Innovate UK

Results of Competition: IDP15: The Road to Zero Emission Vehicles, Feasibility Studies

Competition Code: 1809_FS_MMM_OLEV_IDP_R15

Total available funding is £2 million

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
DRIVE SYSTEM DESIGN LIMITED	Advanced Materials for Highly Integrated Drives	£174,463	£104,678
NCC OPERATIONS LIMITED		£74,757	£74,757

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Funders Panel Date: 12/03/2019

Project description - provided by applicants

This project led by Drive System Design and supported by the National Composite Centre is investigating the development of a novel highly integrated electric drive unit. These will ultimately improve operation efficiency and help towards the delivery of zero emissions, as well as reshoring manufacturing capacity and capabilities to the UK.

Drive System Design (DSD) is an innovative engineering consultancy specialising in design, development and control of driveline systems. It was founded in 2007 and has inherited decades of experience from its key personnel each of whom are leaders in their individual fields of engineering. Working directly for OEMs or Tier 1s or other specialist consultants, DSD supports the industry with a range of services focussed on delivering innovative driveline and powertrain solutions. . In design engineering, this encompasses the generation of concept drivetrain configurations rights through to the micron sensitive design of gear tooth micro-geometry to achieve the most ambitious refinement targets. In control engineering, skills span from the generation of entire suites of software to the ultra-high speed control of electrically actuated systems working at more than 50 kHz. In test and development DSD has one of the largest capabilities in the UK covering the highly accurate characterisation of precision actuators & electronics up to vehicle level dynos with 28,000 Nm capability. DSD also has a proven track record in the build of prototype systems.

Opened in 2011 and forming a core part of the High Value Manufacturing Catapult, the National Composites Centre's (NCC) mission is to accelerate the growth of UK industrial output by enabling design and manufacturing enterprises to deliver winning solutions in the application of composites. It offers opportunities to companies, of any size, to develop, scale-up and validate new and existing composites processes and related simulation tools. The NCC currently has more than forty members from a wide range of industrial sectors. Since its inception, the NCC has been involved in collaborative projects working with a wide range of funding bodies from Innovate UK, the Aerospace Technology Institute, Clean Skies and Horizon 2020 among others. Within this collaboration, the NCC will lead the application of high performance materials and the design and development of a cost effective high volume manufacturing process.

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INEOS AUTOMOTIVE LIMITED	INEOS Grenadier	£75,015	£37,508
AVL POWERTRAIN UK LIMITED		£173,660	£86,830

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Project description - provided by applicants
This project will assess the feasibility and production of a hydrogen fuel cell powered 4x4, including the vehicle requirements, system design and component supply. The key focus will be on meeting the performance, ruggedness and durability requirements for off-road use, while making use of zero emission technologies with a long range. The fuel cell is well suited to this application since it has better energy storage, and therefore weight to volume ratio, than battery electric vehicles (BEVs), but works with electric motors to meet off-road driveability requirements, therefore opening up a large potential market, since traditional OEMs have vacated the space for heavy duty utility 4x4s (e.g. new concept Mercedes G-Wagen, discontinued Land Rover Defender etc), in addition to creating significant opportunity for carry-over to other off-road applications. The defined aims of the project are: *Simulate the powertrain under real world situations (specified temperatures, etc.) to define system specifications for suppliers. *Derive the respective requirements for the electrical drive unit and DC-DC convertor sub-systems within the powertrain. *Conduct evaluations of suppliers for off-the-shelf components and subsystems, to see whether they can meet performance and quality requirements, and financial/delivery-time constraints. *Carry out an integration and packaging study, to explore the vehicle modifications required to include the hydrogen powertrain. The project will be undertaken by INEOS Automotive, in partnership with AVL Powertrain, to develop an off-road vehicle platform from which many variants can be produced, with further applicability to large vehicles including vans and construction plant. INEOS is uniquely positioned to work with its chemical division to develop much-needed hydrogen filling infrastructure in the UK, and AVL will build on their work on vehicle engineering and design to become experts in the hydrogen fuel cell field. Major challenges in the project involve the design and integration of high-performance subsystems with high durability; and development of optimal solutions to contradictory requirements, such as the need to seal the fuel cell for ingress protection, while also providing sufficient cooling to components. If the Grenadier vehicle range captures just 10% of the UK market for SUVs, it will achieve annual sales of 30,000 units. 1% of the global SUV market would equate to 279,000 units per year. Overall, the project will bring a new vehicle manufacturer into the UK, and help to establish the UK as a hub for the hydrogen economy.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
TOYOTA TSUSHO U.K. LIMITED	Using aviation based reclaimed carbon fibres for BMC.	£62,644	£31,322
FIBA TECH INDUSTRIES LIMITED		£84,009	£50,405
NCC OPERATIONS LIMITED		£61,854	£61,854

