



Innovate UK

Investing in Clean Technologies

Directory of Projects

June 2019

Innovate UK is part of
UK Research and Innovation



Introduction


As Plato said: Necessity is the mother of invention, and in our modern day we can now say the same of Innovation, and its other parent, Opportunity.

It is only by questioning the way we do things now that we have any chance of improving them going forward and taking the huge global opportunities of the fourth industrial revolution. Raw science and technology of course play key roles, but it is only by investing in them and also adopting truly innovative and courageous thinking that we can prepare ourselves for the exciting opportunities that new businesses are evolving to take.

For example, we know that one of the greatest challenges we face is to make our use and reuse of plastic more 'circular'. This is because we now understand the impact that plastic pollution is having on our environment.

Innovate UK is therefore supporting risky early-stage ventures and business innovation that have high-growth potential and can develop and use new materials to enable novel products to be offered to all sectors, providing differentiation and competitiveness for the UK.

The vision of our team is to support forward-thinking UK companies in scaling and growing by developing the technologies that will address long-term challenges such as population growth and threats to the environment, whilst increasing productivity.



Innovate UK fundamentally offers support in two distinct ways: Firstly we connect businesses to opportunities, customers and/or partners, internationally and nationally; with relationships developed with partner organisations in Asia, Europe and North & South America.

Secondly, we fund the most innovative businesses developing solutions for the present and future challenges the UK's society and economy faces.

Innovate UK's commitment to advanced materials has been significant. We have contributed over £80 million in innovative projects in the fields of advanced materials and helped at least 235 companies develop innovative materials.

We wish all the Innovate UK supported companies that are detailed in this publication, and the consortium partnerships behind them, every success in commercialising their products and growing their businesses. Onwards and upwards!

Simon Edmonds

*Deputy Executive Chair and Chief Business Officer,
and Director - Manufacturing, Materials & Mobility*

Innovate UK

High Efficiency Precious Metals Recovery from E-waste

101899, Supply chain innovation towards circular economy, 1/2/15 to 31/7/18, £921,945

Tetronics (International) Limited
Vale Europe Limited
Metech Recycling (UK) Ltd

Electronic waste is a rapidly growing market. The prevalent practice is to collect and concentrate valuable fractions of e-waste and ship them overseas for recovery. This leaves the collectors at the mercy of smelter and refinery terms and they only receive a fraction of the true value. The project delivered plasma-based technology to facilitate disruption of this, as a foundation for indigenous e-waste processing as part of a circular (waste to product) economy business model.

Market opportunity

The efficient recovery of copper, gold, silver and palladium from e-waste will allow the UK to minimise its reliance on imported critical raw material. Around half the 1,700,000 tonnes of e-waste, generated annually in the UK, is collected currently with further regulatory-driven growth expected. This suggests the UK could support 3 to 6 plasma recovery plants with annual revenues of >£300 million, disrupting large incumbents and creating a sustainable UK-based industry, with similar international circumstances.

Innovation

The objective of the project was to demonstrate an innovative integrated plasma smelting-based approach to the processing of printed circuit boards in locally-based dedicated facilities rather than in generic large centralised plants. Challenges overcome included highly variable waste streams, sampling and valuing, environmental compliance and financial management whilst demonstrating market-leading precious metal recovery efficiencies. This gave an anticipated RoI of >300% over ten years on a total project investment business model basis.

Exploitation Route

Tetronics is a global leader in the supply of equipment for the recovery of precious metals from secondary sources at a local scale. Following this demonstration of a technically successful and economically attractive e-waste treatment solution at a similar scale, backed up by with targeted promotion and marketing, Tetronics has received many expressions of interest for similar technology designed for precious metal recovery from e-waste. It is in advanced discussions with domestic and international parties.

Outcomes and Next Steps

The project confirmed the technoeconomic viability of integrated plants for processing volumes of printed circuit boards available at a local or regional, rather than international, scale. The anticipated RoI will be further supported by market growth boosted by regulation, industrial demand and commodity prices. It is anticipated that with sustained promotion and marketing Tetronics' plasma technology will have a role to play in addressing the growing epidemic of e-waste to the benefit of all involved.

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Recovery and processing of high value food and pharmaceutical ingredients from waste eggshells

102402, Recovering valuable materials from waste, 1/07/2016 to 31/03/2018, £799,607

Avgo Biotech
Chrysalis Health and Beauty
Nottingham Trent University

Avgo Biotech believe that valuable resources are being wasted through unimaginative disposal of food co-products. Following on from smaller projects with NTU, Avgo are scaling up the extraction of pharmaceutical grade calcium carbonate from egg shell waste, while retaining other high value materials for other novel applications. Avgo believe ALL components of eggshells have a value and a use.

Market Opportunity

In Europe the Pharmaceutical industry uses over 100k tonnes of calcium carbonate a year – of this 20%, worth over £40m is rejected due to contamination with toxic heavy metals. This industry is starting to become more aware of sustainability and social responsibility. Over 250k tonnes of eggshell are wasted annually in Europe - predominantly being sent to land fill. This provides a valuable resource to meet both of these requirements.

Innovation

Avgo Biotech have taken a novel approach to meet and address this problem. Using the RECEGG process, we are not only able to generate pharmaceutical grade calcium carbonate but also additional high value materials – eggshell membrane for novel approaches to improve wound care and small organic molecules for conversion into much needed organic building blocks for the polymer industry.

Exploitation Route

This project has shown that we are able to produce materials at a level of 250-300kg/day. The next step is to scale up to a validation level of 1 plus tonnes a day. We plan to utilize European funding, ideally through the SME instrument and match with equity funding to support this. Market engagement has provided us with a potential customer base – in pharmaceuticals and medical devices. These customers will ultimately be addressed through licensing with a chemical manufacture. Revenues are expected in 2021.

Outcomes and Next Steps

Avgo have developed a process which utilizes all the components and co-products of the conversion to pharmaceutical grade calcium carbonate. We have developed an interest in this material from the industry and with scale up will bring this to market in 2021. Additional co-products will be exploited in novel ways, with additional outside partners, as part of an ongoing R & D plan.

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WATER: Water Accelerated Technology for En-Tyre Recycling

102405, Recovering valuable materials from waste, 1/8/17 to 31/3/19, £728,974

Eastern Waste Disposal Limited
High Speed Sustainable Manufacturing Institution (HSSMI)
Imperial College London
Burgess Consulting Limited
In-Cycle Ltd

Currently, the amount of recycled material in car tyres is minimal (<5%) due to technical limitations associated with re-bonding tyre rubber. The WATER project aims to address this by producing an improved recycled granulate, produced by high pressure water jets instead of conventional mechanical systems. Since winning an Innovate UK grant in 2016, this has successfully been achieved, with a fully operational demonstrator and substantial scientific evidence of a superior product being produced at an economically successful quantity.

Market Opportunity

There is significant market opportunity for the WATER project. WATER-produced rubber crumb produces recycled rubber that's 26% stronger than the commercial alternative, allowing the high performance rubber market to be penetrated in places it wasn't before, such as in tyres. There is significant demand: globally, over 1 billion tyres are produced and disposed of each year. Additionally, the steel wire incorporated within the tyre can be selectively and cleanly removed from the tyre rubber with water jets, allowing additional income generation.

Innovation

The WATER project is an innovative venture due to:

- Using UHPW to granulate tyres instead of mechanical means for tyre recycling
- The superior qualities of the product produced, and how these can be used to create recycled rubber products with enhanced physical properties
- The models produced to optimise the process further and understand the scientific interaction between the fluid and the rubber surface.

Exploitation Route

The next steps for exploitation are:

- Disseminate the information we gained on the project at events to interested parties
- Achieve further grant funding and/or partners to take the project further and commercialise it
- Convert the process from a batch stage to a continuous process
- Further research on the material to produce prototype rubber products
- Optimise to a fully commercialised system

Outcomes and Next Steps

Outcomes

- Operational experimental demonstrator producing high quality rubber crumbs
- Demonstrate higher quality of WATER-produced crumbs compared to crumbs produced mechanically

Next steps

- Meet interested parties at events and gather new consortium of interested members
- Proceed with design, optimisation and production of continuous machine process
- Produce a range of high-value recycled rubber products from WATER-crumbs and showcase these
- Form partnerships with the tyre production industry to incorporate WATER-crumbs in their products

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Materials and cell scale-up for sodium-ion technology for residential energy storage

102780, Materials and Manufacturing R1 - 12-24 Month Projects, 1/8/17 to 31/7/19, £1,148,106

Faradion Ltd
University College London
AceOn Battery Solar Technology Ltd

Energy storage is one of BEIS's top priority areas for development, with the potential to massively cut the cost of decarbonising the electricity supply. The challenge for residential energy storage systems is in providing safe, low-cost, long-life energy storage which can be coupled with renewable energy sources or 'economy' tariffs. This project proposes a scale-up of rechargeable sodium-ion battery technology. Sodium-ion batteries are analogous in many ways to the lithium-ion batteries that are in common use today;

Market Opportunity

The use of cheaper and more abundant sodium in place of lithium addresses concerns of cost and sustainability of lithium ion. The surrounding sodium ion technology will be scaled up from single cells of a few Ah to 250Wh modules suitable for 4kWh residential energy storage at lower cost than current offerings. Sodium ion opens up the possibility of significant technology exploitation for all the commercial partners from intellectual property, materials manufacture, cell manufacture and battery assembly and distribution.

