Results of Competition: APC 15: Developing the UK's Low Carbon Automotive Capability

Competition Code: 2001_BEIS_MMM_CRD_APC15

Total available funding is £48,340,564

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
CONSTELLIUM UK LIMITED	Aluminium Intensive Vehicle Enclosures (ALIVE)	£9,361,450	£3,744,580
BMW MOTORSPORT LIMITED		£993,600	£397,440
Brunel University London		£1,009,166	£1,009,166
EXPERT TOOLING & AUTOMATION LIMITED		£1,469,179	£587,672
INNOVAL TECHNOLOGY LIMITED		£500,089	£200,036
POWDERTECH (BICESTER) LIMITED		£496,328	£347,430
University of Warwick		£1,193,139	£1,193,139
Volvo Cars Group		£299,780	£0

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Funders Panel Date: 13/05/2020

Project description - provided by applicants
Innovative high strength aluminium alloys, novel processing, joining and assembly technologies have been developed for use in light weight crash resistant battery enclosures and for the integration of such structures into ultra-low emission vehicles (ULEVs). The optimum combination of extrusions and sheet can provide architectural flexibility in meeting both the protective structures and the thermal management requirements which can control battery operating temperatures to precise levels reducing, the risk of thermal runaway and optimising battery pack operating temperatures during charging and driving to reduce energy losses. The novel enclosure architectures will provide scalable design and manufacturing concepts utilising agile multi-platform cells on the same production equipment, engineered to meet variable volume demands, while providing a kit of parts for local assembly and export options. This enables the introduction of multiple EV platforms as OEM technology demonstrators, critical to supporting OEM acceleration to high-volume electrification programs. Without such a solution, the high capital and manufacturing costs of the current production methods act as a significant barrier to low, then medium and high-volume production, thereby delaying the electrification timetable. The proposed solution further de-risks the supply chain by providing scale-up to high volume production by keeping capital costs to a minimum. This provides significant advantages in manufacturing and assembly costs and set up time whilst meeting current legislative requirements, providing the opportunity to define new standards of safety, crash management and energy efficiency. The ALIVE project will design, develop, assemble and extensively test aluminium intensive prototype enclosures and full-scale demonstrator enclosures for BMW and Volvo electric vehicles, forming an integrated pathway to UK battery pack production by providing the light weight enclosures aligned to current and future battery module technologies and power densities. The project aims to take another major step with disruptive high strength aluminium alloys and their processing and joining technologies, enabling new enclosure design concepts for the manufacture of both vehicle integration structures and battery enclosures for a new generation of lightweight hybrid and electric vehicles for the UK market that will have a major impact on the UK government's carbon reduction targets for the UK vehicle fleet. The project will establish a UK based manufacturing facility for world leading cost-efficient structural aluminium battery enclosures providing an on-shore resource for BEV and PHEV component manufacture, with the manufacturing concept capable of providing efficient transportation of parts for export assembly.

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CUMMINS TURBO TECHNOLOGIES LIMITED	Trident	£13,477,302	£4,986,602
BOWMAN POWER GROUP LIMITED		£4,757,349	£3,330,144
HOLTEX LIMITED		£496,342	£347,439
University of Bath		£1,338,348	£1,338,348

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Project description - provided by applicants
Challenge The push to decarbonise heavy-duty vehicles lags far behind light-duty applications. This is primarily because the extreme demands on powertrain cost-performance, operational availability, design life and reliability are yet to be wholly met by any existing low carbon powertrain approach, such as fuel cells, battery electric, hybrids and use of alternative fuels (for example CNG or biodiesel). Whilst there is consensus that all are vital to the transformation of the entire on-highway/off-highway transport domain, heavy-duty applications are much more sensitive to the specific operation-critical characteristics of these technologies, creating uncertainty for UK-based OEMs trying to determine specific paths to zero-emissions. Currently, UK supply chains for systems and ancillaries in these segments also lack the capability and flexibility to meet quality, volume, variety and cost-reduction requirements for heavy-duty applications. The risks for OEMs, in terms of long-term security-of-supply, contribute to the inertia adopting new low carbon technologies into vehicle launch plans, with significant impacts on the UK's decarbonisation trajectory. **Opportunity** Cummins aims to become the world's leading provider of decarbonised powertrains for heavy-duty applications by 2030\. Their roadmap culminates in zero-emission thermal propulsion platforms based on fuel cells alongside battery electric architectures, but is also critically-dependent on more rapidly deployable internal combustion engine-based (ICE) powertrains. These will leverage alternative fuels and hybrid technology developments to address the uncertainty within heavy-duty. Innovative energy recovery systems across multiple thermal propulsion platforms therefore remain vital to Cummins' overall competitiveness, directly enabling impacts accelerating the transition away from diesel ICE and undercutting aggressive UK and global CO2 reduction targets. This need remains unmet in heavy-duty applications with challenging operational requirements. **Trident vision and objectives** Building on extensive cutting-edge developments in every major component and subsystem across mechanical and e-machine domains, Cummins Turbo Technologies (CTT, Huddersfield) and partners across the Tier 1 to Tier 3 UK supply chain target a game-changing energy recovery platform, redefining the practical limits of system efficiency across multiple thermal propulsion powertrains. Transforming system-level efficiency at vehicle-level and directly catalysing disruptive range and payload impacts for heavy-duty fuel cell vehicles, and CO2/fuel-consumption improvement for ICE-based platforms such as hybrids, natural gas vehicles and reduced-emission diesel variants.

