Innovate UK

Directory of projects

Energy Catalyst - Round One

Collaboration Nation

Contents

Introduction

These are interesting times for energy innovators. Energy systems across countries around the world are in the midst of huge market & technology disruption. Traditional centralised command and control of generation, distribution and supply is being increasingly unbundled and impacted by localised systems, changing regulatory and policy mechanisms, order-of-magnitude fluctuations in energy pricing, and Moore's-law type cost reductions in clean energy technologies. In this landscape of unpredictability, society's need for solutions to the "Energy Trilemma" of affordable, resilient and clean energy stands out as a defining – even if not always consistently balanced – market driver.

Disruption creates a wealth of market opportunities for innovators, but often at considerable risks. The Energy Catalyst was established by its co-funders – Innovate UK, The Engineering and Physical Sciences Research Council (EPSRC), The Department of Energy and Climate Change (DECC) and, most recently, The Department for International Development (DFID) – to help mitigate those risks and speed our UK innovators to seize advantage of these new opportunities – wherever they have identified them – to address the global Energy Trilemma and accelerate growth of the UK economy.

The UK is unparalleled in its energy innovation excellence. Unsurprisingly, response to the Energy Catalyst is phenomenal. At each competition round, our independent assessors critically examine hundreds of high-quality applications demonstrating outstanding innovation & business opportunity – it would be fantastic to be able to support them all!

These forty projects, and the consortium partnerships behind them, funded under Round-1 of the Energy Catalyst, represent the very best of market-focussed UK energy innovations. We wish them, and also all of our unfunded applicants, every success for the next stages of their technology commercialisation and business growth.

Michael Priestnall

Lead Technologist, Energy Catalyst

"Collaboration Nation" showcases projects funded by Innovate UK. The 23 Early-Stage feasibility projects in Energy Catalyst Round-1 came together at the Royal Institution, London, on 11th February 2016 as part of CleanTech Innovate 2016. This Directory summarises those Early-stage projects and also the 17 Mid-stage and Late-stage projects that comprise Energy Catalyst Round-1 in the words of the project partners themselves.

Transvac Systems

102203

Multistage ejectors for flare gas recovery

Partner organisations
University of Nottingham

Transvac is ejector specialist company that has supplied thousands of ejectors over 40 years and supplies ejector systems using the very latest design and construction techniques. Transvac have a particular oil and gas focus.

What was the business need that motivated the project?

Through conversations with partners it became apparent that Transvac's core technologies could be applied to flare gas recovery. Current flare gas recovery systems employed unreliable systems and partners were approaching Transvac to apply their technology. For Transvac to confidently apply their technology to the problem it would need to undertake a feasibility study to understand all the issues surrounding ejector technology in this unique environment. Given the high risk associated with a research project of this type a grant supported project seemed appropriate to minimise the risk to the company.

What are the potential benefits?

Commercial benefits in the form of significant exports are expected and these will pass down the Transvac supply chain. Flare gas recovery prevents a significant amount of greenhouse gas emissions and is an environmental benefit. Alfreton will see a social benefit in an increase of employment in the local area.

What approach did you take to address the energy trilemma?

Flare gas recovery increases the potential of existing fields in developed nations, securing supply for the UK from north sea fields. Flare gas recovery prevents greenhouse gas emissions for no energy benefit. Existing gas recovery systems utilise expensive rotating machinery and as such the price for developing nations seems expensive.

What are your next steps?

The next step is the creation of an industrial prototype, currently looking at mid-stage funding from the Energy Catalyst award to finance this as it represents a substantial cost. Transvac is aligning itself with partners from a range of end user industries to obtain possible test sites for the technology.

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SMAR Azure

102204

Engineered textile blade with actively controlled surface/profile

Partner organisations
DNV GL, ORE Catapult

Since 2004, SMAR Azure uses its proprietary technology for light weight structures to deliver innovative solution to the marine Industry. Sabrina Malpede, Alessandro Rosiello and Donald MacVicar manage the company that has >200 customers worldwide.

What was the business need that motivated the project?

Wind energy is an essential component of a sustainable, secure and efficient UK and global energy mix. Its installed capacity and adoption has the potential to grow even faster if it can overcome technical, economic and political challenges. The Strategic Research Agenda published by the EWEA technology Platform (2014) clearly describes the need to develop larger blades and integration of advanced control features. Using the proprietary technology used for racing sailing yachts, SMAR Azure blade expands the boundaries of current blade technology and directly helps to overcome these constraints.

What are the potential benefits?

The ACT blade expands the boundaries of current blade technology. It is 50% lighter and 30% stiffer than a conventional blade. Enabling longer recyclable blades, it increases the energy produced, reduces significantly the cost of wind energy and can be used to re-power existing turbine. A patent has been filed.

What approach did you take to address the energy trilemma?

The reduced weight of the ACT blade enables the development of larger diameter turbines thereby increasing annual energy production, resulting in reduced energy costs. Enabling improved energy security due to faster penetration of wind-generated energy into the UK energy supply mix,and reduced energy emissions, through increased attractiveness of wind energy.

What are your next steps?

The technology is at the demonstration stage. The feasibility study has demonstrated that the ACT-Blade is technically feasible and economically viable. The company is seeking to develop and certify a full size prototype. The total investment required is £3.6 million The expected total development time is 36 months.

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102205

Two-phase polytropic energy storage

Partner organisations
Artemis Intelligent Power

The project, conceived by Prof Win Rampen, seeks to use Digital Displacement® hydraulic power technology developed by Artemis, which he co-founded, to enable an energy storage system based on un-pressurised hot and cold rock.

What was the business need that motivated the project?

The need for efficient medium scale (hundreds of megawatts, diurnal or longer) 'storage' of electricity is pressing. If such systems can be built on a few acres of land close to cities, largely based on materials such as crushed rock, the market opportunity will be immense. Artemis technology, successfully developed for very large offshore wind turbines, is well-suited to drive the compression and expansion of the working fluids at constant power. A successful outcome would create a very significant market for a unique UK-based hydraulic power technology.

What are the potential benefits?

The system could provide energy storage with a time constant of at least 24 hours. It would, for instance, be ideal for buffering the increasing penetration of PV solar. It is expected to be cost competitive with hydro pumped storage whilst not relying on geographical features such as mountains.

What approach did you take to address the energy trilemma?

Carbon and security: a diurnal energy storage technology that can be installed wherever a few acres of land are available, will encourage greater penetration of carbon-free PV generation. Costs: the cost-target of parity or better with pumped-hydro seems realistic. The systems can be built close to major urban load centres.

What are your next steps?

This 'early stage' phase of the project lasts one year, to April 2016, after which it is hoped to proceed to the 'mid stage' level of support under the energy catalyst programme. Requirements for then will include the building of compressors, expanders, hot and cold stores and Digital Displacement® machines.

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Arcola Energy

102206

VH flow battery

Partner organisations
Imperial College / Alstom Power Ltd

Arcola Energy is a multi-disciplinary developer, manufacturer and retailer of fuel cell-based low carbon energy solutions. The company's capabilities are in system engineering and control of fuel cell stacks and systems, including balance of plant.

What was the business need that motivated the project?

Increasing the penetration of renewable energy generation contributes significantly to reducing emissions and is one of the most effective ways to secure energy supply. However, renewable sources (e.g. solar and wind energy) are intermittent, unreliable and put stress on the electricity grid. Energy storage systems at scale can compensate and enable greater deployment of renewables at lower system cost than grid reinforcement.

What are the potential benefits?