Innovation

AceOn Group are innovators of portable energy storage systems www.solarsds.com and see the opportunity of using sodium-ion batteries for Energy Storage Systems (ESS). These cells offer a wide-temperature range and are ideal for this market thanks to their high energy density — both by mass and volume — combined with safety and cost advantages.

With issues around shipping lithium batteries worldwide, the sodium-ion cells can be fully shorted (zero volts) which means that they can be utilised in remote locations and applications, including offshore, where transporting batteries is restricted or hazardous, for example by helicopter.

Exploitation Route

AceOn Group are establishing themselves as a leader for battery assembly in Europe and we are in the process of creating a UK service centre for ESS whereby installers can be trained and provided the technical support to install renewable energy solutions.

Outcomes and Next Steps

AceOn would like to work with Faradion as a key battery pack assembler using the sodium-ion cells in many applications for medical, military, security, industrial and energy storage markets. Our portable SolarSDS generator will look to be powered by sodium-ion to meet the demand for portable energy.

Mark Thompson

AceOn Group

Further Information: <https://gtr.ukri.org/projects?ref=102780>

Natural Fibre Reinforced Thermoplastics for Injection Moulding (NAT-IM)

102784, Materials and Manufacturing R1 - 13-24 Month Projects, 1/5/17 to 30/4/19, £778,884

Coventive Composites Biocomposites Centre (Bangor University) Orangebox Limited

Coventive had established the technical viability of long-fibre thermoplastic (LFT) materials using natural fibres, made from commingled yarns. These were not commercially competitive with the incumbent materials, glass-fibre LFTs. Nat-IM sought to develop and implement a process for the impregnation and pultrusion of discontinuous plant fibres, thereby facilitating cost-competitiveness with, and a sustainable alternative to, glass-fibre LFTs.

Market Opportunity

In Europe, around 150,000 tonnes of glass-mat thermoplastics and LFTs were produced in 2018; market projections vary but are uniformly positive, with the forecast for automotive semi-structural composite mouldings in the range 180,000 - 300,000 tonnes/year by 2020. Of this, up to 90,000 tonnes/year (30%) will be directly addressable by the proposed natural-fibre LFT materials, with a value of £270 million. Through Orangebox, we will also target the furniture market and look at new opportunities in the domestic-goods sector too.

Innovation

The innovation in this project is the development of a pultrusion process that is capable of handling discontinuous fibres, and the substitution of a non-sustainable material for a sustainable one. Conventional pultrusion relies upon the use of strong, continuous fibres, that are combined with a polymer and pulled through a forming die. By pultruding directly from low-cost, discontinuous fibre 'sliver' and bulk polymer granules in a novel process, we can reduce the number of material conversion stages, significantly reducing costs.

Exploitation Route

Coventive will sell the materials through Composites Evolution and its global network of distributors; we will also license the technology to third parties, where appropriate. A patent would provide a high degree of reassurance to any potential licensee in respect of their market protection and freedom to operate, therefore Coventive will seek to patent the novel pultrusion process if it is viable to do so. Value arises from the potential for lower weight parts (and the associated reduction in CO2 emissions); reduced environmental impact; and improved processability due to lower fibre brittleness and easier handling - at acceptable cost levels.

Outcomes and Next Steps

The project has successfully proved the process and the materials have been verified in an industrial context. Moulders can use the materials in their existing machines, without modifications being required. Cost targets and material properties have been met, and scale-up can be achieved by replicating parts of the process in modular fashion. Material supply chains have been established, and further development of the materials, through commercial activity and collaborative research, is already taking place.

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Next generation, low cost aluminium matrix composite inserts for the emerging global market

102798, Materials and Manufacturing R1 - 25-36 Month Projects, 1/3/17 to 31/8/19, £1,382,271

Alvant Ltd M. Wright & Sons Limited

We are in the growth stages of a new age, one that is characterised not only by the Internet of Things but also, importantly, by new materials that are sustainable and enhance the capabilities of products. Alvant's material technology satisfies this market demand but for certain applications there is a need to standardise the application of Aluminium Matrix Composites ("AMC") and reduce the cost. This 'Next generation, low cost aluminium matrix composite inserts for the emerging global market' project intends to address this challenge.

Market Opportunity

Alvant estimates that the size of the addressable market is ~£1bn globally targeting high-value products and components that value lightweight high-strength metallic solutions. Target markets include: aerospace, automotive, high-end consumer electronics, sporting equipment, industrial, energy and personal mobility (able and disable bodied).

Innovation

Alvant's core innovation is around a patented process called Advanced Liquid Pressure Forming which allows the company to produce a variety of AMCs for different applications. It is a unique process that brings together aluminium with a secondary high-performance material to create a variety of aluminium composites.

Exploitation Route

Alvant operates a two-stage process to support customers in applying its materials to their products and bringing them to market. An Innovation phase acts as a knowledge transfer mechanism supporting customers with their early technology and prototype demonstrators whilst generating revenue for the business. This Innovation phase is a pre-cursor to the Productionisation phase which can either be an Alvant manufactured output or a design / manufacture licence.

Outcomes and Next Steps

To date Alvant has had active projects with aerospace, automotive and industrial customers generating c.£1m turnover, securing trademarks on its material families and applying for two additional patents over and above Alvant's Advanced Liquid Pressure Forming process. The next step is to continue the development of the following product-focused applications and secure additional funding to accelerate time to market and increase sales:

- High strength lightweight linkages and struts for aerospace and defence
- Lightweight electric motor rotors for the transport sector
- High performance low inertia rotary structures for the industrial, energy and construction

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LaserCure

103545, Materials and Manufacturing R1 - 13-24 Month Projects - ISCF, 1/9/17 to 30/6/19, £1,605,548

LIGNIA Wood Company Limited
Millenium Laser Systems
Bangor University
Coventry University

The project involves using lasers to improve the permeability of wood to facilitate resin impregnation and modification, thus enabling a greater range of sustainably grown timber species to be modified efficiently and cost-effectively. Improving permeability of wood whilst minimising mechanical and visual damage offers the wider timber processing industries benefits over existing mechanical incising techniques.

Market Opportunity

Demand for sustainable forest products that sequester carbon over their service lives is recognised as a tool to combat climate change. Resin modification can greatly improve properties of sustainably grown timbers giving them properties of tropical hardwoods that are highly valued but overexploited due to their desirable properties. Our target is a 25% share of the value of the EU sawn tropical hardwood market valued at 750 million Euros annually.

Innovation

Based on optimising laser incision and targeting incision patterns the project improves the permeability of otherwise impermeable timber species enabling their use in a wide range of applications. The study has tailored incising patterns to improve impregnation and drying whilst reducing the reduction in mechanical strength associated with other mechanical incising techniques on the market.

Exploitation Route

Further development and upscaling of pilot scale laser incising plant to enable a wider range of timber species and dimensions to be exploited in LIGNIA's existing commercial modification process. Demonstration of pilot to wider timber industry for potential transfer of technology to others requiring movement of fluids in and out of timbers. IP protection through patenting/licencing of technology relating to incision patterns optimum for processing.

Outcomes and Next Steps

The technology has been shown capable of producing incisions of required dimensions, depths and patterns in impermeable species enabling these to be impregnated using fluids and subsequently dried at a greater rate. The upscaling of pilot laser incision system is required for longer and thicker species across a wide range of product types. The rapid lowering of wood moisture content combined with small incision widths suggests a far more significant benefit across the wider timber industry than originally envisaged.

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Sweet Perspex

103761, Materials & Manufacturing R2 - 25-36 Month Projects, 1/1/18 to 31/12/20, £1,524,544

Ingenza Ltd
Lucite International
University of Nottingham

This project aims to deliver an innovative bioprocess to manufacture a key methacrylate monomer required for the bio-based production of acrylic glass from renewable feedstocks.

Market Opportunity

Lucite currently have an approximate 30% share of the global market for the petrochemical production of acrylic glass which equates to 1000 ktonne per annum and ~\$2Bn USD revenue. They aim to be the first to market to implement an alternative sustainable bio-based manufacturing route to methacrylate products to meet growing customer demands for renewable materials with a lower carbon footprint and greater sustainability profile.

Innovation

This approach aims to introduce a disruptive biotechnological process that would offer a cost competitive alternative to existing petrochemical manufacturing routes. Recent scientific advances in synthetic biology and metabolic engineering have facilitated the development of an innovative fermentation process to produce a highly active and chemically robust biocatalyst that will be deployed at industrial scale.

