Innovate UK

Results of Competition: Faraday Challenge - Innovation - Research & Development

Competition Code: 1707-9_TRANS_BATTERY_CRD

Total available funding is £30M

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
HSSMI LIMITED	VALUABLE: VALUe chain And Battery Lifecycle Exploitation	£295,987	£295,987
ACELERON LIMITED		£694,014	£485,810
ASPIRE ENGINEERING LIMITED		£579,374	£405,562
ENV-AQUA SOLUTIONS LTD		£402,600	£281,820
NPL MANAGEMENT LIMITED		£180,116	£180,116
TEVVA MOTORS LIMITED		£168,738	£118,117
University College London		£298,126	£298,126

Project description - provided by applicants
Project VALUABLE's key objectives are to develop commercially viable metrology and test processes as well as new supply chain concepts for recycling, reuse and remanufacturing of automotive lithium-ion batteries to create a complete End-of-Life (EoL) supply chain network within the UK. The consortium's vision is to 1) increase the value-add of the battery supply chain in the UK, 2) decrease the environmental impact, and 3) optimise future battery design for EoL. By bringing together many disparate parts of many sectors, the project will provide an efficient and effective route to providing second life battery applications, whilst reducing the packs / cells being fed into the waste streams. The project will investigate key areas that are providing difficulties in dealing with automotive batteries at their EoL: 1) the lack of reliable and cost-effective test methods, 2) the lack of remanufacturing/recycling and reuse processes, 3) the lack of effective value chains, and 4) lack of design considerations for EoL in battery design. To implement efficient processes, the project will investigate and develop advanced 'machine vision' capabilities, to determine which packs have second life potential and at what level and which are for recycling. This development of advanced testing capability in the EoL processing line, will enable the consortium to explore significant value chain applications for end-of-life batteries, ranging from remanufacturing to go back into the same vehicle model, to use in lower demand mobility applications, through to use as energy storage mediums for the energy market. The test results will also aid future first life battery pack design, providing OEMs and battery producers with routes to both realise additional value from future applications for used batteries and to move towards 95% recyclability. In conjunction with the development of new designs and processes, the project team will also explore the growing legal and regulatory issues surrounding the battery producer responsibility / waste classifications in the UK and Europe. In addition, not only will the battery cells be assessed, but the charge controllers, outer jackets, and other components. Reuse of these products contributes to the recycling targets, but also supports improved material recovery routes through better material separation. The project brings together partners across the supply chain, developing new EoL testing techniques, and in creating a UK-based EoL supply chain. The project is not only supported by the supply chain but also an industry-wide OEM support represented in a guiding advisory group.

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NEXEON LIMITED	SUNRISE (Synthomer UCL Nexeon Rapid Improvement in the Storage of Energy)	£8,130,299	£5,691,209
SYNTHOMER (UK) LIMITED		£369,004	£184,502
University College London		£1,113,403	£1,113,403

Project description - provided by applicants

The SUNRISE project will deliver a novel silicon anode material for advanced lithium ion batteries. Silicon has a great affinity for lithium and can (in theory) deliver up to 9x the energy density of graphite on a gravimetric basis. Nexeon's material design is highly innovative. In conjunction with an anode binder from Synthomer and supported by UCL's Electrochemical Innovation Lab, this project will identify optimum process conditions and materials design delivering highest energy density, lowest first cycle loss, lowest volume change and best capacity retention during use. The project will utilise new infrastructure in the National Battery Manufacturing Development Facility to have built batches of automotive Li-ion cells for testing in conjunction with direct material sampling to automotive OEMs and leading cell manufacturers.