All-vanadium redox flow batteries are commercially available developed technology. However, due to the relatively high price and low power of vanadium electrolytes, all-vanadium batteries are costly. Using fuel cell technology, one half of the energy storage system can be replaced by much cheaper hydrogen which reacts much faster than Vanadium.

What approach did you take to address the energy trilemma?

The project targets all aspects of the energy trilemma, addressing carbon reduction and energy security through enabling greater use of renewable energy generation, while addressing the cost of energy storage through a novel hybrid redox flow battery for energy storage at scale at 25% reduced cost compared to existing technologies

What are your next steps?

This foundation is the basis for a potential development of a kW scale VHFB system which can be potentially scaled to MW plant.

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Telemetry Associates

102207

FARMERS - Farm and Rural Mixed Energy from Renewable Sources

Partner organisations
Sharenergy Coop, Harper Adams University

Telemetry Associates Limited, formed in 2000, is expert in energy systems in smart homes and smart cities and has expertise in robotics, agriculture, IoT and runs the secretariat of SH&BA. Associates cover multiple market areas.

What was the business need that motivated the project?

FARMERS' key business opportunity is to examine the prospect of lower cost electricity and heat for farms, rural businesses and households which in turn may afford acceptance of medium scale renewable generation in rural areas thus helping the UK to meet its 2020 targets. The project will encourage renewable energy despite local distribution grid capacity restrictions. Through improved tools for integrated energy optimisation and management it delivers savings in agricultural operations and ultimately drive next-generation rural energy supply hubs that deliver essential and monetisable carbon savings and energy security gains.

What are the potential benefits?

The project benefits lie in optimising renewable generation for use by rural consumers and the farming industry, balancing demand, lessening intermittency from renewable generation and CO2 reduction. It will validate the feasibility of integrated rural and farm energy management systems with secure communication between energy devices within them.

What approach did you take to address the energy trilemma?

Through optimising energy systems in rural areas, the outcome will save uses energy costs, increase DNO reliability in rural areas and increase the use of renewables in rural areas, thus reducing the rural carbon footprint

What are your next steps?

The project commenced in September and completes in August 2016. We aim to have multiple energy optimisation products for rural energy systems and a methodology for delivering local energy communities in rural areas. We need to work with government, funders and Ofgem to create aggregated local rural ESCOs to exploit.

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Ozone Purification

102208

Food processing energy efficiency

Ozopure is 3 years old and provides innovative cleaning and disinfection solutions for the agri-food industry based on novel electrolysed water chemistries. These can save significant amounts of power and water in common industrial processes.

What was the business need that motivated the project?

The agri-food industry is a huge energy consumer and GHG producer (15% of UK total). Current food production & processing methods are highly energy intensive and wasteful in large part due to microbial contamination. This project generated an innovative food-safe, non-tainting, cleaning & disinfection solution produced by electrolysing a dilute solution of food-approved salts. This can be used at all stages of the food production process to reduce microbial load and cross-contamination. Electrolysed water solutions have been shown to save >75% of water & energy in key agri-food processes.

What are the potential benefits?

These solutions have been shown to radically reduce the energy usage of existing food manufacturing processes and to reduce farm to fork losses, having a direct impact on the effective yield and therefore energy demand of the agri-food industry. This reduces energy usage & emissions, safeguarding supply and affordability.

What approach did you take to address the energy trilemma?

We have focused on the demand side, both by making existing cleaning processes significantly more energy and water efficient, and by increasing the effective yield of the agri-food production & processing supply chain. Both play an important role in sustainably intensifying the agri-food industry and securing energy and food supplies.

What are your next steps?

We now secured funding to give us the capital and connections required to scale our business to address the global opportunities offered in agri-food. We are working with major international producers, processors and retailers. As well as improving their margins we help them produce better, safer and fresher food products.

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Fraunhofer UK Research

102209

Wake anemometry for yaw error correction: feasibility and risk evaluation

Partner organisations
SgurrEnergy, SgurrControl

Fraunhofer UK Research Ltd is a research and technology organisation in Glasgow and runs the Fraunhofer Centre for applied photonics. The mission - to support UK industry by providing R&D services to commercialise photonics innovations.

What was the business need that motivated the project?

The business need is the need to reduce the costs of wind energy by improving turbine efficiency, reducing maintenance costs and extending lifetime of components. Correct alignment of turbine yaw angle relative to the incoming wind direction is currently done using a single point wind vane mounted on the nacelle. This approach is not representative of the true wind direction hitting the rotor and a more accurate measurement is required.

What are the potential benefits?

Benefits from an improved yaw alignment are associated with the elimination of chronic yaw error and an improved tracking of the real time in flow angle. This will lead to increased efficiency and more balanced loading of the rotor leading to reduced wear on the turbine components.

What approach did you take to address the energy trilemma?

We address the energy trilemma by improving efficiencies of new and installed turbines leading to reduction of energy cost and increasing this low carbon contribution to the UK energy mix and improving security of supply by having the potential to reduce uneven loading of turbines thus improving lifetime of components.

What are your next steps?

After this feasibility study funds are being sought to build a prototype system to demonstrate the wake sensor required at the heart of this new turbine control system.

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Synaptec

102210

Low-cost distributed multi-parameter sensing for energy networks

Partner organisations
University of Strathclyde

Synaptec is an award-winning micro-SME based in Glasgow. The company spun out from Strathclyde University in 2015 and specialises in photonic engineering for energy applications. We work closely with industry to develop unique measurement technologies.

What was the business need that motivated the project?

The increased global electricity demand and simultaneous move to greater penetration of distributed renewable energy sources challenges the established technologies for monitoring, protection and control of power electricity networks. To ensure stability and to minimise the impact of faults, modern power networks require increased monitoring of voltage and current, and increasingly also of temperature, strain and vibration of items of plant in order to determine system health and capacity. Using existing technologies, solutions to this problem are likely to be prohibitively expensive, and therefore an alternative is sought.

What are the potential benefits?

We are developing technologies to allow electricity network operators to leverage their existing fibre-optic cables to enhance and extend their measurement systems. This will enable a most robust and adaptive grid, able to accommodate more distributed renewable energy sources and better manage the increasingly complex supply and demand of energy.

What approach did you take to address the energy trilemma?

We believe that power instrumentation must be more extensive and faster-acting, allowing operators to respond with greater speed and accuracy to system faults. To bring on board more renewables, we need a system-wide awareness. Finally, we need to push down costs by better utilising existing hardware. These are our focuses.

What are your next steps?

Synaptec is currently working with the major UK electricity operators to prototype this technology. We are now seeking partners with sales and manufacturing experience in the power industry with whom to take this unique technology to market. We believe there is a large global opportunity and would welcome discussions.

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XL Technology

102211

OCTOPUS

Partner organisations
Imperial College London

OCTOPUS is a rising star in oil & gas well completion technology. It could reduce or eliminate fracking by boosting well productivity, faster and with minimal environmental impact, putting UK gas reserves within reach.

What was the business need that motivated the project?

The controversial fracking method of exploiting shale gas reserves in US, EU and Asia, has resulted in widespread bans and firm environmental resistance. In the UK, there is strongly conflicting pressure to reduce UK's carbon budget rapidly. There is a need for cleaner exploitation of UK shale resources so that replacement of coal-fired power can accelerate, reducing Carbon emission by 50% - even more for SOx and NOx emissions. Struggling operators are desperate for improved margins; Octopus will reduce well completion time and cost, helping operators survive the slow recovery.

What are the potential benefits?