Exploitation Route

Lucite will be the end user of this new technology and already possess the commercial insight and business knowledge required to manufacture methacrylates. They will provide a seamless route to market with the customer supply chain already in place.

Outcomes and Next Steps

The delivery of this new bio-based process will bring a number of benefits and outcomes including: generating valuable IP that delivers maximum return for stakeholders; expanding the projected UK bioeconomy market to £58bn by 2030 (13% increase); reducing the environmental impact of GHG emissions by up to 80%; creating new employment opportunities and promoting the UK as a major player in successful industrial biotechnology development.

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Aircraft Window Advanced Refurbishment Machine (WARM)

103765, Materials & Manufacturing R2 - 3-12 Month Projects, 1/7/17 to 30/4/18, £96,883

Bryant Symons Technologies Limited

The project outline was to design, develop and prototype a machine capable of refurbishing aircraft cabin windows. Our brief was heavily influenced by the desire in the aviation industry to drastically reduce waste and carbon emissions. Cabin windows are currently a consumable that is sent to landfill after use. Over several years, we developed the necessary technologies and successfully incorporated these into a prototype, which we were able to use to prove the technology.

Market Opportunity

The rationale behind the project is to fill a gap in the market that others had either not fully developed or ignored, mainly due to the comparatively low cost of the cabin window (\$320) compared to the engines (\$4 million). Whilst we have some competitors, none can match our throughput capability and cost. This has allowed us to make a non-desirable item into a potentially significant cost saving whilst also being more environmentally friendly.

Innovation

The project relied heavily on the innovation of new technologies and techniques to allow the machine to be more efficient and reliable. This has allowed our machine to produce a clearer finish faster, whilst also increasing the lifespan of the components. The use of innovative materials in its basic construction and new techniques in the design has been particularly crucial to the overall success of the project and the desirability of the finished product.

Exploitation Route

Following feedback from potential customers we have decided to initially focus on setting up an approved refurbishment facility to immediately exploit the opening in the market. Following on from this we would look to produce more machines and open more facilities (potentially in collaboration) in key markets around the world. In addition to this we are currently exploring the possibilities of using the technology in the production of new cabin windows with current manufacturers.

Outcomes and Next Steps

Following on from the success of the project we would look to repurpose some of the technologies developed into new industries. The first step would require us to identify a suitable candidate, something that we have already done; the second step would be to design the projects parameters and goals, including any potential collaboration and whether it would be suitable for grant funding.

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Further Information: <https://gtr.ukri.org/projects?ref=103765>

Feasibility Study of Biodiesel Production at Heterogeneous Catalysts

103771, Materials & Manufacturing R2 - 3-12 Month Projects, 1/6/17 to 31/3/18, £99,999

Green Fuels Research Ltd University of St Andrews

The project aimed to address technological, commercial and environmental challenges in the production of biodiesel. The chemical reaction in biodiesel production commonly uses a homogeneous catalyst. While this compound is widely used in the biofuel industry, it presents drawbacks due to its solvency in biodiesel: the final product needs to be purified and the catalyst needs to be constantly renewed, resulting in increased production costs. A heterogeneous catalyst, which does not dissolve during the process, addresses these problems: the purification step is avoided and the catalyst can be re-used.

Market Opportunity

This project addresses the biodiesel industry, which worldwide produces some 150 billion litres of fuel annually. A large fraction of this is produced using homogeneous catalysis. The biodiesel industry is growing strongly as a result of increasing mandates for blending in many parts of the world. We identified six target markets in which biodiesel supply and demand is increasing or is likely to increase in the future: the EU, the USA, Brazil, India, South Africa and South-East Asia.

Innovation

Two heterogeneous catalysts with a high scientific and commercial potential were highlighted during our research. They both displayed high conversion rates, enabled biodiesel to reach the EN and ASTM standards, and cost less than homogeneous catalysts. These results are promising, especially for a feasibility study which consisted of early-stage research: we believe further work based on the results of this project will allow us to reach our initial goals.

Exploitation Route

We will scale-up and commercialize this new catalyst by integrating it to the current design of the biodiesel plants manufactured by Green Fuels Ltd., GFR's sister company. We aim at upgrading current customers' equipment, as well as reaching new customers, who will have the opportunity to produce higher amounts of biodiesel (broader range of feedstocks) and increase margins.

Outcomes and Next Steps

Results from this feasibility study were promising. The technology is being developed further.

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Carapace Slate Modular Roofing System (CASMOS)

103773, Materials & Manufacturing R2 - 3-12 Month Projects, 1/1/18 to 31/12/18, £190,281

SunScape Systems Ltd Swansea University

High volume manufacture relies on repeatability and efficiency. Despite successfully being able to produce Carapace Slate at low volume, SunScape sought the support from Innovate UK to collaborate with Swansea University to refine and optimise its current material formulations and processes to produce low cost, high quality Carapace slate roof tiles in a scaled manufacturing process.

Market Opportunity

UK construction is in a continued period of growth, largely stimulated by ongoing government policy to build an additional 300,000 houses per year beyond 2025. However, an ageing workforce plus cultural shifts that disfavour manual trades has led to a 7% labour deficit in the roofing industry. Both government and industry must now work together using building technique innovation and training incentivisation to revive and replenish the UK's construction workforce.

Innovation

Carapace Slate is a patent-protected, composite snap-fit slate roof tile system designed to deskill the roof installation process. Almost indistinguishable from the iconic and beautiful quarried Welsh Slate but it can be installed 90% quicker, thus increasing overall build speed and contributing to the growth of UK construction.

Exploitation Route

Custom material injection systems and samples were made by SunScape for Swansea University to analyse against current industry state of the art materials. The results formed critical foundations of a comprehensive analytical research report that examined the relationship between slate loading and part strength, slate particle size distribution, the addition of fillers, post-mix quality control measures, mix abrasion and rheology. Based on the materials development, SunScape was able to design and develop a low energy smart manufacturing solution far beyond the scope originally envisaged at the start of the project.

Outcomes and Next Steps

SunScape Systems is now working in collaboration with the Manufacturing Technology Centre to deliver a fully automated turnkey manufacturing solution enclosed in a shipping container - a factory in a box. The modular manufacturing solution will enable Carapace Slate to be manufactured at volume in a repeatable and scalable fashion. The new consortium has submitted an application with Innovate UK as part of their *Improving Productivity, Performance & Quality in UK Construction competition call*.

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Optimising materials and manufacture of an in-wheel suspension system

104045, Materials and Manufacturing Round 3 - 13-24 Months, 1/12/17 to 31/5/19, £342,590

Loopwheels (Jelly Products Ltd)
Strategic Simulation and Analysis Ltd
Composite Braiding Ltd

Reinventing the wheel: putting suspension inside the wheel is a much more energy efficient solution, absorbing shocks and reducing damaging vibration. We have developed a wheel with integral carbon composite suspension with applications within wheelchairs, bikes and the vital electric lightweight vehicles of the near future. It optimises carbon composite spring technology so the wheel is strong, lightweight and easy to manufacture.

Market Opportunity

There are billions of wheels in the world, from castor wheels to tractor wheels, and hospital trolleys to lightweight urban vehicles.... lowering vibration maintains the health of the vehicle and its cargo. Moreover, lowering the weight and minimising the unsprung mass leads to hyper-efficient transportation of people and goods with low energy consumption, low maintenance bills, and lower health bills. Many choked cities are searching for this type of solution now.

Innovation

Old patents show attempts at putting suspension inside a wheel for 150 years, because of the efficiency compared with an external system. There are just two companies globally who have successfully developed in-wheel suspension technology: ourselves and the Israeli company SoftWheel. Our design is innovative in its use of carbon composite materials to create leaf springs in a specific design that optimises performance. We have formal IPR.

Exploitation Route

Loopwheels are established as a manufacturer of wheelchair wheels, selling in the UK and export markets since 2015, because we're proven to reduce damaging vibration and pain for wheelchair users. We will co-develop solutions that allow us to put a motor and steering into the wheel for optimal efficiency. Further exploitation routes are the licence of IPR for application of the technology in other sectors. SSA is already benefiting from dissemination of its project developments.

Outcomes and Next Steps

The project has delivered a lightweight wheelchair wheel with reduced materials and higher performance than our current product range. We're currently doing final user testing before finalising the design for manufacture from September 2019. Initial customer reactions are hugely positive. Next steps are exploiting the technology for other non-wheelchair applications including electric lightweight vehicles for congested urban cities. We're seeking an exploitation partner and investment for this next stage.

