Innovate UK

Results of Competition: APC 12: Advancing the UK's Low Carbon Automotive Capability

Competition Code: 1901_CRD1_TRANS_APC12

Total available funding is £25 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
CATERPILLAR (U.K.) LIMITED	Electrification of an off-highway vehicle	£3,550,414	£1,455,670
AVID TECHNOLOGY LIMITED		£3,110,920	£1,866,552

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Project description - provided by applicants
The public description is being reviewed by the Caterpillar corporate public affairs team and will be provided once approved.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
YASA LIMITED	EV-LIFT (Electric Vehicle Light-weighting Integrated Future-proof Traction)	£13,600,335	£7,344,181
Coventry University		£191,471	£191,471
HSSMI LIMITED		£331,574	£331,574
LOTUS CARS LIMITED		£8,711,284	£3,484,514

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Project description - provided by applicants

Electric Vehicle Light-weighting Integrated Future-proof Traction (EV-LIFT)

The EV-LIFT project is a collaborative APC project between YASA, Lotus Cars, HSSMI and Coventry University. The project aims to produce a best-in-class Electronic Drive Unit (EDU) for next generation battery electric vehicles (BEVs). The project will utilise best-in-class motor, SiC inverter, and gearbox technology that enables significant light-weighting and efficiency improvements for next-generation BEVs.

Lotus will use the YASA EDU on a number of their upcoming high performance BEVs which start production in 2023\. Analysis has shown that up to 200kg of mass and 15% efficiency gains can be achieved by YASA's novel EDU architecture.

The EDU will also enable independent traction of the rear wheel, offering new opportunities for improved handling and performance for next generation BEVs. Coventry University will also research and the possibility to increase safety back using the torque vectoring capability to reduce the hazard of certain failure modes, such as tyre blow-outs on motorways.

In addition to developing the EDU and vehicle technology, the APC project has assisted the partners in the following ways:

YASA will create a new facility dedicated to EDU test and production

* Full system support and design for a complete EDU, designed to Lotus' specification
* Full performance and durability test facilities in-house
* Fully integrated motor, inverter and gearbox capability

Lotus will create a new R&D facility, which will enable the development of a range of new high-performance BEVs

* BEVs which follow the Lotus brand of performance, light-weighting, advanced aerodynamics and styling, with best-in-class efficiency
* Full EDU integration, with torque vectoring control
* Optimisation of the package, installation and test of a high performance EDU
* Advancements in safety using novel features available with the YASA EDU

HSSMI will assist Lotus in the design of their production facility to assist the production planning and ramp up

Coventry University will focus on the research aspect of the project. This will include:

* Investigating the safety implication of a torque vectoring system
* Failure modes, and how the severity can be reduced with torque vectoring capability
* The longer term opportunities for autonomous vehicles with this type of architecture.

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Overall, the project aims to keep the UK at the forefront of electric vehicle development, and will have a positive impact on the UK, the partners and their supply chains.

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MCLAREN APPLIED TECHNOLOGIES LIMITED	ESCAPE - End-to-end Supply Chain development for Automotive Power Electronics	£8,407,945	£3,195,019
CLAS-SIC WAFER FAB LIMITED		£1,429,991	£857,995
COMPOUND SEMICONDUCTOR APPLICATIONS CATAPULT LIMITED		£1,500,946	£1,500,946
COMPOUND SEMICONDUCTOR CENTRE LIMITED		£295,764	£112,390
LYRA ELECTRONICS LIMITED		£1,477,091	£886,255
MaxPower Semiconductor		£1,154,850	£519,682
MICROSEMI SEMICONDUCTOR LIMITED		£891,827	£338,894
MURATA POWER SOLUTIONS (MILTON KEYNES) LIMITED		£1,700,552	£646,210

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TECHWORKSHUB LTD.		£30,237	£18,142
TRIBUS-D LTD		£163,444	£98,066
TURBO POWER SYSTEMS LIMITED		£1,520,334	£760,167
University of Warwick		£646,815	£646,815
ZELENERGY LTD		£291,173	£174,704

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Project description - provided by applicants
Most vehicles run on fossil fuels like petrol or diesel. Their exhaust gases are responsible for most of the carbon dioxide (associated with global warming) and particulate emissions (that can cause athsma) in the UK at present. Making these vehicles electrically driven moves all emissions away from the tailpipe of the vehicle, and if renewable energy is used to charge the vehicle, can completely eliminate the emissions associated with transportation and mobility as well as reducing the UK's dependency on imported fossil fuels. This applies to all modes of transport including automotive, off-highway, rail, marine and aviation. At its core, an electric drivetrain is very simple, with an electric motor providing the tractive power generated from energy stored in a battery. To convert the DC voltage of the battery to the AC voltage required for the motor, power electronics, in the form of an inverter, are required. Further power electronics are also required for use in high power DC/DC converters and rapid chargers. Until recently, the switching devices used for these applications have been based on standard silicon technology. Silicon Carbide is expected to replace the use of silicon in future applications, due to its superior switching speed and efficiency. This also includes in non-transport applications including electrical grid interfaces and renewable energy systems. At present, this technology cannot be made in the UK and is imported, rather than building in the UK and exporting. The aim of this project is to kick-start the manufacture of these high value components, and their resulting systems in the UK. This will protect skilled manufacturing jobs in the UK and provide significant export potential for the associated vehicles and components. The timing for this innovation is perfect, with massive demand expansion predicted over the coming decades as electric cars become mainstream. The opportunity is for the UK to be at the forefront of this revolution. The focus of ESCAPE is to bring together industrial leaders and pioneers from across the supply chain to work as a single coherent team to deliver this vision. We aim to break down many of the barriers that slow down the development cycle time and to capture the full value in the UK. ESCAPE will be supported by academics and engineers who are expert in the area building on over 25 years of research to date.