Operators could save £1.1 million per well and benefit from production 40-70 days sooner (£200,000-800,000k/day). The UK gas reserves (~20 trillion cu.ft.) could be safely exploited to provide a low-cost, secure supply for decades. Environmental benefits: potentially 6 million tons pa (mpta) CO2; 3.5 mpta SO2; 10.1 mpta NO2.

What approach did you take to address the energy trilemma?

We investigated emissions of coal-fired power, UK's increasing net energy imports (security) and costs borne by well operators (economy). All three aspects of the trilemma were addressed, with potential improvements to quality of life from: reduced pollution, transport disturbance and greenhouse gas emissions; job creation; lower gas prices.

What are your next steps?

We are applying for funding under InnovateUK and EU (H2020) frameworks and are in discussion with several oil majors. We are seeking investment for the next development stage: prototyping and testing a directional drilling head and casing-deployed multilateral OCTOPUS station. Commercialisation in US and UK markets is projected in 2018.

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OakTec

Bio-gas EDGE

102212

The project will develop a dedicated small biogas engine with a unique architecture with step change in combustion and output efficiency, reliability and manufacturability for electricity generation for application alongside micro biogas production facilities.

What was the business need that motivated the project?

Oaktec had developed a concept engine called Pulse-R that showed excellent efficiency and power density burning conventional fuels including LPG. It had high tolerance to poor fuel quality making it potentially suited to the growing UK and global markets for renewable bio-gas fuels. Contact with UK developers of small AD bio-gas plants identified the market opportunity for a dedicated small bio-gas engine that could bolt onto a micro-digester and so create a highly efficient 'micro power station' that converts waste into renewable energy with minimum emissions and maximum energy conversion.

What are the potential benefits?

The development of Pulse-R goes against the trend of new engine developments that tend to add cost and complexity to gain efficiency and emissions reduction. By contrast Pulse-R is fundamentally simple, low cost and very robust,yet takes the small 4 stroke piston engine to new levels of efficiency and performance.

What approach did you take to address the energy trilemma?

The energy trilemma of reduced emissions, security and reduced cost is met on all counts by this technology as it seeks to cleanly create useful clean energy from undesirable and significant waste sources such as cow slurry by using a flexible robust low cost technical solution.

What are your next steps?

The project has been highly successful in creating a prototype that converts bio-gas into useful energy. These results have attracted considerable high quality commercial interest and a new collaborative project is being created with a Global OEM to take Pulse-R to the next step towards a high volume manufactured product.

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CEAD

102213

Combined Energy Recovery & CO2 Removal (CoERCe)

Partner organisations
European Thermodynamics Limited, Cranfield University

CEAD provides outsource CFD & Thermofluids service to: 1. Green sector – design development innovative energy recovery systems. 2. Aerospace, automotive – bespoke thermal solutions. 3. Data, telecommunications centres – thermal management & cooling solutions.

What was the business need that motivated the project?

The project focuses upon the development of carbon capture technologies that will enable application into medium scale decentralised power generation using a broad range of fuel types. The CoERCe project addresses three main challenges associated with carbon capture industry; i.e. (i) cost reduction, (ii) reduction of emissions and (iii) security of supply.

What are the potential benefits?

Successful development of the CoERCe carbon capture technology will enable the UK to greatly increase its security of energy supply by significantly reducing the carbon emissions from existing fossil fuels including natural gas, coal and shale gas and by reducing carbon emissions from renewable biomass and biogas sources.

What approach did you take to address the energy trilemma?

The CO2 adsorption technology consists of a that adsorbed CO2 molecules. The advantage of the novel solid CO2 sorbent material being developed under the CoERCe project is its low cost, ability to be mass produced and lower energy input to recover the CO2. The technology reduces CO2emissions and reduces cost of CO2 regeneration. Its low cost will likely result in increased uptake of biomass and other decentralised generation systems. The technology will make biomass systems “carbon neutral” thus making them more attractive to end users thus increasing uptake.

What are your next steps?

To produce scaled-up prototype of CoERCe system that captures and removes CO2 emissions within a real application, either biomass generators or existing fossil fuels process plant. To achieve this we require power plant producers or OEM partners in the above industries and additional funding top up our own investment.

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WDS Green Energy

102214

Ground heat network strategy at city scale

Partner organisations
British Geological Survey and the City of Cardiff Council

This energy catalyst project is aimed at examining the feasibility of using low grade heat within the shallow urban groundwater under Cardiff to support the design and implementation of district to city scale heat networks

What was the business need that motivated the project?

Latent geothermal heat in ground water could provide a sustainable, low carbon and affordable means of producing heat energy, which with ground source heat pumps, could meet much of heating requirements within Cardiff, and give the market for heat pumps a major uplift. Heat pumps still lacks confidence for large scale usage and are currently mostly used by private home owners, schools, churches etc. Also no attempt has been made to upscale this technology for use in heat distribution networks on a city scale to supply new and older buildings.

What are the potential benefits?

The benefits this project will bring to the collaboration between WDS Green Energy, British Geological Survey and the City of Cardiff Council are more heat pump sales, a better understanding of how aquifer flows behave beneath the city and reduced energy bills for city residents and businesses.

What approach did you take to address the energy trilemma?

Cardiff's city wide network of boreholes is being used to prove ground heat can be sustainably extracted from urban aquifers, and represent a step-change in the UK renewable energy market, and contribute to solving the energy trilemma by directly addressing carbon reduction, energy security and fuel poverty reduction.

What are your next steps?

The project will characterize the variability of aquifer groundwater temperatures, investigate critical geological conditions, and support the design, planning and implementation of up-scaled urban district heating networks. Also a small bespoke heat pump project will be used to demonstrate the benefits of the technology to residents and future end users.

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Ceres Power

102215

Internal reforming in ceres power solid oxide fuel cell technology

Ceres Power is a world leader in low cost fuel cell technology. Used in energy products, our steel cells enable a change in power generation; reducing energy costs, lowering emissions, increasing efficiency and security.

What was the business need that motivated the project?

This project explores and evaluates the technical feasibility of performing internal reforming (IR) of hydrocarbon fuel directly within its metal supported solid oxide fuel cell (SOFC), the steel cell, which operates at 500-600°C, well below the accepted IR range used in high temperature SOFC (>720°C). Exploitation of IR provides an opportunity to further reduce the overall system cost and increase efficiency by designing out (or reducing the requirements of) the dedicated indirect reformer in the fuel cell module (FCM) and reducing the cooling load on the SOFC stack.

What are the potential benefits?

Project success would significantly reduce overall fuel cell power system costs and increase affordability of Ceres' low emission energy generating steel cell technology for a wider range of applications. Additional benefits include increased system efficiency, volumetric power density and robustness with reduced system complexity.

What approach did you take to address the energy trilemma?

Emissions: Improvement in system efficiency and associated carbon emissions of the Ceres Power fuel cell system. Security of supply: wider fuel cell use extends life of fuel assets, enables distributed generation and supports renewables. Affordability: significantly reduces upfront system cost and shortens payback time

What are your next steps?

Having achieved very promising project results on prototype fuel cells with internal reforming capability during short stack testing, we are now scaling up the testing onto 1kW class stacks with active cell chemistry where we aim to run full performance and durability tests on a number of samples.

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VerdErg Renewable Energy

102216

Exploration of bi-directional VETT configuration

The project explores and evaluates the potential and technical feasibility of a bi-directional VETT (Venturi Enhanced Turbine Technology, developed by VerdErg) for tidal applications.

What was the business need that motivated the project?