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Further Information: <https://gtr.ukri.org/projects?ref=104045>

GenDrive: Gamification for consumer engagement in V2G services

104225, Innovation in Vehicle-to-Grid (V2G) Systems: Stream 2 Collaborative Research and Development, 1/7/18 to 31/12/19, £378,015

GenGame Ltd
Northern Powergrid (Northeast) Limited
Enappsys Ltd
Newcastle University
Ecotricity Group Limited

Lead Partner GenGame Ltd have developed a modular ‘white label’ smart energy mobile app for energy suppliers, that delivers consumer engagement and unlocks demand flexibility from ‘new energy’ technology such as smart meters, solar panels, domestic storage technologies and EV’s. This project brings together energy market data experts EnAppSys, Newcastle University power systems group and leading renewable energy supplier Ecotricity to develop the Vehicle to Grid (V2G) functionality of GenGame’s app and investigate novel ways to engage and incentivise EV drivers to offer V2G services.

Market Opportunity

For V2G technology to deliver on its potential requires significant consumer take-up and acceptance of this novel technology beyond early adopters. As EV ownership is beginning to shift from primarily technical/engineer types to those with no technical background, new ways are required to engage these consumers with less ‘technical’ messaging.

Innovation

‘GenDrive’ aims to exploit these trends by researching, developing and evaluating the effectiveness of a series of innovative consumer engagement methods. The mobile phone application blends user focused design, behavioural science and gamification to engage ULEV users, and drive behaviours we wish to encourage: Regularly/consistently plugging in a ULEV; allowing it to be discharged; sharing data around travel plans; using/not using Ecotricity’s highway chargers at certain times; others we may establish as part of our research.

Exploitation Route

Primary route to market for project outputs will be through GenGame who provide B to B to C services to energy suppliers and distribution companies. Project partners Ecotricity and Northern Powergrid acting as ‘friendly/pilot’ customers allow the V2G functionality of the product to be developed and tested, before offering it to GenGame’s wider customer base which includes suppliers Green Energy UK and Octopus Energy.

Outcomes and Next Steps

The first iteration of the app is currently available/being tested by Ecotricity EV customers, who responded extremely positively to the initial marketing campaign. Usability testing and feedback are being incorporated into 2 more iterations that will be tested as part of the project through to the end of 2019.

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Metal composite actuators for exposed high load damage tolerant landing gear

132317, Materials For Aggressive Environments, 1/11/16 to 30/4/18, £150,000

TISICS Limited

The Advanced Manufacturing Research Centre's Advanced Structural Testing Centre (University of Sheffield)

Aircraft landing-gear operate at exceptionally high loads on landing, operating at very high and low temperatures with aircraft and runway chemicals, and impact damage from runway debris. Metal matrix composites offer over 30% weight saving compared to conventional materials with better corrosion resistance. A 30% lighter landing-gear could deliver a 340 tonnes less CO₂/year per Airbus A320. TISICS aimed to design and build a hydraulic actuator piston and cylinder for test at the AMRC-AST facility.

Market Opportunity

The market opportunity for these components is around £10,000/actuator and two systems per plane. Airbus and Boeing make over 600 single aisles and over 200 twin aisle aircraft each per year. The technology is scalable to larger aircraft and beyond landing gear as well as other civil, military and non-aircraft uses. TISICS is the only producer of this technology world-wide creating a market opportunity of tens of millions of pounds in UK exports.

Innovation

The project built on an earlier Innovate UK programme and addressed the challenges of manufacturing a very near net shape titanium composite piston rod which had impacted the previous programme, the details of which are commercially sensitive. The project also aimed to produce a very large aluminium composite piston cylinder which had not been attempted before. The AMRC-AST had to develop test systems for both static and dynamic testing of the parts and system.

Exploitation Route

TISICS will continue to develop the manufacturing technology and optimise the design, working with AMRC-AST to prove the performance to the two major aircraft producers and their supply chain. These discussions are on-going. TISICS needs to build pilot production facilities to show the process can be scaled and then work with a UK supply chain to meet aircraft build quantities and economics. Initial production of actuators may be in lower risk areas and outside aerospace.

Outcomes and Next Steps

The net-shape manufacturing trials created new challenges. Some were due to the problems scaling from sub-scale tooling to full size tooling and the impact of defects in the processing. The aluminium system had issues especially with mould release. Therefore, the project produced parts but did not get as far as full system tests. TISICS is planning further research to address the new issues identified and will then test the new parts in collaboration with AMRC-AST.

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Commercialisation of MSW-derived sugars for the production of thermoset resins

132515, Materials and Manufacturing R1 - Under 12 Months, 1/3/17 to 31/5/18, £302,921

Fiberight Ltd Knauf Insulation Limited

The purpose of the project was to demonstrate and evaluate the use of waste-derived sugars in the manufacture of thermoset resins. Fiberight's residual waste recovery and recycling technology generates several sustainable materials including waste-derived sugars. Knauf currently use food-grade sugar in the production of thermoset resins for insulation products. The project successfully demonstrated the replacement of food-grade sugars with Fiberight's waste-derived sugars in commercial scale production trials.

Market Opportunity

Sugar is an essential raw material in industrial biotechnology applications; these processes use first-generation sugars produced from agricultural biomass such as sugar cane. These sugars are currently used in thermoset resins as a binding material for insulation products. The global thermoset resin market is estimated to be 10 million tpa with good growth potential. The European insulation market is estimated to be worth €11.5 billion, with strong market drivers including rising energy conservation standards and increased insulation usage.

Innovation

Fiberight has developed an innovative and game-changing technology for residual waste recovery and recycling, generating sustainable materials for manufacturing. The aim of the project was to demonstrate the use of waste-derived sugars in the manufacture of thermoset resins for insulation products. Fiberight is at the forefront of the production of waste-derived second-generation sugars globally. Knauf's objective was to evaluate the replacement of food-grade sugars with a more sustainable and secure supply of sugar. The project involved a commercial scale production trial with evaluation of both the processability of the Fiberight sugars and the resulting product.

Exploitation Route

Fiberight and Knauf Insulation continue to collaborate with the aim of developing a long-term off-take agreement for Fiberight to supply waste-derived sugars for thermoset resin production. This enables Fiberight to establish an end market for one of its key outputs, contributing to the improved commercial viability of the whole process. For Knauf the benefits of exploitation are in securing a cost-effective, sustainable supply of sugar that also enhances the environmental credentials of its product.

Outcomes and Next Steps

Following completion of this project Fiberight and Knauf have been awarded further funding from Innovate UK for a follow-on project to enable the sugar production and recovery process to be optimised and for further trials and evaluation to be conducted by Knauf. In addition, a new European-funded project will start later in 2019 involving both Fiberight and Knauf, plus other partners, to enable a demonstration facility to be established in the UK for production and further valorisation of waste-derived sugars. This will enable a new value chain to be established for a range of outputs from Fiberight's innovative waste recovery and recycling process.

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Further Information: <https://gtr.ukri.org/projects?ref=132515>

Energy Efficient Far Infrared Radiant Heating Panels

132892, Development and Application of Advanced Coatings - ISCF, 1/9/17 to 28/2/19, £221,057

2DHeat Limited

2DHeat manufacture novel permanently-bonded thick film spray-on ohmic heating elements in a multitude of configurations that are physically robust, radiation tolerant, energy efficient, thermally uniform with fast heat-up rates. Applications include aerospace, automotive, white and brown goods, medical, chemical and manufacturing industries. 2DHeat is now also focusing on the manufacture of far infrared radiant heater panelling, the most cost effective method of heating personnel and surfaces in housing, offices, factories and large open-air spaces.

Market Opportunity

Improved energy efficiency targets, requirements and tighter regulations together with the 2025 ban on gas boilers in new homes are opening the market to alternative heating technologies. We see 2DHeat energy efficient far infrared radiant heater panels as the best solution in terms of cost, maintenance, reliability, flexibility of use and user friendliness. 2DHeat technology also far exceeds existing infrared technologies across the board.

Innovation

2DHeat are multiple patent owners of a host of novel thick film heating element technologies. With particular reference to the far infrared heating panel market, 2DHeat panels are thinner, lighter, heat up five times faster, run at higher more energy efficient temperatures, have much higher power outputs, are self-regulating and can run from low voltage dc sources including batteries and photovoltaic solar panels making them highly suitable for both portable and remote location applications.

Exploitation Route

We have agreements in principle with (i) an established NW based developer/modular house builder; (ii) a Dow 250 supplier of architectural panels, who is also interested in licensing production expansion of the heater panels at an appropriate stage; and (iii) a Footsie 250 building supply merchant to distribute our products. Details will be provided under appropriate disclosure arrangements. The builder considers our heating panels to be the most elegant & versatile for an all-electric solution.

Outcomes and Next Steps

2Dheat has successfully completed an InnovateUK project taking our 'at-scale' infrared heating panels to pre-production prototypes. Energy efficiency tests have been run in the Building Research Establishment houses at JMLU. Further tests using 'client specification' panels are scheduled in modular build houses (well-known NW based company). Production scale-up with identified partners awaits grant funding, as does ongoing dialogue with trade distribution partner. Discussions with social housing sector commencing imminently.