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MAGNETIC SYSTEMS TECHNOLOGY LIMITED	Industrialisation of Magtec Motor Production for OEM Volume Demand	£4,342,219	£1,606,621
ANGEL TRAINS LIMITED		£88,056	£22,014
DENNIS EAGLE LIMITED		£19,284	£4,821
Manufacturing Technology Centre		£897,226	£897,226
PANELTEX LIMITED		£152,228	£38,057
University of Sheffield		£352,354	£352,354
VOLTA TRUCKS LTD		£116,100	£29,025

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Project description - provided by applicants
This collaborative R&D project will demonstrate the development of production technologies for traction motor production. This will enable production scale-up of motors produced by Magnetic Systems Technology (Magtec), a leading UK supplier servicing the commercial vehicles market. Magtec's electrification solution can be fitted as original equipment or as a retrofit/repower solution for fleets of commercial vehicles (buses/trucks etc.). The project will directly address both issues by providing the electric alternatives to diesel power solutions, at required volumes, with demonstrable operational reliability. The project accelerates innovative production technologies at Magtec, with the motor manufacturing pilot line being the focus area. The forecast for growth (post project completion) represents an order of magnitude increase in production demand over the following 5 years. This is driving the need to accelerate the development and delivery of innovative and bespoke manufacturing processes and assembly methods. The project consortia led by Magtec includes four leading transport sector OEM's - Dennis Eagle, Paneltex, Volta Trucks and Angel Trains. These partners will support the definition of requirements and verification of the solutions developed within this project, ensuring the manufacturing processes and approach, are repeatable and robust, and therefore delivering reliable products to their respective markets. It includes two High Value Manufacturing Catapults -- the Manufacturing Technology Centre (MTC) and the Advanced Manufacturing Research Centre (AMRC) at the University of Sheffield, whose expertise will be focused on utilising the most innovative manufacturing process and assembly methods development activities. This will cover the integration of data and information systems and embedded quality assurance methods, to ensure robustness and repeatability throughout. Magtec sources most of its components and materials from the UK, with a large proportion of these within a short distance from its Sheffield assembly facility. The project will become a catalyst to reduce risk in the supply-chain proposition by developing deep relationships, predominantly in the region, to maximise the UK value-added content accordingly. Forecast supply and production requirements have created supply-chain resilience challenges, which shall be addressed through the project. Skills development within all partners and the wider supply-chain will be core, as partners move towards electrified propulsion systems at a vehicle level, and automated/semi-automated processes within the value stream.

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BMW MOTORSPORT LIMITED	@FutureBEV	£15,612,700	£5,932,826
COMPOUND SEMICONDUCTOR APPLICATIONS CATAPULT LIMITED		£2,325,246	£2,325,246
CUSTOM INTERCONNECT LIMITED		£2,807,000	£1,403,500
LYRA ELECTRONICS LIMITED		£2,401,680	£1,200,840
MCLAREN APPLIED TECHNOLOGIES LIMITED		£5,216,121	£1,982,126
University of Warwick		£2,178,646	£2,178,646

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Project description - provided by applicants
Accelerated Technologies for Future Battery Electric Vehicles (@FutureBEV) will ensure competitive powertrains in function and costs and enable UK technology transformation to zero emission mobility. Two premium automotive global companies, BMW and McLaren Applied join forces to bring together a development team to include Custom Interconnect Limited (CIL), Lyra Electronics from industry and Compound Semiconductor Applications Catapult (CSAC) and University of Warwick (UoW). Together the team will develop a new UK supply chain for subcomponents and system capability for future electromobility addressing UK Government targets for industrial growth, generation and safeguarding of jobs and the transformation to zero emission mobility. This technology drives BEV from niche to mainstream. This will be delivered through two strongly interlinked workstreams addressing volume and performance. Customer oriented requirements implemented through this development provides real world benefits in improved efficiency, lower vehicle level CO2, reduced weight and better use of storage providing value add and competitive customer value to the end user. UK engineering talents and skills will be developed in harmony with the BMW Munich based background knowledge within the project to open development and manufacture opportunities for vehicle electrification within the UK. **Core goals**: * Development of EV powertrain * Development of UK content (sub-components and Inverter supplier) * Increased powertrain efficiency (reduction of CO2) * Reduced development cycle time/time to market (acceleration of CO2 benefits) **Specific development:** * Design for volume manufacture target of 2025 * High Power Charging (HPC) enabling technologies * Thermal Management and connection systems for high integration * Sensor development Revolution to 800V will significantly reduce charge times enabling HPC, accelerating end-user acceptance, and optimising the powertrain by efficiency

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improvements.