VETT (Venturi Enhanced Turbine Technology) is an innovative low-head hydropower technology by VerdErg. VETT uses 80% of the available flow to amplify pressure across a turbine in the remaining 20% flow. This reduces the size and kind of generating equipment as well as civil works required and achieves a substantial reduction in the cost of energy. A one-directional device for river installations has been developed but in order to make this technology available for exploiting the vast energy from the tides a bi-directional tidal VETT needs to be configured.

What are the potential benefits?

Besides a cost of energy reduction VETT does not impound water like a conventional barrage or lagoon (water constantly moves through the device) which preserves the tidal signal and important intertidal areas. 80% of the flow does not see moving parts and the device is therefore friendly to aquatic life.

What approach did you take to address the energy trilemma?

A tidal VETT exploits this reliable and continuous energy source and secures the energy supply with inherently environmentally friendly power, which reduce use and dependence on high emission fossil fuels. VETT's reduction in the size of generating equipment and civil infrastructure will reduce the cost of renewable energy mix.

What are your next steps?

This project has explored and evaluated the potential and technical feasibility of a bi-directional tidal VETT. It is now ready for further development, which will in particular include the development of a prototype testing programme. In addition VerdErg continues the development of onshore projects using the developed one-directional VETT device.

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Modular Tide Generators

102217

MTG tidal raft platform concept

Partner organisations
A&P Falmouth Ltd, Mojo Maritime Ltd, Plymouth University

The consortium partners are well established in industry and academia with specialist skills in marine fabrication, operations and science. The business is the extraction of energy from tidal current flow to power homes and industry.

What was the business need that motivated the project?

Power demand is high in developing countries with limited reliability and supply. The challenge is to integrate a standard barge type platform with a universal turbine to extract power from the tidal current. The technology can also provide energy to the UK and can be adapted to provide energy in deprived global areas located near fast flowing rivers identified in Nigeria, Bangladesh and East India. The primary role is to ensure the floating tidal platform is versatile, easily maintainable, cost effective and can be deployable in far out reaching areas.

What are the potential benefits?

The floating platform is innovative in the simplistic terms of modular design. The system will produce electrical energy economically from tidal current flow. The cost of power produced, based on estimated capital cost including repair and maintenance is from £80-£100 MWhr, with a 25 year service life.

What approach did you take to address the energy trilemma?

Tidal currents are predictable and reliable so continuity of supply is sustainable. By using tried and tested industry technology maintenance is considerably low. The platform will be accessible to all, including developing countries as cheap and affordable. By using underwater turbine technology the system is designed to be emission free.

What are your next steps?

By investing in the consortium's skills the project will require further Innovate UK funding to mid-stage to allow for the scaled model, prototype and full scale testing of the device. We have established a consortium including a turbine supplier and this will enable us to live test a floating platform.

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102218

InertStrain: Long term creep strain measurement at high temperature using inert gas

Partner organisations
Kingsnorth Engineering Ltd

The project aims to develop a long-term creep strain measurement technique able to be applied in power plants which uses inert gas to protect the inspection area from oxidation at high temperature up to 650°C.

What was the business need that motivated the project?

Long term creep monitoring in steam pipes is of crucial importance to the safe operation of power plants. Existing techniques can only be applied during outages, and only about 20% of the welds can be inspected. This yields an inadequate information to predict creep life thus putting power plants at risk. Our project aims to develop an innovative technique to address the problem so that long-term creep strain can be measured accurately. It will improve the effectiveness of planned maintenance and reducing the frequency of unplanned outages and environmental pollution.

What are the potential benefits?

A successful project outcome will increase the probability of detecting creep damage in power generation and petrochemical processing plants. This will reduce the probability of failure of high temperature components due to creep damage and type IV cracking, thus catastrophic mechanical failures and associated environmental pollution.

What approach did you take to address the energy trilemma?

The project will help improve the safe operation of power plants with reduced running cost and increased revenue. With improved efficiency of the power plants and reduced risk of catastrophic failure, the greenhouse gas emissions from power plants will be greatly reduced. Therefore the energy trilemma will be addressed.

What are your next steps?

When this feasibility study project is successful, we need further funding for a mid-stage project to demonstrate the technology to potential customers and conduct extensive in-field performance tests. This will result in a more detailed case study material so that power plant operators will have confidence to use the technique.

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WITT

102219

The capability of the WITT wave energy convertor to generate megawatts of offshore power at a competitive LCOE

Partner organisations

Mojo Maritime, DNV GL, Gibbs Gears Precision Engineers, University of Bristol, University of Southampton, University of Plymouth, ORE Catapult

WITT Ltd (WL) is developing the WITT that is a new technology that converts motional energy into electricity. WL has built prototypes to demonstrate the technology and has generated considerable interest from commercial partners.

What was the business need that motivated the project?

One of the potential applications for the WITT technology is as a wave energy convertor (WEC) that has the capability to capture energy from all six degrees of motion enabling it to absorb waves from any direction. WL faces credibility and validation issues in securing commercial and investment interest to develop WITT WECs (WWEC) for offshore deployment. This project will assist WITT to get WWECs commercialised by getting support from industry experts and validation from universities for the technology.

What are the potential benefits?

By demonstrating that WWEC's have the potential to generate power at a competitive Levelised Cost of Energy (LCOE), WL will be able to attract investment and commercial interest so the technology can progress to larger scale sea trials. The WWEC will become recognized as a leading marine renewable energy solution.

What approach did you take to address the energy trilemma?

Offshore marine renewables are seen as a vital component in solving the energy trilemma. By assessing the capability of the WITT technology as a WEC and focusing the project on the LCOE, the project is focused on identifying whether the WITT will contribute to addressing the trilemma.

What are your next steps?

Attracting investment and commercial partners for further research in to the WEC components resulting in improved power output and a lower LCOE. This will lead to the development of larger scale WWEC's for sea trials as individual units and in arrays.

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Soltropy

Low cost solar thermal system

102220

Soltropy have invented, a patented, modular solar thermal panel that allows the system to freeze without causing damage. It uses the existing tank, increases the efficiency of the system and reduces capital and installation costs.

What was the business need that motivated the project?

Quite simply solar thermal panel systems are too costly with long paybacks. When retro-fitting to a home, the main cost is associated with replacing the hot water tank with a new tank with a heat exchanger. If you can use the existing tank when retro-fitting than the installation time and capital costs are drastically reduced. Our design allows this and is also modular which means that it can be mass produced easily and so reducing the cost of the system even more.

What are the potential benefits?

Typical paybacks are between 3 and 5 years in the UK with the RHI subsidy and between 5 and 12 years without subsidy.

What approach did you take to address the energy trilemma?

The main drive was to reduce cost without reducing the efficiency of the system.

What are your next steps?

The next step is to undertake a large scale domestic field trial. We are seeking partners to help with this. We are looking for organisations with access to housing stock and installers to fit the systems.

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University of St Andrews

102221

Scaled electricity storage using lithium-sulfur batteries

Partner organisations
Oxis Energy Ltd

OXIS Energy, a manufacturer of a revolutionary new battery technology, and the University of St Andrews have joined together to demonstrate a new battery concept for the storage of grid-scale quantities of electricity.

What was the business need that motivated the project?

OXIS Energy, a manufacturer of a revolutionary new battery technology, identified an opportunity to use the expertise garnered from developing products for transport applications in the potentially vast grid storage sector. The University of St Andrews, having complimentary expertise in the area, were keen to increase the understanding of energy storage technologies and in doing so help create economic impact.

What are the potential benefits?

Our technology has the potential to dramatically reduce the cost of storing electricity at the grid scale. This will enable electricity suppliers and end-users to better control the dispatch of their resources, and hence enable them to integrate more renewable generation, reducing cost, carbon and uncertainty.