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Development of Innovate Extrudable Poly-ceramic Composite

133252, Materials and Manufacturing R3 - Up to 12 Months, 1/12/17 to 31/10/18, £99,300

Impact Solutions

This project aimed to develop a new lightweight, highly fire-resistant polymer-ceramic composite, PolyCi, for passive fire safety application such as pipes, ducting, cladding and panels. This new low cost material has the fire resistance of a ceramic with the processing ease and mechanical properties of a polymer making it ideal for construction and transportation applications where there has traditionally been a trade-off between weight, cost, performance and robustness.

Market Opportunity

PolyCi improves on a variety of passive fire-resistant materials which are used in ducting, pipes, roof tiles and wall panelling/cladding, with a UK market of over £600 million. The project initially focused on developing the material for fire doors which has a current UK market value of £30 million and is growing at 15% per annum. Fire safety in construction is in the spot light with the impact of Grenfell still being felt across the industry leading to demands for new more advanced and fit-for-purpose materials.

Innovation

PolyCi is a unique composite produced by combining polymer with inorganic ceramic within an extruder or compression moulder. This means the material can be shaped and formed like a plastic using existing equipment, whilst also retaining the fire performance of the ceramic. The material is also environmentally greener than other materials such as concrete or geopolymers producing no CO₂ and can be made with waste plastics. This leads to PolyCi being cheaper than other materials such as hardwoods, lighter than concrete, and more robust than rockwool.

Exploitation Route

The initial route to market will be through the fire door market where PolyCi has an immediate need in fire door beading. Impact can manufacturer the material at small scale and we have an established partner in-market who will begin seeding the market once final certification testing of the material is carried out. Once the material is established in market, we will look to license the material in a variety of industries, in particular wall cladding, roof tiles and piping.

Outcomes and Next Steps

- Exploitation partner for fire doors identified
- Final fire rating certification of PolyCi mid-late 2019
- Launch of material in fire doors 2020
- Identify potential collaborators in other passive fire safety product markets
- Optimisation of material for other markets – pipes, cladding etc.

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Carbon Capture and Reusage- Conversion of CO₂ from steelworks to coating products

133275, Materials and Manufacturing R3 - Up to 12 Months, 1/8/18 to 31/7/19, £285,134

Cyanetics Ltd
University of Nottingham
Tata Steel UK Limited

Tata Steel Port Talbot emits 19 million tonnes CO₂ per year (mtCO₂/yr) during the production of coated steel products, the cost of which will increase dramatically over the next 10 years. Cyanetics' platform technology sequesters CO₂ from industrial off-gas and converts this to high-value raw materials. This project aims to develop this to produce monomers for the production of resins used in coating products.

Market Opportunity

Cyanetics' process will be able to produce cost competitive, carbon-neutral raw materials which are traditionally sourced from petrochemicals. The process is designed as a single-step conversion from CO₂ to chemical intermediate, thereby directly coupling the cost saving from CO₂ emissions to bioproduction. Our initial target products are 1,4-butanediol (\$8.96bn) and succinate (\$48.7mn), accessible through the emerging market trend for sustainable and carbon-neutral products.

Innovation

The innovation centres around a process based on microalgal fermentation. Our chassis organisms sequester CO₂ through photosynthesis, deriving energy sustainably through light generated in our proprietary bioreactor systems. These organisms are modified by the Green Chemicals Beacon, University of Nottingham, and tailored to produce specific chemicals. These technical innovations are supported and enabled with a business innovation which sees the avoidance of CO₂-related costs balance the cost of bioproduction.

Exploitation Route

The ultimate aims of the project are twofold: to commercialise a CO₂-to-paint process which addresses a critical need for the UK steel industry, and to exemplify our platform and position it as a licensable technology for application in other fields (energy, chemical). For the current opportunity, we are in discussion with coating manufacturers to establish sourcing agreements for our product, and chemical producers through which the technology can be rolled out via a joint venture.

Outcomes and Next Steps

This project is a feasibility study, and so will produce a bench-scale (5L) demonstrator, a set of techno-economics and a deployment plan which positions it for further development. We envisage the next stage requiring further optimisation of production and carbon sequestration, scale-up and piloting on-site, and the establishment of a putative supply chain through joint development and sourcing agreements.

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Feasibility of modular wind turbine micro-factories for remote & developing world sites

133321, Investment Accelerator Pilot - Stream 1 Infrastructure Systems, 1/1/18 to 31/3/19, £149,959

Spinetic Energy Limited

Spinetic has designed a modular wind energy system which takes its inspiration from solar panels, in that the economies of scale come from manufacturing huge volumes of small units rather than small numbers of giant structures. The Spinetic 'Wind Panel' enables distributed generation of wind energy with the same ease of installation as solar panels and at a competitive cost. The project explores the feasibility of manufacturing Wind Panels in micro-factories close to their end-use markets.

Market Opportunity

In many regions there is an inverse correlation between wind and solar outputs. Most solar energy is generated in summer, daytime only, whereas the wind blows day and night, with most output in winter. By harvesting both wind and solar, output can be smoothed significantly. This is particularly valuable at remote locations where huge wind turbines are inappropriate, creating a market need for a community-scale wind energy system offering a competitive cost of energy.

Innovation

The Wind Panel design incorporates multiple innovations, 11 aspects of which are patented. Wind Panels are made from low cost, readily available materials and offer flexible capacity (each unit is 1 kW), along with ease of delivery (each weighs <100kg) installation and redeployment. Spinetic's innovations in micro-factory manufacturing techniques enable increased use of local labour and materials, saving on shipping and fabrication costs.

Exploitation Route

Around 100m people rely on fossil-fuel gensets for power at off-grid locations. Their average cost of energy can be reduced by replacing a proportion of the fuel with solar energy in a 'hybrid microgrid'. The advent of Wind Panels will allow additional fuel substitution, in winter and at night, further reducing the blended cost of energy. Engineering, Procurement and Construction companies which currently install hybrid microgrids will provide a route to market for Wind Panels.

Outcomes and Next Steps

The project demonstrated that the smaller and more compact sub-components of Wind Panels can be mass-produced and then shipped alongside the raw materials needed to manufacture locally the larger components (frames, blades). These final manufacturing steps take place in a containerised micro-factory which can itself be readily redeployed. The precursors for ca. 150 kW of generating capacity can be shipped in a single 20' ISO container weighing ca. 22 tonnes. Field trials are now planned.

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Self-Powered Smart Valve

133323, Investment Accelerator Pilot - Stream 1 Infrastructure Systems, 1/4/18 to 31/3/19, £150,000

Oxford Flow

Oxford Flow makes Pressure Reducing Valves and has added intelligence to the valves. But data collection in these remote locations is limited by battery life. A solution is to generate electricity at the source. Oxford Flow accentuates the temperature drop at pressure reducing locations and use that temperature differential to generate electricity.

Market Opportunity

The gas distribution companies in the UK spend £100,000s every year on battery replacement at the current usage rates. The tendency is for more measurements in more locations more regularly. This will only increase the requirement for battery replacement, unless a new power generation system could be used.

Innovation

Oxford Flow have developed a device to generate electrical power from the pressure drop at pressure reducing locations within the Local Transmission Systems (LTSs) of natural gas networks. Gas flow is passed through a vortex tube, producing hot and cold flow paths. These flow paths transfer thermal energy through heat exchangers in the thermoelectric generators (TEGs). This produces enough power to supply sensors and transfer data.

Exploitation Route

The route to market in the UK will be through a further development project (NIA or NIC project) to fully define a specification for the final product in terms of communication protocols and security scripts. This project should involve as many Gas Distribution Networks (GDNs) as possible to ensure the specification is defined to be suitable for all potential customers.

Outcomes and Next Steps

The Self Powered Smart Valve project took a concept and worked this through to a laboratory demonstrator (TRL 1 through to TRL 5/6). The next steps are to fix a design with future customers and take the product through ATEX/IECEX approval. This must involve a field trial to prove the concept. Internationally, Oxford Flow are looking for other companies to work with in a similar manner.

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Hydrogen Fuel Cells for Portable Power Generation (HydroGenset)

133327, Investment Accelerator Pilot - Stream 1 Infrastructure Systems, 1/1/18 to 31/12/18, £149,999

Bramble Energy

Bramble Energy was born out of the desire to construct hydrogen fuel cells using materials and manufacturing techniques with well-established supply chains; thereby solving perhaps the greatest barriers to the adoption of fuel cells: manufacturing complexity, scale-up and cost. As the only fuel cell company with the manufacturing capacity to supply gigawatts of fuel cell hardware, this project exploits our unique manufacturing route and techniques to develop a low-cost 1.25 kW hydrogen fuel cell systems as a diesel genset replacement.