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Project description - provided by applicants
The objective of the project is to research and develop a range of composite materials (known as bulk moulding compounds) using recycled carbon fibres reclaimed from end-of-life (EOL) aircraft and aerospace production waste. The material will be suitable for large scale volume production of lightweight automotive components, using material that is currently sent to landfill or burned. This approach will reduce the environmental impact of the vehicle through reduced energy usage in manufacturing when compared to the production of virgin carbon fibres. All the consortium members are UK based but the output has large scale export potential and job creation possibilities. GKN can supply aviation waste CFRP and process the developed material giving a circular supply chain. FTI Group will develop the BMC materials and TTUK supply the reclaimed fibres.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
CLAIRVAUX LTD	Zero Emissions capable Ready for Autonomous Urban Deliveries (ZERAUD)	£60,078	£42,055
TETRA DESIGN SERVICES LIMITED		£61,191	£42,834

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Project description - provided by applicants
It is universally recognised that the internal combustion engine is responsible for a great many of the air quality issues that developed countries have to face. It is also widely accepted that the ICE will continue to provide a large proportion of the traction requirements of long distance haulage and regional distribution for several years to come. The challenge for today's transport and logistics operations is how to comply with Ultra Low Emissions Zone requirements without further trans-shipment of goods from efficient medium to high volume vehicles and trailers into small volume Ultra Low Emissions Vehicles for urban distribution. Project ZERAUD will add an electric drive axle to a conventional diesel driven truck, storing the electrical energy on the trailer in the space that is often left empty at the front of the lower deck of a double deck trailer. Urban step frame double deck trailers are already relatively expensive (compared to the full length alternative). Project ZERAUD intends to offer an alternative to the high cost of a typical low floor independent suspension (typically £10-12000 more than a pair of standard axles) by redesigning either the axle or the chassis frame to allow sufficient wheel movement without needing independent wheel ends. This will help to offset the cost of the hybridisation. Because ZERAUD will retain the diesel engine for journeys between distribution centres and Ultra Low Emissions Zones, the suspension will make use of functions already available within electronic suspension controls to reduce aerodynamic drag at speeds above 40mph (65km/h). It is believed that this function can save 1-2% on fuel consumption and therefore reduce exhaust emissions by a similar proportion. By treating the combination of truck and trailer as a whole, rather than separate units, there are design benefits that can be taken advantage of to make optimal use of space that is not available if the tractor unit is treated separately. Similarly, the approach will allow the individual elements to be used as conventional tractor / trailer which, whilst not gaining the ZE benefit, does help maximise versatility of the fleet and reduce emissions through the reduced drag of the trailer.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
D2H ENGINEERING SERVICES LTD	Ultra Low Cost Electric Vehicle Platform	£108,050	£75,635
NETCOMPOSITES LIMITED		£77,220	£54,054
University of Warwick		£64,276	£64,276

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Project description - provided by applicants
The Ultra Low Cost Electric Vehicle Platform project is aiming to understand the technical and commercial viability of a multi-configuration vehicle that is cheap to buy, cheap to run and cheap to maintain - therefore being suitable for sale throughout the world, especially in emerging markets where the road network and support infrastructure is far less developed than in the West. The project will look at both the design of the vehicle platform itself, the use of novel natural-fibre based composite materials and the overall production process to develop a system that can blend the best of UK engineering design with the potential for localised, low-cost production suitable for personal and commercial vehicles alike.

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TECHNELEC LIMITED	High Speed, Magnet Free Traction Motors and Drives	£174,890	£122,423
University of Strathclyde		£74,806	£74,806

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Project description - provided by applicants
Electric vehicles are powered predominantly by one type of motor containing rare earth permanent magnet. The rare earth magnet material is extracted from its ore at considerable environmental cost. Permanent magnet motors are limited in speed, and always consume power when the vehicle is moving. Premature end of motor life occurs by the magnet degrading. The subsequent recycling process is a challenging task. This feasibility study is looking at a different type of motor: the Switched Reluctance Motor which contains no magnet and has a simple construction. The motor can run fast enabling the same power to weight as the permanent magnet motor, has no drag torque and a longer life in the harsh automotive environment. At the end of life the recycling of constituent motor parts is simpler. The switched reluctance motor has not been adopted as an alternative drive motor because the power electronics driving the motor is not a standard design increasing its cost. Capacitors in the circuit are put under more stress and the control of the motor is complex to maintain low acoustic noise and smooth motor rotation. This feasibility study is investigating combining a switched reluctance motor with a new configuration of power electronics which will potentially create a low cost, highly integrated, efficient electric vehicle drive with power available over a wide speed range.