What approach did you take to address the energy trilemma?

By exploiting OXIS Energy's core "lithium-sulfur" technology using a novel battery configuration the collaboration will demonstrate the feasibility of a new energy storage technology capable of operating at vast scales.

What are your next steps?

The consortium has plans to develop the battery from the current lab-scale system, to a robustly engineered model battery with fully optimised chemistry. The evidence from this second phase will be used to prepare a detailed business plan and product designs ready for a third commercialisation phase.

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Encraft

102222

Optimising Regional Clusters of Smart Electricity Networks (ORCSEN)

Partner organisations
e2E Services Ltd, EA Technology Ltd, Western Power Distribution, Aston University, Wolverhampton City Council

Encraft is an established engineering consultancy specialising in energy for the built environment. ORCSEN is one of a number of market leading smart projects, investigating the benefits of innovative community energy optimisation at substations.

What was the business need that motivated the project?

Locally controlled smart electricity grids present an opportunity to reduce energy costs and improve security of supply for customers, making it easier for communities in cities and towns to optimise their own energy system before calling on the National Grid. However in order to unlock the full potential of these systems, the interaction with the national distribution network will need to be understood and de-risked. This project aims to study the impact and explore the benefits of a new kind of local network control system, located on the low-voltage network.

What are the potential benefits?

The benefits to the national system are reduced demand on the central control system. The benefits to localities are scope for them to make more efficient use of distributed generation assets (solar, wind, storage, etc) and potential to realise greater value from demand management approaches and technologies.

What approach did you take to address the energy trilemma?

Developing a concept which significantly enhances the capability of existing electricity networks to accept low carbon generation and demand management technologies. These technologies are made more affordable by implementing an innovative local grid control architecture which enables access to a wider range of revenue and benefit streams.

What are your next steps?

The next stage of the project will be a demonstrator site to pilot the approach. The project is looking for both investment and project partners who can deliver technical and electricity network market expertise.

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Nyak Technology

102223

Design, build and testing of a 2cm x 2cm organic perovskite solar cell as a building block for electricity generation from transparent glass windows

The project aims to study, assess and quantify the technical and commercial feasibility of a newly developed Solution-Processed Sintered Nanocrystal (SPSN) organic perovskite solar cell technology for Building Integrated Photovoltaice (BIPV) applications.

What was the business need that motivated the project?

Nyak's organic perovskite solar cells promise substantially higher efficiencies and more cost-effective fabrication processes than alternative technologies, proven on laboratory scale devices. Nevertheless, their performance e.g. efficiency and stability, and economics must be demonstrated and quantified at industrial scale and with commercial manufacturing processes. This project aims to prove the feasibility of Nyak's organic perovskite technology for commercial applications through design optimisation, fabrication and testing of 2cm x 2cm devices, for the first time, as a building block for large-scale applications.

What are the potential benefits?

Nyak's organic perovskite technology has the potential to achieve 70% cost reduction at competitive efficiency versus silicon-based solar cells. Its low-cost manufacturing and high efficiency will enable far greater applications to become economically viable for benefiting from the solar power, for example consumer electronics applications and building integrated photovoltaic.

What approach did you take to address the energy trilemma?

Nyak's technology will enable substantial cost reduction, as much as 70%, in the production of organic solar cells. Reduced cost of energy contributes to wider adoption of solar power which inherently contributes to stronger energy security and CO2 emission reduction for the UK and reducing reliance on fossil fuels.

What are your next steps?

High-level discussions with major players have confirmed that delivery of a proof-of-principle prototype will allow the exploitation of the technology through strategic partnerships with commercial partners. The findings from this project will allow us to provide sufficient evidence to establish active negotiations with investors.

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Solaris Photonics

102224

Low-cost alkaline solar cells

Partner organisations
Cranfield University

Our aim is to lower the cost of conventionally generated electricity at point of use, this is achieved through reducing production cost of Solar Cells down to $0.13/W by simplifying solar cells manufacturing steps.

What was the business need that motivated the project?

Alkaline Photovoltaics (APV) aims at very low cost electricity generation that is competitive with the cost of conventionally generated electricity at point of use. APVs offer following advantages over existing PV and other renewable energy technologies: (1) high sustainability utilising low cost inorganic materials and reliable supply chain; (2) high performance PV cells, with higher efficiencies (20-30%); (3) utilising current manufacturing facilities (no need for substantial capital investment); (4) lower process temperatures; (5) non-toxic constituents and unrestricted end-of-life; (6) compatibility of APVs with a wide range of substrates.

What are the potential benefits?

(1) Far higher energy return on investment due to reduced production cost of APVs compared to existing PVs. (2) A reduction in energy bill that will increase disposable income as well as contribute to overall GDP. (3) Reduced energy cost will have a positive impact on the UK manufacturing industry.

What approach did you take to address the energy trilemma?

The project clearly addresses the three major challenges facing the energy sectors: 1) reducing carbon emissions having an environmental impact (zero emission) 2) improving security of supply (unlimited continuous 24/7 free supply anywhere) 3) reducing overall cost, e.g. significant cost reduction compared to current alternatives such as fossil fuel.

What are your next steps?

We are looking for strategic partners to accelerate our route to market and provide: 1) funding, to build a manufacturing plant or to subcontract manufacturing 2) market access, industrial partners for joint-venture, joint development and with estabilished sales channels.

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Heatgen

102225

Combined Heat and Power (CHP) system with efficient Free - Piston Engine Generator

Partner organisations
Durham University

The project will deliver the world's first experimental investigation into the feasibility of using a high compression Free Piston (FP) engine as the power source of an efficient, multi-fuel, Combined Heat and Power (CHP) system

What was the business need that motivated the project?

A report by the UN states that there are 1.5 billion people in the world who are 'off grid'. Any available local electric supply is usually generated by diesel fueled crankshaft engines which can be noisy, inefficient and polluting. Much of the cooking is done with kerosene with severe adverse effects on the health of everyone in the household. A fuel efficient, quiet and low pollution Heatgen free-piston generator (running on kerosene) could provide a major improvement in living conditions for hundreds of millions of such people.

What are the potential benefits?

We predict our engine will deliver an increase in efficiency of more than 25% over current best practice, with proportional reductions in fuel cost and CO2 emissions. High, controllable CR allows the use of a range of different liquid and gas fuels, further improving choice and security of energy supply.

What approach did you take to address the energy trilemma?

Operating at compression ratios that offer a 25% increase in efficiency predicted to reduce CO2 emissions by 40% Multi -fuel capability to reduce the reliance on any one source of fuel thereby improving security of supply. Using less fuel to generate the same power reduces the cost of energy generation.

What are your next steps?

This feasibility study is key to de-risking the project prior to going forward into next phase of prototype development. Both in terms of sourcing the future investment required and to review the working relationships with contractors before deciding on the composition of the consortium for the next stage of development.

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EA Technology

102231

Common application platform for LV network management

Partner organisations
Nortech Management Ltd, University of Manchester

A collaboration between EA Technology, Nortech and the University of Manchester to develop a low-cost monitoring and management system for the electricity distribution network, building on extensive experience of innovative solutions for electricity network operators.

What was the business need that motivated the project?

Electricity network operators face unprecedented challenges as electricity usage patterns change with increased use of low-carbon technologies, such as solar panels and electric vehicles. To date, there has been little monitoring or active management of electricity distribution networks, resulting in higher costs and reduced flexibility. Network operators must simultaneously improve security of supply, improve flexibility and reduce costs - all in the face of an aging infrastructure. To meet this challenge, network operators need a cost-effective way to monitor and understand the operation of their networks in real time.