Market Opportunity

Bramble Energy's 1.25 kW system will form the building block to provide output powers up to 5 kW. This allows for applications spanning many portable power markets including but not limited to lighting towers, off-grid installations, event power, catering trucks as well as commercial and residential back-up power. The portable power market is expected to be worth \$5bn by 2022, however given the radically reduced environmental impact of fuel cell gensets, the market is expected to grow at a much quicker rate.

Innovation

Bramble Energy's PCBFC™ utilises cost-effective production methods and materials from the PCB industry to reduce the cost and complexity of manufacturing of hydrogen fuel cells. Leveraging the global high-volume PCB industry does not only mean access to standardised procedures, techniques and materials, but also ensures that we are the first fuel cell company with the manufacturing capacity to supply gigawatts of fuel cell hardware, something the battery industry has spent many years and £B's to achieve.

Exploitation Route

Bramble Energy focuses on a B2B market and a route has been set up for the sale of our first 20 W product through a large multinational industrial gases company. Like our 20 W product, the 1.25 kW system will have initial sales in the UK and Ireland expanding to the international market through strategic partnerships with industrial gasses companies.

Outcomes and Next Steps

The outcome of this project is the development of a modular 1.25 kW building block fuel cell system which can produce output powers up to 5 kW. This project will help to expedite the complexities surrounding industrial product design and importantly fuel cell stack design and optimisation, not only for this product but also for the future Bramble Energy product line.

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Sensor distributed network for Corrosion Under Insulation monitoring in smart infrastructures

133328 , Investment Accelerator Pilot - Stream 1 Infrastructure Systems, 1/1/18 to 31/12/18, £149,939

CorrosionRADAR Ltd

This project fits within CorrosionRADAR's vision of developing a new technology for corrosion monitoring and prediction with the main focus at the moment on hidden corrosion such as Corrosion Under Insulation (CUI). The main mission is to support industry moving from reactive to predictive corrosion management, using cutting-edge technologies from distributed sensing networks to Industrial Internet of Things (IoT) and advanced predictive analytics.

Market Opportunity

Corrosion remains a problem since the industrial revolution. The global annual cost of corrosion is more than £2 trillion which equates to 3.4% of the world's total GDP. Hidden Corrosion such as CUI is one of the biggest challenges to industry. Insulation is used in many sectors and applications with the aim of minimising heat loss to the environment and also for operational efficiency. Unfortunately, condensed water can find a way in, causing the insulated structure to corrode hidden from sight. The Oil and Gas sector alone spends over £3.5 billion annually on tackling CUI.

Innovation

CorrosionRADAR system is based on an innovative distributed sensor system (hardware, predictive and analytics) for remote corrosion monitoring and prediction specially for CUI. Harnessing Industry 4.0, the data is transmitted wirelessly, simplifying the installation procedure, and allowing for remote access to the data for analytics. The output of the CorrosionRADAR system is valuable information for safety critical assets and operations in multiple sectors.

Exploitation Route

The CorrosionRADAR product will be a hardware-software system for detecting, localising, monitoring and predicting CUI. This is the first-of-its-kind distributed sensor network, being flexible and modular and can be used for new assets or retrofitted in existing plants. This has a global market for offshore and onshore assets.

Outcomes and Next Steps

The project was aimed at maturing the technology of CorrosionRADAR Ltd. Through this Innovate UK project, prototypes were built and field trials were performed at a large chemical company in Europe. A data analytics method and software tool was developed to provide data analysis and a report to the users. After this project, further commercial sales are being pursued with several end users across the globe. CorrosionRADAR is open to discuss support on any of these, including access to oil and gas operators and large chemical companies.

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Feasibility of integrating distributed cloud computing services into the household water tank

133332, Investment Accelerator Pilot - Stream 1 Infrastructure Systems, 1/2/18 to 31/1/19, £148,653

Mixergy Ltd

This project was a feasibility study on how to maximise the value to households from new smart energy technology. This was done by assessing the potential to add new income streams from the distributed cloud computing device to the household electricity tank, building on Mixergy's initial demand side response tank.

Market Opportunity

The main area where this project explored new value creation was in co-locating distributed cloud computing with hot water tank loads. 500,000 tanks were installed in the UK in 2016 alone. It was estimated that by 2025, data centres are predicted to consume 10% of the UK's total energy supply. The ability to utilize the waste heat from the computing device provides a great market potential.

Innovation

A novel system configuration was designed to allow the Mixergy tank to recover waste heat from the distributed computing device. With the new configuration and control algorithm, the Mixergy tank was able to absorb heat from the computing unit constantly at a high efficiency (70% waste heat recovery) and save 46% of energy to provide a hot water service.

Exploitation Route

The viable route to market will be through: 1. the device providing the distributed computing service through high performance cloud computing service (HPCC) such as AWS (Amazon Web Services) and 2. Integrating a large data centre with district heating using the same system topology.

Outcomes and Next Steps

A TRL 5 hot water tank system integrated with the distributed computing unit was designed and built. Lab experiments using standard draw cycle profiles were carried out to validate the energy saving figures and revenue claims, showing a potential of 3 years ROI. The next steps are: 1. Test the domestic user market. 2. Investigate the possibility to scale up to a larger system, i.e. district heating with data centre.

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Battery management control system for Advanced Battery Engineering (BABE)

133367, ISCF Faraday Battery Challenge: Innovation - Feasibility Studies, 1/2/18 to 31/3/19, £208,636

Brill Power Ltd E-Car Club Ltd

Batteries within electric vehicles (EVs) comprise thousands of cells connected in series, yet the performance of the battery is limited by the performance of the weakest cell, reducing driving range. Eliminating this phenomenon can extend battery lifetime by up to 60%. Electric vehicle fleet operators typically have hundreds of electric vehicles under their control and are thus in a unique position to assess real battery performance. This project exploits that valuable information to the benefit of both project partners.

Market Opportunity

The market opportunity of supplying our battery management system (BMS) to a leading UK OEM of high-performance hybrid electric vehicles is estimated to be ~£1,000,000. The addressable market for BMS in MHEVs and electric buses in Europe is estimated to be >£19,000,000 based on vehicle registration figures by SMMT and ACEA in 2017. The size of our ultimate target market - BMS for passenger electric vehicles in the Europe - is expected to reach >£300,000,000 by 2022, with a CAGR of 42%.

Innovation

The BrillMS technology is unlike any technology currently available. It uses a PCB with power electronics in a patented circuit topology that can control the full current in each series-connected module within a pack. This level of connection and control is unique for a number of reasons: (1) Detailed information about every series-connected module can be collected; (2) A unique measurement of internal module resistance can be obtained; (3) Current flow can be controlled to each connection, targeting stronger or cooler cells to increase system lifetime, optimise thermal management and/or maximise charging speed. The key elements of our technology are a PCB with patented topology and software that controls the PCB with advanced battery modelling and embedded software controls.

Exploitation Route

The ultimate target market for Brill Power BMS technology is passenger electric vehicles, both hybrid-electric and all-electric vehicles. The business model for this market is to license our technology (both hardware topology and software) to OEMs and Tier 1s, who can integrate it with their system design and use their own, optimised supply chain to manufacture the electronics. Our first point of entry to the electric vehicle market are niche vehicles, such as hybrid electric high-performance cars, medium and heavy commercial vehicles (MHCVs) and electric buses. We will work with UK-based battery system developers to break into these markets, validate our technology and achieve first low to medium volume sales.

Outcomes and Next Steps

This project will allow access to previously unobtainable data on EV fleet performance (through E-Car's telematics), which will give Brill Power real data to use for the substantiation of the likely impacts of the BrillMS. In turn, the results of this will be used to underpin proposition testing with Nissan/ Renault/JLR/EV manufacturers, to determine design/cost parameters that must be met for the system to be widely implemented. E-Car will profit from the innovation through increased car club membership as factors such as range anxiety are overcome through BrillMS load balancing, and as EVs become cheaper to lease due to improvements in the battery/EV supply chain.

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Further Information: <https://gtr.ukri.org/projects?ref=133367>

Advanced electrode materials for Sodium-ion batteries

133370, ISCF Faraday Battery Challenge: Innovation - Feasibility Studies, 1/3/18 to 28/2/19, £409,410

Deregallera Ltd University of Southampton

As the world progresses to an all-electric future it is unclear if lithium-ion (LIB) can meet the projected demand for energy storage. Dwindling supplies of lithium, an over-reliance on “African blood cobalt” and increasing safety concerns all shroud its future. Enter Sodium-ion batteries (NIBs), reliant on globally abundant, ethically sourced lower cost materials the future of NIBS is brighter. Deregallera tackle the conspicuous drawbacks of NIB, energy density and cycle-life, by developing advanced electrode materials.

