng.enq@lboro.ac.uk

Loughborough Design School

Please contact the School to discuss a variety of part-time and short course opportunities covering a range of topics including Driver and Vehicle Ergonomics, Road and Vehicle Safety, Design for Behaviour Change, and User Experience Design.

Contact
T: +44 (0)1509 226900
E: dsoffice@lboro.ac.uk

Mechanical, Electrical and Manufacturing Engineering

The Continuing Professional Development courses offered in this area are modules from the School's Masters programmes. These modules cover a range of topics including Sustainable Development, Lifecycle Assessment, Environmental Management, Sensors and Actuators for Control, Soft Systems Engineering, and Systems Architecture. All programmes are accredited by the IET, IMechE, InstMC or Energy Institute.

Contact
T: +44 (0)1509 227158
E: ws.pgsupport@lboro.ac.uk

Materials

Programmes in this area are accredited by IOM3. The Department offers:

- Intensive short courses lasting four to five days, including Adhesive Bonding, Sustainable Use of Materials, Rubber Compounding and Processing, and Plastics Processing Technology
- Part-time and distance-learning options are available in two Masters, Diploma and Certificate programmes, Materials Science and Technology and Polymer Science and Technology.

Contact
T: +44(0)1509 228592
E: M.E.White@lboro.ac.uk

Ways to work with us

An overview of the many ways you can work with the University – together with the contact details you will need to find out more.

Partnerships	**Knowledge Transfer Partnership (KTP)** kt@lboro.ac.uk	• A KTP enables organisations to access knowledge, skills, expertise and Government funding to improve business performance.
	Consultancy consultancy@lboro.ac.uk	• Enhance your organisation's research capabilities or hire in trusted expertise to tackle time-critical and complex challenges. • A potential route into a mutually beneficial long-term partnership. • We can help you to establish relationships with either individual academics or an expert team drawn from different areas of research across the University.
	Commissioning research research@lboro.ac.uk	• You can undertake contract research, sponsor a PhD student or involve staff through secondments and visiting appointments at the University.
	Intellectual Property enterprise@lboro.ac.uk	• We can advise on licensing opportunities and technology development partnerships that may be relevant to your organisation.
	SME support (The iNet) inet@lboro.ac.uk	• We support collaborations between companies across the Midlands and UK universities to encourage innovation and growth within key engineering, manufacturing and related industry sectors. • Grant funding towards external costs of capital investment and revenue items, for innovation and growth projects to improve SME competitiveness. • Advice, connections, and incubation support to new Space and Space-enabled businesses.
Student and graduate recruitment	**Graduate recruitment** employer.services@lboro.ac.uk	• Free consultation service to devise a bespoke recruitment package. • A range of events including employer fairs, presentations and workshops. • Free advertising service for all vacancies.
	Student placements and internships employer.services@lboro.ac.uk	• Employ highly qualified individuals who can deliver tangible benefits to your organisation. • Identify potential future employees. • Raise your organisation's profile across the University and build great relationships with our academics, researchers and students.
Skills and training	**MBA** **www.lboro.ac.uk/mba**	• AMBA-accredited MBA – choose to study one year full-time, two-years full-time with an internship, or part-time over two-three years. • Applicants must have a minimum of three years' professional experience.
	Executive education programmes www.lboro.ac.uk/exec	• Accredited and tailored executive education programmes are delivered on campus or in-company. • Areas of expertise include Leadership and Management, Occupational Health and Safety Management, and Automotive Management.
Science and Enterprise Park	**LUSEP** www.lusep.co.uk	• With 70,000 sq m of office, laboratory and workshop space, LUSEP is the ideal base for start-ups and large organisations alike. • Access to University R&D facilities, graduate recruitment, and unique campus partner benefits.

Much more than a business base

Loughborough University Science and Enterprise Park, one of the UK's largest science parks, is at the heart of the Loughbrough and Leicestershire Science and Innovation Enterprise Zone.

Outstanding

- Immediate access to M1, 90 minutes from London
- Home to over 65 organisations, 2,000 people
- Thriving low carbon cluster
- Co-location with world-class R&D and skills base
- Office and lab space from 50 to 500 sq ft available now
- 7 acres (20,000 sq m) fully serviced plots or design and build available now

Contact
T: +44 (0)1509 223 178
E: enterprise@lboro.ac.uk

www.lboro.ac.uk/enterprise

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