What are the potential benefits?

The proposed platform will enable widespread, low-cost active management of electricity distribution networks, with the potential to significantly reduce the required investment, while enabling greater adoption of low-carbon technologies. Modeling at GB level has shown that appropriate deployment of smart grid solutions will save £20 billion in capital investment by 2050.

What approach did you take to address the energy trilemma?

Our aim throughout is to find a way to delivery reliable, sustainable electricity networks at lower cost. We aim to achieve this by releasing the latent capability that already exists in our networks, but cannot be accessed due to lack of information. This project aims to fill this information gap.

What are your next steps?

Electricity network operators are naturally cautious and require evidence of benefits and reliability before they consider widespread adoption of new technology. Therefore the primary aim of this project is to confirm the benefits and reliability of the proposed solution. Additional investment will then be sought to bring it into production.

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M-Solv

102232

OSI - One Step Interconnect for thin film PV modules

Partner organisations
Oxford Photovoltaics, Dycotec Materials Ltd, Loughborough University

M-Solv is a supplier of novel additive/subtractive processes and equipment, specialising in thin-film electronics such as touch panels, thin-film photovoltaics and micro-electronics packaging. With core competencies in laser micro-structuring, inkjet printing and spray deposition.

What was the business need that motivated the project?

The entire solar market is forecast to be worth US$50 billion annually by 2018, thin-film photovolatics (TF-PV) currently accounts for c.10% market share. TF-PV is a second generation solar technology made by depositing multiple thin layers onto a substrate. Historically TF-PV has been low efficiency but now the best TF modules are comparable to standard crystalline silicon cells due to rapid performance increases over the last decade, CIGS (48%), CdTe (73%) and Perovskite (>450%). Although the materials technology has advanced rapidly the interconnect has seen little development.

What are the potential benefits?

OSI greatly simplifies the manufacturing process for TFPV by replacing three laser tools with one hybrid laser/inkjet tool and removing many heating/cooling stages and load locks, reducing capital cost. A particular benefit for the semi-transparent, building integrated cells, targeted by this project is the flexibility to manufacture non-standard module dimensions.

What approach did you take to address the energy trilemma?|

OSI addresses all three aspects of the energy trilemma, cost, emissions and security. Reducing the complexity of manufacturing TF-PV leads to directly reduced cost/Watt. The simplified manufacturing process is also less energetic and therefore reduces the embodied carbon content of each panel, reducing emissions. A reduced cost is also expected to increase uptake of PV as it becomes price competitive with energy generation from traditional sources without the need for subsidy. The building integrated PV, which is the focus of OSI, allows the local generation of electricity at the point of consumption, increasing security and resulting in further cost savings since there are minimal transportation losses.

What are your next steps?

The next step for OSI is engaging with TF module manufacturers in order to prove the technology in production. This is enabled by the development of a prototype machine at M-Solv and a defined materials set from Dycotec.

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Powerline Technologies

102233

SYNAPS (Synchronous Analysis and Protection System)

Partner organisations

Techna Ltd, Akya Ltd, Intel Ltd, University College London, University of Bath

Designs, manufacture and market of solutions in the smart grid and communications market place. The company was established in 2005 and has expertise in LV & MV smart grid, telecommunications, powerline communications and network management.

What was the business need that motivated the project?

Low voltage networks are the final, essential link from the grid to the customer, today they are built with outdated technology and managed by expensive, labour intensive processes. Underground low voltage network faults account for 80% of LV costs and 50% of customer minutes lost. These faults are expensive to locate and repair and are subject to penalties levied by OFGEM in the network operator. Additionally, the increased introduction of renewables and electric vehicles has the potential to cause these networks to become unstable and unreliable.

What are the potential benefits?

SYNAPS will provide real-time visibility of low voltage network operational and maintenance status, together with advanced protection and network reconfiguration. This will enable operators to make radical improvements to the cost of network operations by replacing expensive manpower intensive operations with smart supervision, maintenance, protection, control and reconfiguration systems.

What approach did you take to address the energy trilemma?

Cost of energy: reducing maintenance, operating costs, network reinforcement and site visits. Security of supply: increasing network reliability, reducing time to locate/fix faults, fixing faults proactivitely and reducing power quality issues. Carbon emissions: removing barriers to, and simplifying, a high level of renewables and electric vehicles and reducing truck rolls.

What are your next steps?

To deliver a demonstrator to allow Distribution Network Operators (DNO) trial the solution. We require DNO input and support for the development process and trials. We are open to funding opportunities and working with partners to commercalise the solution.

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Zyba

102234

Mid-stage development of the CCell wave energy converter

Partner organisations
The University of Bath

Zyba's main business is the development of a curved wave energy device called CCell. This has been in development for 3 years, and the company now employs six people full time.

What was the business need that motivated the project?

There is a large potential source of energy within ocean waves that has largely remained untapped. Wave energy is well situated to address three key challenges: seawater desalination requires a lot of power and there is high correlation between wavy coastal waters and adjacent arid land; many remote coastal locations use diesel to generate electricity which though reliable is expensive; and finally the destruction of coral reefs can be reverse using the BioRock technology, but this requires power at sea that can ideally be provided by a wave energy devices.

What are the potential benefits?

CCell represents a step change in wave energy technology delivering at least twice the power of alternatives. The curvature of the structure also allows it to be made very thinly using light weight materials, while retaining its strength.

What approach did you take to address the energy trilemma?

CCell address all three aspects of the energy trilemma: Being renewable it reduces the emissions in the generation of power; It improves energy security especially for remote locations; and through its innovative structural shape it is reducing the cost of manufacturing and operations.

What are your next steps?

The deployment of a device for long term testing at our offshore site. This is currently aimed for February 2016 with this quickly followed by a floating unit in Q4 of 2016.

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Nanoco Technologies

102235

Low cost solution processed CIGS solar cells

Partner organisations
Loughborough University

This project will develop new solution processed Cu(In,Ga)Se2 [CIGS] thin film photovoltaic [PV] devices from nanoparticle precursors leading to cheaper routes to produce commercial PV modules.

What was the business need that motivated the project?

Demonstration of the scalability of solution-processed Cu(In,Ga)Se2 [CIGS] technology to potential customers/commercial partners by scaling from small area devices to sub-modules.

What are the potential benefits?

Improved efficiency PV devices. Reduced processing costs. Environmental benefits: reduced emissions; reduced carbon footprint. Social benefits: reduced dependence on energy supplies from areas of political unrest. Economic benefits: lower cost of energy production.

What approach did you take to address the energy trilemma?

As a renewable energy technology, energy is generated with reduced emissions compared to the burning of fossil fuels. Reduced dependence on imported energy supplies from overseas ensures security of supply. The solution deposition method has lower material usage and capital expenditure than conventional vacuum deposition resulting in reduced costs.

What are your next steps?

Successful completion of the project which started recently. Further scale-up of the technology to module dimensions, with a view to commercialisation.

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Sheffield Forgemasters

102236

Innovative forging and fabrication solutions for the energy sector

Partner organisations

Rolls-Royce plc, NAMRC, University of Sheffield, Sheffield Hallam University, TWI

Sheffield Forgemasters International Ltd (SFIL) has a long history in manufacturing large steel components for heavy engineering. SFIL is the UK's only large Forgemaster and a world leader in large scale forged and cast components.

What was the business need that motivated the project?