Market Opportunity

The cost of *prototype* NIB (\$100/kWh) compares favourably with LIB matured over 30 years (\$150/kWh) and is anticipated to diverge significantly owing to the more sustainable future of NIB. In the meantime, 80% of the global battery market is still lead-acid which represents £60bn in 2021 when the EU exemption of lead is reviewed. At three times lighter with a similar volume, NIB are waiting in the wings to encroach lead-acid as a stepping stone to lithium.

Innovation

To approach the energy density of LIB, advanced NIB electrode materials are required. To this end, Deregallera have developed a *core/shell* composite material. The nanostructure affords the high capacity *shell* material the necessary room to safely expand during cycling. The core material is synthesised hydrothermally at low temperature, significantly undercutting the conventional batch furnace processes which require temperatures in excess of 1400°C over several hours.

Exploitation Route

Penetration into the EV sphere targets the 12V (lead-acid) and 48V (LFP) mild hybrid applications as natural stepping stones towards full (NMC) EV packs. Existing NIB manufacturing activities are targeted as the shortest route to license our advanced materials. The SPECIFIC Innovation and Knowledge Centre provide a facility to demonstrate our technology in a commercially relevant environment for stationary storage applications.

Outcomes and Next Steps

Follow-on research to realise the full potential of our material commences in July 2019 with partners in the National Physical Laboratory, Warwick Manufacturing Group and QinetiQ to optimise our material against a comprehensive list of full system dependencies: electrolyte, additives, binder, loading, calendaring and 1st cycle conditioning. The Centre for Process Innovation will come on board to help assess our material for unforeseen technical and economic challenges to manufacture at scale.

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Further Information: <https://gtr.ukri.org/projects?ref=133370>

Carbon Allotrope for Lithium Ion Batteries (CALIB)

133374, ISCF Faraday Battery Challenge: Innovation - Feasibility Studies, 1/2/18 to 31/1/19, £506,143

Plasma App Ltd
Johnson Matthey Plc
University of Cambridge

The project goal is to develop a new type of Li-ion battery anode based on a totally new form of carbon material - Carbon Allotrope for Lithium Ion Batteries (CALIB). CALIB was discovered in a joint collaborative project between Plasma App Ltd and Cambridge University within funding from an Innovate UK project. The consortium is going to explore the new material with the goal of developing the functional electrode to be integrated within the standard Li-ion battery manufacturing process.

Market Opportunity

The value of the world battery market could have expanded to US\$250 billion or more by 2040. The anode accounts for 13% of an xEV battery's material cost which is of 60% of the complete cell cost. Novel anode having twice higher specific capacity could yield an increased market penetration rate of 5% per year even without including the possibility of a reduced production cost.

Innovation

Plasma App applied its proprietary technology, VCD, to produce a new polymorph/allotrope of carbon. This new material has at least twice higher specific capacity of Li ions than standard anode material. Furthermore, using this material Plasma App has developed a new anode manufacturing process which allows the anode a weight and volume reduction through superior precision of manufacturing enabled by the vacuum process.

Exploitation Route

Plasma App have filed the patent for the material and electrode manufacturing process. Scientific results will be published to attract potential users of the new material. The goal is to provide the LIB manufacturers with the new anode which can be integrated into the Gigafactory-like production lines enabling the performance improvement accompanied by weight and volume reduction.

Outcomes and Next Steps

Plasma App has developed a new anode for LIB with reduced weight and volume. We are looking for strategic partners to scale up the new anode production and optimisation of battery manufacturing with the new anode. Also, we are investigating the possibility of applying our technology to the LIB cathode and solid-state battery manufacturing.

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Further Information: <https://gtr.ukri.org/projects?ref=133374>

Black Soldier Fly Larvae: Urban, Local, Bio-Conversion Unit

133640, November 2017 Sector Competition Strand 1: Materials and Manufacturing - Up to 12 Months, 1/7/18 to 30/6/19, £98,126

InsPro Ltd University of Lincoln

Conversion of food by-products into animal feed using Black Soldier Fly Larvae is proven. The challenge is to make it happen frequently and repeatedly across the country and the world so that it makes a difference. Our Bio Conversion Units (BCU) are modular and mobile and can be located on any hard standing thus addressing the other key environmental and financial consideration, namely that substrate is not transported large distances.

Market Opportunity

To a multiple food retailer we offer two benefits: 1. To locate BCUs throughout their supply chain to capture and divert food by-products back into the human supply chain. 2. To influence their suppliers of fish, eggs and potentially poultry and pork to use sustainable insect meal rather than less sustainable fish meal and soy.

Innovation

Innovation lies in the internal design of our BCU, our urban locations, the use of different substrates and the configuration of our business model.

Exploitation Route

Working with food retailers, manufacturers, farmers and growers as well as the National Centre for Food Manufacturing (NCFM) we will trial BCUs in a range of circumstances and then scale up rapidly to exploit them. Patent applications are in progress. We are looking to work with food producers and the NCFM to optimise the capture of by-products with minimal disruption while maintaining the supply chain integrity. We are keen to license and support the use of our technology in order to maximise impact.

Outcomes and Next Steps

Next steps are to build a MVP for demonstration, to build and trial 5 prototypes (IUK application in progress) around the UK and then to scale rapidly. We are seeking a partner with the capacity to rapidly and cost effectively fabricate large numbers of BCU and another to provide the monitoring, control and communications capability.

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Moisture Barrier Coatings for PVOH Soluble Products to Reduce Packaging and Extend Product Life

133641, November 2017 Sector Competition Strand 1: Materials and Manufacturing - Up to 12 Months, 1/11/18 to 31/7/19, £121,236

PVOH Polymers Ltd Swansea University

Polyvinyl Alcohol (PVOH) is a water soluble nontoxic biodegradable polymer which conforms to European composting and biodegradability standards coupled with excellent oxygen barrier properties making it suitable for Zero Waste single use moulded consumables and packaging applications. Being hygroscopic its material properties are compromised by atmospheric moisture. This project aims to provide a solution by incorporating coatings and migrating additives to form a hydrophobic barrier to prevent atmospheric moisture absorption and reduce secondary packaging requirements.

Market Opportunity

The market opportunity to replace single use plastic products with a soluble alternative is truly global. Detergent primary and secondary packaging is currently 2000 tonnes per annum. The global water-soluble (PVOH) film market is projected to reach \$404.8 million (~£336 million) by 2020, signifying an annual growth of 5.2% between 2015 and 2020. Of all the subsectors in this market, the detergent packaging subsector is anticipated to expand at the highest CAGR of 4.4%. We will initially target the high volume, consumer segment of this

subsector, which accounts for nearly 59% of the market share.

Innovation

The innovation combines low cost PVOH formulations incorporating high levels of sodium chloride stabilising developed formulations to 700 RH with additional hydrophobic migrating waxes and nano particles to provide stability to 900 RH and above. Novel coatings adapted to breakdown in specific environments to provide 100% protection from H₂O during use but naturally dispersed upon product disposal for Zero Packaging Waste.

Exploitation Route

PVOH Polymers is a materials supply and development company, providing novel water-soluble PVOH polymer solutions in key industry sectors to include detergent, packaging and health care. Our core strategy for growth is through direct polymer sales and licensing through material distributors Distrupol. Their European sales network is well positioned to identify new product areas for biodegradable and water-soluble polymers applications using our low cost and easily processable polymer grades with reduced packaging requirements.

Outcomes and Next Steps

Positive outcomes have attributed to four potential product launches before project completion to include detergent packaging, shotgun ammunition components, national charity organisations products and food packaging. This innovation permits the substitution of conventional polymers with a water-soluble alternative which provides zero waste via dissolution and ultimate biodegradation in waste water treatment plants or in the natural environment. New manufacturing processes have been developed in line with current demand and future growth and opportunities for investment exist.

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UK's first Solar Electric Forecourt

133817, Electric Vehicle Charging for Public Spaces: Feasibility Studies, 1/1/19 to 31/3/19, £114,154

GRIDSERVE Sustainable Energy Upside Energy

The UK's first Solar Electric Forecourt® demonstrator is a key step in GRIDSERVE's vision to develop, build, own and operate a national network of ultra-rapid EV charging hubs supplied by solar energy to deliver convenient, mass-market, rapid charging at prices competitive to home charging. Our demonstrator project will design, deliver and operate a site in Braintree, Essex consisting of 24 charging bays, 5MW on-site battery storage, solar PV canopy and retail building demonstrating a modular, scalable, low-cost solution ready to replicate across 100 sites across the United Kingdom.

Market Opportunity

Public rapid charging is currently limited in capacity, expensive and the stand-alone business model is unviable. Most current public charging solutions are low power (typically <22kW, few up to 50kW) and these typically AC solutions are limited by available grid capacity and are insufficient for the 30-40% of UK population that live in urban environments without access to off-street parking. If this significant proportion of the population cannot access adequate charging infrastructure, we will not hit national targets for EV uptake and electrification of transport.