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ECHION TECHNOLOGIES LTD	High Powered Anodes for Fast Charging Buses	£859,812	£601,868
University of Cambridge		£343,261	£343,261
VANTAGE POWER LIMITED		£182,538	£82,142

Project description - provided by applicants
The University of Cambridge, battery start-up Echion Technologies, and electric bus powertrain supplier Vantage Power are partnering to turn a disruptive battery technology that was demonstrated at the lab scale into a commercial product enabling long-range electric buses which can be recharged 5 times faster than the current state of the art. The automotive industry is about to undergo a profound disruption with the advent of mass-market electric transportation. As the benefits of electrified transport progressively outweigh internal combustion engine due to the environmental, social, political and eventual economic improvements. Industry experts agree that the majority of the UK's automotive fleet will be electrified to some extent by 2035\. To embrace that revolution and remain a global leader in vehicle manufacturing, the UK's automotive supply chain will need to develop large scale lithium ion batteries (LIB) production capabilities, as the battery system capture up to 50% of the added value of electric cars, and are impractical to import in large quantities due to inherent shipping safety restrictions. This project brings together young, highly innovative, UK companies and one of the country's oldest institution together to industrialise a unique battery technology. These developments contribute to creating a favourable ecosystem for battery manufacturing in the UK, which will ultimately attract foreign capital to invest in UK jobs and form the backbone of a strong UK automotive industry for the 21st century. This innovation relies on a novel material enabling significant improvements to a key battery component. LIBs store and release electricity by means of chemical reactions of lithium ions within electrodes -- the positive and negative terminals seen on everyday batteries. Our invention replaces the standard negative electrode material, graphite, with a unique nanomaterial that can store 3 times more lithium ions for a given mass, at a 5-times faster rate, without safety concerns or long-term battery degradation. This material can be produced cheaply in industrial quantities, and drops in as a one to one replacement to graphite in the battery manufacturing process. The goal of this project is to manufacture vehicle-ready LIB cells and a demonstration module using the innovative anode technology, which will be extensively tested in a relevant environment to quantify their performances and safety prior to vehicle integration. It is a significant step towards bringing that disruptive technology to the market and will serve as a flagship for the UK ability to produce world-leading battery technologies.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
PERKINS ENGINES COMPANY LIMITED	BATMAN - BAttery Thermal MANagement and Diagnostics for Heavy Duty Applications	£897,075	£448,538
AVID TECHNOLOGY LIMITED		£1,200,833	£840,583
Imperial College London		£715,319	£715,319
Project description - provided by applicants			
Perkins Engines Company, AVID Technology and Imperial have joined together to develop a new battery storage system. This will significantly improve battery life through advanced controls and monitoring and thermal management. The consortium will implement this technology breakthrough in a Caterpillar wheel loader. Utilising sophisticated simulation techniques the team will also demonstrate that integrated powertrain systems utilising battery storage can be commercially viable for Electric and Hybrid vehicles in the commercial on-highway as well as off-highway sectors.			

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JOHNSON MATTHEY PLC	CALIBRE - Custom Automotive Lithium Ion Battery REcycling	£991,355	£495,678
AUTOCRAFT DRIVETRAIN SOLUTIONS LIMITED		£451,440	£270,864
AXION RECYCLING LTD.		£541,192	£324,715
BENCHMARK MINERAL INTELLIGENCE LIMITED		£250,127	£175,089
NISSAN MOTOR MANUFACTURING (UK) LIMITED		£55,021	£27,511
University of Warwick		£926,223	£926,223

Project description - provided by applicants
As the number of electric vehicles on the road increases so does the number of lithium-ion batteries in use. At the end of life these batteries must be safely disposed of, which currently involves shipping them to Europe for recycling. Most current battery recycling focusses on recovering the cobalt in batteries, as cobalt is a relatively expensive metal that can be resold easily. Establishing a recycling supply chain within the UK would lower the cost of recycling, create jobs and wealth within the UK. This project brings together Johnson Matthey, Axion, Nissan, Benchmark Minerals, Autocraft Drivetrain Solutions and the University of Warwick to demonstrate a UK based recycling supply chain. Our aim is to extract maximum value from battery packs at their end of life so that the materials within can be repurposed. Not only will this result in less waste, it will also decrease the requirement for materials supplied from abroad.