The worldwide steel industry is a competitive and difficult market to successfully operate in. There are only a small handful of manufacturers capable of manufacturing ultra large, high integrity forgings and castings required in nuclear power station reactors. To increase domestic forged component size capabilities, two options are available; build larger forging presses, or devise novel forming and fabrication techniques. By co-developing hollow ingots and thick section electron beam welding, efficiency gains can be realized over multiple manufacturing sectors saving material, time, emissions and money.

What are the potential benefits?

The project targets the advancement of forgings and fabrications for nuclear components, to bring major energy savings, efficiency improvements and enhanced component capability. Additionally, a significant increase in component sizes can be brought to the World market.

What approach did you take to address the energy trilemma?

Manufacturing accounts for a major proportion of greenhouse gas emissions. Large scale, hot processes consume huge amounts of material, electricity and gas. Efficiency gains when manufacturing nuclear components yield considerable environmental savings as well as providing a UK supply chain which is cost effective, encouraging low carbon nuclear power generation.

What are your next steps?

To prove and validate both hollow ingot and thick section electron beam welding technology for key representative components. This is hoped to generate future orders and expressions of interest for SFIL, prompting acquisition of onsite electron beam welding equipment which can be deployed over a range of industries.

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Coreteq Systems

102237

CERAMOTOR

Partner organisations
TWI Limited; STATOIL Limited

Coreteq is a young company, incorporated specifically to develop high performance, versatile, rugged and reliable electric motors. Initially for downhole, Oil and Gas applications, these highly innovative motors are applicable to many other industry sectors.

What was the business need that motivated the project?

High failure rates in electric submersible pump systems (ESP) can lead to the loss of millions of dollars in a single oil or gas well, due lost production. Also, the physical size of high power ESP motors can create problems when they are to be deployed in deviated wells (with curved/ branching bore). Furthermore, the relatively poor performance of existing ESP motors leads to a considerable cost in terms of energy and their lack of efficiency at low speeds may require different motors to be installed, as a well ages.

What are the potential benefits?

Operating costs will be lower, saving power and improving 'green' credentials. Reliability will be a step-change improvement on existing ESP motors. Lifetime will also be considerably higher than currently available ESP motors, further reducing operating costs. Very high tolerance to gas voids or fluid consistency variations when pumping.

What approach did you take to address the energy trilemma?

Lower operating costs and consistently high efficiency and performance across the entire speed range will improve the viability of smaller or abandoned wells, creating opportunities for UK operators. The increased efficiency will reduce energy consumption by 145kWh per year per motor - equivalent to 76.4 tonnes of CO2 reduction.

What are your next steps?

Our first O&G sector motor will be in production in early 2017 and we are proactively developing a high pressure/high temperature (HPHT) motor. We are seeking joint investment partnerships to develop further variants of the motor and would be interested to discuss geothermal, aerospace and other propulsion applications.

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BRE

102238

Renewable Integrated & Sustainable Electric Heating System (RISE Heating System)

Partner organisations
Glen Dimplex; EDF Energy, University of Liverpool, Eastbourne Homes Ltd

The objective of the RISE-MDU project is to establish a cost effective all-electric heating system for space & water heating in domestic dwellings that displaces the market dominance of gas boilers especially in social housing.

What was the business need that motivated the project?

Long term affordable and secure heat supply to social housing is essential to offset increasing fuel poverty and heating carbon emissions in line with 2020+ carbon emission targets. UK gas supplies are less predictable as is the future sustainability of increasing peak time electricity; a novel heat solution is urgently needed. A sustainable heat pump solution's efficiency increases with improvements in building performance. At present there is no economic and flexible solution to efficiently decarbonise heating of social housing MDUs in the UK. RISE-MDU is a promising solution.

What are the potential benefits?

RISE resolves the market need to develop compact heat storage materials to mitigate potential strain on the electricity grid using low carbon heat technologies. RISE increases UK's energy resilience, reducing national demand for gas for space & hot water heating in domestic dwellings, an alternative to gas condensing boilers.

What approach did you take to address the energy trilemma?

RISE has seasonal performance factor >250%, uses >80% off-peak electricity, provides competitive system running costs for social housing, limiting rises in fuel poverty. RISE contributes to Government's targets to decarbonise heat, using heat pumps and DSR, increasing renewable power and preventing rises in peak power demand on the national grid.

What are your next steps?

The RISE Project will carry-out Phase 3 trials of a pilot system, pre-commercial validation. A key project objective is to establish links with target market groups, eg developers, local authorities and housing associations, identifying routes to market. The objective: establish initial contracts for installation and commissioning of the RISE-MDU system

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SWEPT2

Partner organisations

Zenotech Ltd, CFMS Services Ltd, ORE Catapult, STFC/Daresbury, University of Bristol, University of Strathclyde

The SWEPT2 project brings together ten academic and industry partners to development and validate a GPU-accelerated computational fluid dynamics model of wind turbine wakes, designed to stimulate next-generation wind farm design, analysis, and control.

What was the business need that motivated the project?

The analytical tools currently used within the wind industry to design and analyse wind farms rely on a common set of simplifying assumptions. For example, wind turbine wakes and the atmosphere are traditionally analysed separately, often with simple models first developed in the 1980s. These tools allow for the development of wind farms within reasonable time frames, but can also result in higher uncertainty and sub-optimal energy production. Higher-fidelity simulations delivered efficiently, particularly in the area of wakes, are needed to drive uncertainty lower and production higher.

What are the potential benefits?

The SWEPT2 model will offer fast-turnaround high-fidelity simulations of wind turbine wakes interacting with the atmospheric boundary layer. These simulations offer a number of benefits including improved physical insight, yielding better engineering models and more productive wind farm designs, and lower prediction uncertainty, resulting in reduced financing costs.

What approach did you take to address the energy trilemma?

SWEPT2 addresses the energy trilemma via improved prediction of UK wind turbine array performance, leading to uncertainty reduction and better wind farm layouts and control strategies. This (i) reduces costs, thus enabling a displacement of fossil fuels thereby (ii) cutting carbon emissions & (iii) reducing dependence on insecure imports.

What are your next steps?

In the coming months we will refine our computational fluid dynamics model of wind turbine wakes. We will then benchmark the model against wind tunnel and field measurements as well as other flow models.

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2020 Power Generation

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Innovative low carbon, high fuel efficiency power generation technology

Partner organisations
Lontra, Integral Powertrain, Brunel University

Patented, independently ratified engine with 20% fuel efficiency increase & reduced emissions for off-grid continuous power generation. Rolls Royce steering committee, working with Integral Powertrain, Lontra & Brunel to build on £1 million invested to date.

What was the business need that motivated the project?

In the continuous (24/7) 1MW off-grid diesel power generation market, fuel costs are 88% of the total cost of ownership & carbon emissions are high. Globally power demand is increasing rapidly, while supply is not growing at the same pace creating a huge power deficit in many parts of the world. Despite rapid renewable generation growth, fossil fueled power generation will be essential to the energy market for the foreseeable future. 2PG's increase in fuel efficiency delivers a vital contribution towards meeting carbon legislation, affordability & economic growth targets.

What are the potential benefits?

Commercial deployment of this UK owned patented high efficiency engine in continuous off-grid power generation improves fuel efficiency from 225 to 187.5l/hr diesel at 1MW. The saving of £250 million & 0.85MT of CO2e per GWY improves affordability and lowers emissions. £0.5/W capital cost provides a 2yr payback promoting rapid adoption.

What approach did you take to address the energy trilemma?

A 20% fuel efficiency increase at 1MW (225 to 187.5l/hr diesel) addresses the energy trilemma saving £250M & 0.85MT CO2e / gigawattyear (GWY), reducing carbon & improving affordability & improving security of supply by operating alongside current technology.