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TATA MOTORS EUROPEAN TECHNICAL CENTRE PLC	Zero Emission Tata hydrogen Engine (ZETE)	£3,004,000	£1,081,440
JOHNSON MATTHEY PLC		£308,785	£138,953
REVOLVE TECHNOLOGIES LIMITED		£798,691	£479,215
ULEMCO LTD		£400,002	£280,001
University of Brighton		£527,991	£527,991

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Project description - provided by applicants
This 36-month project addresses the challenge of dramatically reducing carbon and air quality emissions in heavy goods vehicles (HGV). The market opportunity is to address this critical global energy and environmental requirement to reduce emissions, by delivering practical, cost effective solutions for truck and fleet operators, as the costs of vehicle ownership are acutely important for business operation success in this sector. Low emissions technological solutions for commercial vehicles proposed to date, either add significant cost to the vehicle or require extensive change to the duty cycle and patterns of use. Tata Motors European Technical Centre through this project seeks to build on its capabilities and that of the project partners including Revolve, ULEMCo, Johnson Matthey and University of Brighton, to develop a viable ZERO emission engine platform. The outcome of this highly innovative approach would develop the Zero Emissions Tata hydrogen Engine (ZETE) enabling Tata Motors to compete across a wider range of HGV platforms, and ensure that their UK developed technology stays ahead of regulatory standards, providing a world beating commercial proposition that is not only relevant for the UK market but also globally significant. Tata Motors is a $45 billion organisation. It is a leading global automobile manufacturing company. Its diverse portfolio includes an extensive range of cars, sports utility vehicles, trucks, buses and defence vehicles. Tata Motors is the Indian market leader in commercial vehicles and top three in passenger vehicles, the world's fourth largest truck manufacturer and the second largest bus manufacturer. Tata Motors, who also own Jaguar and Land Rover has around 81,000 employees around the world. TMETC, based in NAIC, University of Warwick, is a critical part of the Tata Motors Research & Development footprint leading advanced Powertrain innovation across both commercial and passenger vehicles. The Tier1 partner in the project, Johnson Matthey (JM) is a £7 billion organisation. Specialising in chemicals, catalysts, pharmaceutical materials, and pollution control systems and exploiting previous publicly-funded R&D, Johnson Matthey will utilise their hydrogen selective-catalytic reduction (SCR) technology to ensure any small amounts of NOx produced by the 100% hydrogen thermal engine will be converted in the after-treatment system to produce a real world ZERO emission. The OEMs/Tier 1 are supported by SME technology innovators and Hydrogen experts, Revolve and ULEMCo with additional research supported by the University of Brighton (UoB), who are the internal combustion engine thermal efficiency spoke of the Advanced Propulsion Centre (APC)

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UNIPART POWERTRAIN APPLICATIONS LIMITED	H1perChain	£3,843,831	£1,614,409
Coventry University		£867,518	£867,518
DAGE PRECISION INDUSTRIES LIMITED		£248,280	£124,140
DIREC-TEC LTD		£205,720	£144,004
HSSMI LIMITED		£355,034	£355,034
HYPERBAT LIMITED		£5,034,856	£2,114,640
TWI LIMITED		£249,477	£249,477
WILLIAMS ADVANCED ENGINEERING LIMITED		£1,004,183	£421,757

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Project description - provided by applicants
Hyperbat Limited is an embryonic joint-venture between Unipart and Williams Advanced Engineering, aiming to become the largest independent battery manufacturer of high-performance battery packs, based on disruptive APC-supported collaborative R&D (H1PERBAT, APC6). The H1perChain project, which will be led by Unipart Powertrain Applications, targets the developments and resource growth for Hyperbat to reach critical mass as a commercial-scale Tier 1 producer, operating independently of its parents. The H1perChain consortium brings together key stakeholders across the whole value stream, with the overall vision to reach maturity across the Tier 1 and Tier 2 functions. This will be delivered both through direct technology partnering to develop internal design-for-manufacture and production capability -- with the High Speed Sustainable Manufacturing Institute (HSSMI), the Institute for Advanced Manufacturing Engineering (Coventry University), TWI, Nordson Dage and Direc-Tec -- as well as engaging the wider Tier 2 supply chain for prioritised commodities for cost-reduction in the overall bill-of-materials. Innovations at a product technology and manufacturing process level will be delivered through a disruptive platform for digitally-integrated design-for-manufacture. Real-time simulations to validate the product and processes, as well as virtually commission the optimum facilities, will enable this virtual manufacturing data to be fed back into the design process. This functionality is fundamental to capturing component-level cost-sensitivities across the supply chain, within a broader design-to-cost paradigm. Through creation of a robust framework to drive cost-reductions from component to full-system level across the supply chain, alongside automated module/pack assembly and inline testing, Hyperbat and partners target a step change in both cost and readiness for flexible series production of high-performance electric vehicle batteries for challenging applications. H1perChain outputs embody digitally enabled concurrent engineering which will deliver the speed and robustness required to achieve OEM time and cost targets. The targeted outcomes therefore increase both the UK's long-term innovation and production capacity, extending capabilities beyond a global R&D lead to establish a manufacturing position and secure supply from a UK-sourced bill of materials.

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