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
FARADION LIMITED	Sodium-ion batteries for automotive power applications	£822,361	£575,653
CRODA LIMITED		£181,650	£90,825
JAGUAR LAND ROVER LIMITED		£265,090	£132,545
TALGA TECHNOLOGIES LIMITED		£187,297	£131,108
University of Warwick		£576,092	£576,092

Project description - provided by applicants

The projects aims are to develop and demonstrate low cost 12V batteries for electrified vehicles. These batteries are used for lighting, security, control of the traction battery management system and other critical features. Generally, in electrified vehicles, these batteries use lead acid technology on account of their low cost and specialised requirements. The consortium is seeking to replace these batteries with lower weight and lower volume batteries of comparable cost and performance based on sodium-ion chemistry, a technology which uses more sustainable and lower cost materials than lithium-ion technology but is otherwise very comparable. The consortium members include Jaguar Land Rover the automotive supplier, Croda the specialty chemicals company who will be developing electrolyte additives, Talga Technologies who will be focussing on natural carbon anodes, Faradion Ltd the developer of sodium-ion batteries and Warwick University home to the Warwick Manufacturing Group and the centre for battery pilot plant manufacturing in the UK..

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
TALGA TECHNOLOGIES LIMITED	Supply Chain Accelerator for Li-ion Electrode materials in UK (SCALE-Up)	£497,911	£348,538
PV3 TECHNOLOGIES LTD		£391,945	£274,362
University of Warwick		£333,524	£333,524

Project description - provided by applicants
With the increase in electric vehicles and the slow fade out of combustion engines. There is an ever-increasing demand for energy storage devices for the automotive industry. To answer this critical need, and create value for the UK we must develop the supply chain for materials to cell to module to pack. Ensuring the supply of good quality anode and cathode materials for cell production and establishing a more connected supply chain to support the future for the UK in this sector. This project aims to solve one of the key issues of the supply chain for battery manufacture in the UK; material supply. Material manufacturing is essential if we are to maximise the research and development outputs from the UK research base, and commercialise new battery technologies. As part of this project we will seek to establish a supply chain and route to market for existing and novel battery materials. PV3 and Talga technologies will scale-up an economical and cost effect manufacturing processes for high energy density cathode and anode materials respectively. This will create a novel cell chemistry based upon improvements of a known anode and cathode (graphite and NMC). Scale-up of the materials manufacturing will enable the scale-up of a high energy lithium ion battery, and will lead to further advancement in knowledge for materials manufacture and cell manufacture. Battery materials are at the forefront of the battery supply chain, and currently the UK manufacturing base is limited. The quality and control of these materials is essential for consistency of electrodes and inherently the good performance of a lithium ion battery. Ensuring a good quality material supply, with a good heritage, will support the move to manufacturing batteries in the UK. This project will look to demonstrate the UK's potential capability in this field, ultimately assisting to advance the UK's competitive position in battery cell technologies and production, and importantly, the transition to a low-carbon economy.

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OXIS ENERGY LIMITED	Lithium Sulfur: Future Automotive Battery (LiS:FAB)	£4,607,454	£2,764,472
CEETAK LIMITED		£500,576	£300,346
Cranfield University		£838,280	£838,280
University College London		£546,026	£546,026
WILLIAM BLYTHE LIMITED		£247,980	£123,990
WILLIAMS ADVANCED ENGINEERING		£125,723	£75,434

Project description - provided by applicants
The Lithium Sulfur: Future Automotive Battery (LiS:FAB) project will develop a next generation cell and module that is suitable for large electric vehicles such as trucks and buses. It will deliver a 400 Wh/kg Li-S cell that has the significantly improved power and cycle life required by large automotive applications. This cell will allow buses and trucks to carry significantly more payload and due to the abundant cell construction materials, cost less. The module cell and module state of health and charge (SoH & SoC) will be improved, along with the manufacturability. The project is split into 4 work packages: _Cell Performance_ By building on past projects that increased cell specific energy (Wh/kg), further improvements will be made to cycle life, power and cell design to meet the performance and safety needs of EVs. OXIS, UCL and William Blythe will utilise new materials to improve performance and characterise electrodes and cells using X-ray tomography and other techniques to accelerate development. WAE will advise on cell design. _Cell Characterisation_ Extensive testing of cells will be carried out to inform development. This will include rigorous safety tests, rapid test protocols/formation studies, degradation/abuse analysis. Software tools will also be further developed from the REVB project to allow analysis of large amounts of test data. _Cell Manufacturability_ BPE will lead the design of a pilot facility for the cells that are developed on this project. OXIS and Ceetak will develop critical pouch cell sealing technology required to make a robust automotive cell. OXIS and UCL will develop a novel, non-invasive X-Ray quality control process for cells. _Module Development_ OXIS and Cranfield will build on the control algorithms developed on the earlier REVB project to better predict SoC and SoH and to create intelligent charging algorithms to improve lifetime. Cell matching and module construction techniques will be investigated and a final module will be demonstrated. The LiS:FAB project will deliver multiple improvements for EVs and the technology developed will be applicable to wider markets such as aerospace, space and energy storage.