Faster switching capability of technologies will be further developed to doubling up power density, reducing volume, cost and optimising overall vehicle powertrain integration.

Deliverables:

* Silicon Carbide (SiC) power switch with transfer for other systems (charging)

* Development of UK academia
* System optimisation and delivery of core Power Electronic systems for powertrain
* Customer safety impact for new high voltage systems, analysis and design implementation
* UK based supply chain development for high value automotive components

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JAGUAR LAND ROVER LIMITED	ZEUS	£12,873,049	£5,535,411
DELTA MOTORSPORT LIMITED		£3,524,982	£2,467,487
MARELLI AUTOMOTIVE SYSTEMS EUROPE PLC		£991,372	£495,686
UK BATTERY INDUSTRIALISATION CENTRE LTD		£243,902	£243,902

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Project description - provided by applicants
Jaguar Land Rover requires the development of cutting-edge electrified propulsion technologies to remain globally competitive. This aligns to the strategy for all new Jaguar Land Rover models to have an electrified option from 2020\. Jaguar Land Rover has created a consortium of world-class academic and industry partners to create a hydrogen fuel cell electric vehicle (FCEV) prototype to evaluate Hydrogen Fuel Cell Technology large premium SUVs. The project will deliver a benchmark, zero emissions premium FC SUV concept with Jaguar Land Rover attributes such as long range, quick refill, towing, off-road capabilities, low temperature performance. To deliver this exciting project, Jaguar and Rover has assembled a tightly focussed consortium of UK based world-class experts including: Delta Motorsport -- A UK based SME will lead the development of a class-leading, high performance battery Marelli Automotive Systems - part of a global automotive group with UK base will support the design of the cooling system and the development of high-performance heat exchangers suited to FCEV. The UK Battery Industrialisation Centre is part of the UK government's Faraday Battery Challenge to establish a new national facility for battery manufacturing development. Jaguar Land Rover will provide programme leadership, lead technology integration, and hardware and software development for vehicle power management. Jaguar Land Rover will lead the vehicle physical integration and manufacture demonstration vehicles Successful execution of the project will result in significant opportunities for UK production sourcing to sustain and drive new jobs growth in the UK during the critical transition period from conventional internal combustion engines to electrified powertrains. The project will also drive significant growth in FCEV design and manufacturing capability within the partnership and will provide the consortium partners with a competitive edge to create UK intellectual property (IP); a strong UK supply chain; and downstream exploitation opportunities in adjacent fields.

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FORD TECHNOLOGIES LIMITED	eSHADOW	£3,308,994	£1,025,788
AUTOTECH ENGINEERING R&D UK LIMITED		£2,353,954	£1,176,977
EDWARD DAVIES COMMERCIALS LIMITED		£1,717,172	£841,414
University of Warwick		£1,098,599	£1,098,599

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Project description - provided by applicants
eSHADOW ~ Electrified Structural Hybrid Automotive Developments for Optimised Weight eSHADOW is a Ford led collaborative industry research project that aims to focus on the development of hybrid material structural engineering tools to promote lightweight design and verification for Product Development processes. The research will be conducted with a total of three UK industry based partners and an academic partner, who will develop key design tools to allow UK companies to leverage the next generation product development and training capability. The eSHADOW project will develop lightweight multi-material solutions for rolling chassis ladder frames to improve vehicle efficiency and promote the adoption of zero emission vehicle architectures. Specifically, using a hybrid material combination of carbon-fibre reinforced polymer composite and alloys in a volume manufacturing process, weight savings of over 30% as compared to conventional all steel systems will be achieved and these step reductions in vehicle mass will promote the adoption of EV technologies. During the project, the team will demonstrate a new approach for engineering practices that enable the next generation electrified vehicle technologies to be developed. Reducing the reliance on traditional engineering and materials will provide the efficiencies needed to provide a class leading weight optimisation for major CO2 reduction and simultaneous payload increase for commercial vehicles which can translate to all body on frame vehicles. The underpinning predictive design capabilities will be developed within the project, enabling the formulation of reliable digital design tools to accurately predict the performance, durability and failure of hybrid material structures in dynamic chassis applications. The current development methodology relies heavily on known technology and materials. Lightweighting is restricted to optimisation of steel and aluminium components. This approach limits capability to reduce weight significantly. Due to increasing complexity and technology, there is a necessity for a pragmatic approach to lightweighting; to introduce hybrid structures that utilise the right material in the right location. A candidate affordable ladder frame (Ford Ranger) will be developed via multiple design iterations, then optimised and demonstrated with the production of several full-size ladder frames and the performance of this demonstrator frame will be evaluated against all relevant benchmarks. Physical test data will enable the validation of the newly formulated predictive design tools.