Innovation

GRIDSERVE's Electric Forecourt® concept is highly innovative as it integrates multiple hardware, software and modelling technologies into a single utility-scale site. A novel business model will be demonstrated that uses multiple revenue streams from grid balancing services and energy trading to support up-front investment in EV charging infrastructure at a time when EV penetration is still low. Our site will be operated using a cloud-based platform incorporating the latest data science techniques to enable real-time forecasting of EV demand and optimal energy trading of on-site battery storage.

Exploitation Route

Our UK-wide network roll-out will include over 100 future-proof local community charging hubs requiring an ambitious £1B capital investment programme over the next 5 years. This investment opportunity has been promoted by the UK Department of International Trade as a key part of the UK's first £5B Energy Investment Portfolio and is strongly aligned to the UK Government's Road to Zero strategy.

Outcomes and Next Steps

GRIDSERVE has now secured over 80 sites as part of our national development programme, commenced construction on two highly advanced solar and battery storage sites in York and Hull and successfully completed an integrated feasibility study covering technical design, commercial model, project delivery and site operations alongside our consortium partners. We are currently raising up to £20M growth capital to build the first 4 Electric Forecourt® locations.

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Electra EV

104561, Open Round 5 March 18 0-12 Month, 1/11/18 to 31/10/19, £975,357

The Zeta Group
Oxfordshire County Council
Urban Integrated
Oxford University

The Zeta Group alongside Oxfordshire County Council, Urban Integrated and Oxford University, has developed a state-of-the-art, intelligent Electric Vehicle charging unit. Offering advanced features like dynamic charging, fault detection, remote fault rectification, V2G support, dual output with variable charge balancing, remote software upgrade, built in CCTV and Bluetooth. The Electra EV Project will hopefully encourage electrical vehicle take up in the area and maximise improvements in the local air quality.

Market Opportunity

The market opportunity identified is that existing car parks in close proximity to residences can be used at night to provide Electric Vehicle Supply Equipment (EVSE) to potential electric vehicle buyers. 30% of homes do not have access to EV chargers and through a detailed survey, 70% of potential EV buyers are willing to walk 5 minutes to charge their vehicles.

Innovation

The Electra will have features such as site location tools which allows local authorities to optimise the choice of placement of potential EV charging points. The charger offers a dynamic and fast charging point for 2 vehicles, up to 22 kWh. EV users will also be able to pre book a charging point via the app. Local authorities will also have an overview website with statistics and data on utilisations.

Exploitation Route

Zeta are working in close partnership with Oxfordshire County Council and Oxford University to exploit and conduct several surveys. 300 intelligent EV chargers will be installed in Oxford as part of a trial. This project will address all the issues local authorities face when having to provide EV chargers throughout the borough.

Outcomes and Next Steps

The outcomes of the project will be a fully developed business model that offers a de-risked model to enable large scale commercial investment. The installation of 300 intelligent EV chargers in 35 existing public sector car parks will demonstrate the best business and operational model. Following a successful trial, Zeta and partners will be able to engage with other local authorities aiming for a national roll out of EV chargers.

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ALERT ‘Real-Time Airborne Asbestos Detection’

830002, Innovation Loans: Infrastructure Systems, £744,583

Alert Technology Ltd

Alert Technology Ltd (ATL) have developed ALERT, the world’s first and only real-time warning device for airborne asbestos. Its patented, innovative technology offers a vital early warning when asbestos fibres have been disturbed and released into the air reducing the risk of prolonged exposure. The project is incorporating feedback from field trials and is focused on improvements to further optimise the device’s algorithm, electronics, firmware, software, end user interface and ergonomics.

Market Opportunity

The Asbestos ALERT PRO 1000 is a unique, innovative technology with no competitor or established market comparison. As such we can only estimate the size of the potential market, but over the product’s development we have identified **over 30 diverse global industry sectors** to which ALERT is relevant. With no competitor barriers to market entry and market drivers that include: increased legislation and regulation for greater monitoring, control and the removal of legacy asbestos and rising acute medical and legal costs for asbestos related diseases, we expect to have unchallenged market presence for at least three years.

Innovation

Despite the global scale of the asbestos problem, there is at present no portable, accurate, real-time asbestos detector available on the market. Its innovative and patented technology currently makes ALERT the only real-time instrument capable of **distinguishing** asbestos from other non-asbestos fibres in the air where it is most lethal. It does so by assessing fibres’ light scattering patterns and the behaviour of those fibres as they pass through a magnetic field, using this to determine the probability of asbestos which is paramagnetic to a statistical confidence level of 99%.

Exploitation Route

With such a large number of potential markets, ATL will focus sales efforts on the professional B2B market initially in the UK & EU construction, demolition, asbestos abatement, occupational health and emergency services sectors. Exploitation will be achieved via a mix of direct sales and specialist regional distributors. Targeting our database of 1300+ unsolicited enquiries, Alert's early revenues will come from unit sales and monthly hire charges, with additional income streams from maintenance, calibration and bespoke consumables. Once established in the UK & EU, the company will focus on the massive market opportunities for real time asbestos warning demonstrated in Australia, Asia and the Americas.

Outcomes and Next Steps

Our Innovate UK project has enabled the incorporation of feedback gathered from both end users and internal field trials to make improvements that will further optimise the device's algorithm, electronics, firmware, software, end user interface and ergonomics to a production ready state. Early ALERT PRO 1000 units will be soft-launched in mid-2019 to carefully selected customers and distributors who have registered their interest to purchase the first units available. As leaders in health and safety within their given industry sectors these companies are keen to be early adopters of new disruptive technologies. The ALERT PRO 1000's technology will then be cascaded to produce working demonstrators of two new model variations in 2020 that will offer the market an enhanced model with wireless comms and a simplified Yes/No model for the trades.

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Nuron: First of a Kind Implementation of a Nervous System for the Sewers

830004, Innovation Loans: Infrastructure Systems, 31/10/18 to 30/1/22, £855,034

Nuron

Climate change and population growth are increasing pressure on sewerage, drainage and flood defence networks. Faced with this challenge, and increasing regulatory and public pressures to reduce environmental impacts and internal sewer flooding, a step change is needed in sewer flow monitoring and management technology.

This is a key priority for UK Water and Sewage Companies (WaSC). In their current business plans, several specifically highlight that ‘smart networks and increased remote automation’ will be a key driver in reducing such incidents. nuron is delivering just such a transformation. Our continuous optical fibre monitoring system delivers network wide flow, depth, temperature, and structural measurements. These enable real time control techniques such as in-system storage, better use of capacity and deferral of capacity upgrade capex.

By 2018, with the support of this Innovate UK loan, our system will be field proven with a UK water company to: reduce sewer flooding and environmental pollution; improve sewer asset management; lower the cost of high speed broadband; and provide a low cost fibre grid to enable SMART cities.

Arcola Energy: Commercialisation of zero emission hydrogen fuel cell powertrains

830064, Innovation Loans: Open Round 2, £983,596

Arcola Energy

Arcola Energy have developed and tested a powertrain for a prototype fuel cell electric double deck bus demonstrating the target zero emissions range of over 200 miles with full passenger carrying capacity and fuel efficiency as good as the current generation of single deck hydrogen buses. This project will continue the development of the powertrain and vehicle integration, and strengthen Arcola Energy's capability as a Tier 1 supplier to bus manufacturers and will achieve a market ready and fully homologated product for bus operators. The project will develop the powertrain including hydrogen system, fuel cell system and traction battery as well as the power electronics, thermal management, mechanical packaging and powertrain control system. The focus of the project development will be on safety, quality, reliability and robustness of the sub-systems and the whole vehicle integration and homologation.

Market Opportunity

Driven by city air quality and public health, the bus sector will be a leading adopter of truly zero tailpipe emissions vehicles. Zero emission double deck buses are a good market entry as requirements can't be met by other technologies. High capacity and high duty routes require double deck buses and non-stop, even 24 hour operation, neither of which can be practically met by battery electric buses. Zero emission trucking is becoming a key focus of cities and operators - where high payload and/or high duty routes mean battery electric is not feasible. Hydrogen fuel cells are a practical solution.

Innovation

- Design and integration of high efficiency hydrogen fuel electric powertrains
- Creation of a Tier 1 hydrogen fuel cell system supplier to enable heavy vehicle OEMs to quickly and cost-effectively add hydrogen fuel cell powertrain options to their line-up

Exploitation Route

- Supporting heavy vehicle OEMs to develop the market and establish supporting infrastructure for hydrogen fuel cell vehicle deployment
- Commercial supply of the Arcola Energy hydrogen fuel cell to heavy vehicle OEMs
- Ongoing specialist maintenance and support of vehicles to enable cost-effective whole-life operation

Outcomes and Next Steps

- Arcola Energy established as a Tier 1 supplier of hydrogen fuel cell powertrain systems
- Commercial deployment, initially in double-deck buses with Alexander Dennis and then in to trucks, trains and off-highway vehicles.

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Further Information: <https://gtr.ukri.org/projects?ref=133827>

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