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SIGMA LITHIUM LIMITED	Development of 3D porous Lithium electrode for new generation electric vehicle batteries	£432,574	£302,802
AGM BATTERIES LIMITED		£88,813	£62,169
JLS DESIGNS LIMITED		£259,300	£181,510
Project description - provided by applicants			
Sigma Lithium proposes a proprietary patented method of forming porous 3D metallic lithium electrodes for applications in lithium-based batteries. This metallic lithium electrode technology will enable the creation of a new generation of batteries, with higher energy density, longer cycle counts, and improved efficiency in high-power applications. Our technology will bring about a step change in the performance of electric vehicles.			

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AGM BATTERIES LIMITED	UK Niche Vehicle Battery Cell Supply Chain	£2,126,756	£1,488,729
CENTRE FOR PROCESS INNOVATION LIMITED		£348,656	£348,656
DELTA MOTORSPORT LIMITED		£226,304	£158,413
Lancaster University		£436,299	£436,299
TVS SUPPLY CHAIN SOLUTIONS LIMITED		£204,220	£102,110
University of Warwick		£359,339	£359,339
WILLIAM BLYTHE LIMITED		£509,729	£254,865
WILLIAMS ADVANCED ENGINEERING LIMITED		£126,803	£76,082

Project description - provided by applicants
The UK Niche Vehicle Battery Cell Supply Chain project brings together niche vehicle manufacturers and Tier1 developers and suppliers with the UKs only Li-ion cell manufacturer, a UK materials manufacturer, an automotive supply chain specialist and three prominent Research and Technology Organisations. It addresses a problem that affects many developers and manufacturers of specialist products that rely on batteries. Although Li-ion technology was invented in the UK, it was the Japanese technology giant Sony that commercialised and brought the first Li-ion products to market. The UK is very strong on battery technology research. This project aims to bridge the gap between research and product and to bring battery cell manufacture to the UK. We're doing this in a very focused way, where we can support one of the UKs strong existing manufacturing sectors, niche vehicles, helping it to thrive in the new world of vehicle electrification. The volume of cells required by this industry are manageable by global production standards and play to the UKs strengths of high performance, quality and customisation. This is the first step to creating a significant UK industry.

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DELTA MOTORSPORT LIMITED	AMPLiFII-2	£2,690,083	£1,883,058
ALEXANDER DENNIS LIMITED		£497,992	£248,996
ARIEL LTD		£876,124	£613,287
J.C.B. SERVICE		£644,612	£322,306
JAGUAR LAND ROVER AUTOMOTIVE PLC		£1,803,589	£901,795
POTENZA TECHNOLOGY LIMITED		£733,794	£513,656
TRACKWISE DESIGNS LIMITED		£603,257	£422,280
University of Warwick		£2,844,400	£2,844,400

Project description - provided by applicants

AMPLiFII 2 is aimed to take the results of the successfully delivered Amplifii project (in the form of a modular, scalable, flexible battery architecture for deployment on low to medium volume vehicle platforms) and accelerate their integration into vehicle products for JLR, JCB, Ariel and ADL. It will take the manufacturing technology developed during Amplifii and adapt it for implementation by the partners. Further, it will develop additional functionality for the AMPLiFII battery system, including 800V high power charging and discharge, location based BMS control, advanced and highly robust cooling, distributed BMS, use of new 21700 cell format, and cost-down measures. The project will result in four fully developed management demonstrator vehicles, a pilot production facility at Delta Motorsport, and a production ready BMS system by Potenza and Trackwise.

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