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DEARMAN ENGINE COMPANY LIMITED	Combined Battery-electric technology and Dearman System (CBDS)	£172,355	£103,413
University of Warwick		£71,050	£71,050

Note: you can see all Innovate UK-funded projects here: https://www.gov.uk/government/publications/innovate-uk-funded-projects
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Project description - provided by applicants
As the automotive industry strives to meet government's environmental targets, the move towards electrification, both for propulsion and to meet the demand of system loads, is key to decarbonising transport. UK food distribution by refrigerated road transport accounted for 1.8% of total UK CO2 emissions (Food Miles Final Report, 2005). Since then, both the convenience store and home delivery services for fast moving consumer goods (FMCG) have seen significant growth of 27.3% in 2017 (Sainsbury's) and 17.8% in 2018 (IGD research). Meanwhile, the need to tackle Britain's air pollution problem has led to a number of initiatives being rolled out by central and local government. The government's Clean Air Strategy and the draft Environment Bill are also due for publication shortly. Meaning there will be an increasing impetus to tackle disproportionate pollution from diesel-powered refrigerated vehicles. A Dearman transport refrigeration unit (TRU) can support effective deployment of electrified propulsion on refrigerated vehicles. This projects aims to assess the feasibility of a new design concept of a combined battery-electric technology and the Dearman system (CBDS). Specifically, it seeks to replace smaller diesel vehicles where the refrigeration is also powered by the main engine (e.g. vans). CBDS will target applications such as back-to-base convenience store supplies and home delivery services. With CBDS, the TRU is powered by the Dearman system for high-performance cooling and mechanical power generation. The power generated can also be used for charging the battery and the cooling generated can also be used to cool down the battery pack to optimise the battery life. This will mean benefits for the automotive industry in terms of zero emissions, higher energy efficiency, more lightweight design with low costs, and greater reliability. The consortium comprises Dearman and University of Warwick (WMG) who will leverage their relationship with: * End users for industry data * And involve Siemens (the powerful system design and simulation tool provider) through in-kind contributions.

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STRYKER DESIGN LIMITED	CURVE -- Compact URban VEhicle	£67,517	£47,262
DEVELOPMENT ENGINEERING AND ENTERPRISE LTD		£156,920	£109,844
PRINTING PRESS SERVICES INTERNATIONAL LIMITED		£25,216	£17,651

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Project description - provided by applicants
CURVE will assess the feasibility of a radically new zero-emission electric vehicle. CURVE is a Narrow Leaning Vehicle (NLV) designed to meet category M ('normal' car) classification and provide a comfortable and familiar driving experience through technical innovations. CURVE will accelerate the drive to zero emissions: * directly, by making EVs more affordable and attractive for key market niches, increasing adoption; and * indirectly, by reducing congestion. Congestion in urban areas has been shown to double emissions. Academic studies and major OEM research (e.g. Toyota, PSA Groupe) have identified electric NLVs as the ideal vehicle to overcome congestion by maximising road space use and allowing lane splitting. Despite the well-publicised benefits of NLVs, they have not yet achieved commercial success for several reasons. Technical limitations in the implementation of leaning, steering, and suspension ride and handling have reduced the appeal of previous NLVs. Those that have reached production have been too expensive due to complex drives and controls. Moreover, because the entire market segment is new, there is an opportunity for a niche manufacturer to deliver the first successful NLV if the technical and cost barriers above can be overcome. CURVE will provide the manoeuvrability, comfort, and price point that will open the NLV market segment through technical innovations as follows: * A novel hybrid steering mechanism that can switch between high-speed steering through lean and slow-speed upright steering through independent wheel speed control. This allows the vehicle to manoeuvre effectively in traffic and on the open road. * A leaning mechanism that increases the lean angle (and hence speed) of the vehicle, whilst maintaining suspension at full lean. This improves both performance and comfort. * A radical drivetrain technology that allows fully variable differential steering from a single downsized electric motor, reducing complexity, weight and cost. CURVE can succeed commercially because it will be sold initially as a niche product, produced by a consortium of small businesses operating successfully in the UK's dynamic niche vehicle industry sector. Stryker and PPSI bring patented enabling technologies, with experienced niche vehicle designer, DEE, providing the engineering and market knowledge to realise our vision. This feasibility study will validate our technology and business strategy, enabling us to move with confidence into the development of a demonstrator vehicle. Upon successful commercialisation, we will create a £16m p.a. niche vehicle opportunity, plus technology licensing, and contribute to achieving the UK's Road to Zero strategy.

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