What are your next steps?

The next step will deliver a correlated 1D simulation of the engine, providing industry standard evidence of final performance +/-2%; a 10kW (1/8th scale) single cylinder prototype used to provide test data for correlation; development & testing of Lontra's high efficiency compressor technology for integration with the engine.

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Technology development of the DUO wave energy converter

Partner organisations
University of Exeter

Pure Marine have developed and patented the DUO wave energy converter, which captures power from both the vertical and horizontal motions from waves at the same time, thus reducing the levelised costs of energy

What was the business need that motivated the project?

There are large renewable energy resources in ocean waves, however, there remains a need to develop new wave energy technologies to advance the state of the art and reduce the levelised costs of generating electricity if wave energy is to make a meaningful contribution to our energy generation mix.

What are the potential benefits?

The reduction in levelised costs from the DUO wave energy converter means wave energy can become competitive with other renewable energy technologies. In addition to providing sources of clean sustainable energy from secure resources, there will be significant job creation in manufacturing and marine based industries.

What approach did you take to address the energy trilemma?

Pure Marine's focus has been on developing a wave energy technology that addresses the major challenge facing the growing marine energy industry – how to produce more energy at a lower cost. Lower cost wave energy technology will means that secure renewable energy resources can be harnessed.

What are your next steps?

Funding from Innovate UK will support the company on completing sea trials of the DUO wave energy converter at the FabTest facility in Falmouth as a stepping stone to deploying commercial demonstration projects in the UK and elsewhere. Additional funding from the private sector is needed to scale up our business.

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Environmental Process Systems

102242

High temperature PCM/brayton cycle

Partner organisations
PAK-Engineering Ltd, SG BioDrying Ltd, University of Nottingham

EPS Ltd, along with our sister companies PCM Products Ltd and EAS Ltd, are heating, ventilation and air conditioning (HVAC) specialists. Existing knowledge of high temperature phase change materials enabled the project to develop an effective energy storage system.

What was the business need that motivated the project?

The existing UK infrastructure will have difficulties in handling electricity supply and demand as an increasing proportion of renewable solar, wind, biomass and wave energy is connected to the grid. Therefore there is a requirement for smart grids for electricity distribution combined with storage, which will offset large and steady electricity production with more variable rates of production from renewable sources. The proposed energy storage/power system will assist in balancing the mismatch in renewable energy and consumer energy demand, and also act as a buffer to the grid.

What are the potential benefits?

The current UK storage capacity is just over 3GW, with an estimated additional 2GW required by 2020. The project will design and test a 5kW proof of concept system that will be scalable based upon the customer's requirements from 20kW and 100kW to 7.5MW, thus combating the energy storage problem.

What approach did you take to address the energy trilemma?

This project aims to aims to address the Energy Trilemma by providing a solution for all 3 of the core dimensions: firstly, energy security - the proposed system will be able to store energy in a localised environment, reducing the requirement for access to the national grid. Secondly, by reducing amount of energy required from the grid the energy equality issue is addressed as energy will be accessible and affordable. Thirdly, the proposed system is environmentally friendly using both renewable and low carbon sources, thus addressing the environmental sustainability issue.

What are your next steps?

The project is currently in the pre-prototype construction and testing phase, but is currently ahead of schedule as preliminary investigations have been successful. With the project progressing it is generally believed, within the consortium, that this system has the potential to address the energy storage challenge that the UK faces.

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Magma Global

102226

m-Jumper carbon fibre pipe qualification

Partner organisations
BP Exploration, Subsea7, National Composites Centre

Design, development and manufacture of carbon fibre subsea pipes to supply the deep water oil and gas industry.

What was the business need that motivated the project?

To qualify a carbon fibre composite subsea pipe for deep water oil and gas production. Magma has identified an opportunity to qualify a lightweight composite pipe that can be flexed to fit and installed by a much smaller installation vessel than conventional steel technology. The oil and gas industry requires new technology to be qualified to rigorous standards, and this project will take the composite pipe to Technology Readiness Level 4.

What are the potential benefits?

A composite pipe will greatly reduce the time and overall cost of the installation in comparison to conventional steel technology. The longevity of the composite material will increase the product lifetime, and reduce the cost and impact of repair and replacement.

What approach did you take to address the energy trilemma?

The use of composite materials will greatly reduce the energy consumption of the manufacturing processes and transportation vessels, in comparison to conventional steel technology.

What are your next steps?

Having qualified the composite pipe to Technology Readiness Level 4, we will target commercial deployments on BP applications around the globe using installation know-how developed by Subsea7. This will be a key milestone in demonstrating industry confidence in Magma's pipe technology.

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AES UK & Ireland

102227

Large scale storage for network services

Partner organisations
Queen's University Belfast

AES UK & Ireland is part of The AES Corporation, a global Fortune 200 power company. AES are constructing the largest battery-based energy storage array in the UK, a 10MW project at Kilroot Power Station.

What was the business need that motivated the project?

Northern Ireland has particularly ambitious renewables targets, working towards 40% of electricity coming from renewable resources by 2020. The majority of this is from an expansion in intermittent onshore wind generation. The maximum allowable penetration of wind at any given moment is currently capped to 50% of demand to ensure grid stability. The consumer impact of this cap is significant; zero carbon and fuel cost wind energy is increasingly curtailed, at cost, and conventional generation run instead. AES saw an opportunity to deliver a better solution.

What are the potential benefits?

Battery arrays are always on, extremely reliable and provide a response virtually instantly, with no start up time usually associated with conventional generation. The resource is modular, scalable and can be located virtually anywhere. Because storage arrays can charge as well as discharge they provide double the nameplate flexibility.

What approach did you take to address the energy trilemma?

AES proposed a market demonstration of battery energy storage technology we've seen lower costs and carbon in every market Advancion performs within. We set up a steering group, ambitious timetable and low-risk installation within an existing power station to overcome the market barriers to energy storage we see across Europe.

What are your next steps?

In January 2016 the array will commence commercial operation under the existing Harmonised Ancillary Services structure, as well as demonstrating additional system services that could improve the grid's security, cost and carbon performance. AES' consortium partner, Queens University Belfast, will be independently quantifying how the array performs in the system.

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ONZO

102228

Development, deployment & verification of highly personalised customer energy usage advice solution

Partner organisations
Imperial College

ONZO analyses big data from utilities to deliver a personalised insight into energy consumption per home - for better service, marketing and consumer engagement and to help each customer improve their use of energy.

What was the business need that motivated the project?

Governments and regulators around the world recognise that providing better energy consumption information to customers is a key component in making energy more secure, affordable and less carbon intensive. ONZO's solutions use smart meter energy data analytics to enable utility companies to provide their customers highly personalised, actionable advice to reduce and manage energy use, while delivering improved levels of customer engagement and service.

What are the potential benefits?

By deploying ONZO's solutions, utilities benefit from a more attractive offering, and more engaged customers. The energy system benefits from reduced load, and in particular, better managed peak demand. Customers benefit from being better educated and informed about their energy use, allowing them to manage and reduce the energy costs.

What approach did you take to address the energy trilemma?

Through applying data analytics to energy consumption data, the project aims to educate and empower consumers to better manage their energy consumption. Reducing and shifting overall energy usage away from peak times decreases the total generation need and reduces reliance on "peaking" power stations, reducing emissions and facilitating renewable energy.

What are your next steps?

ONZO will present customers with highly personalised information and advice around their energy usage in order to spot energy waste and reduce demand, helping those who struggle to pay their bills in the winter, better manage their energy use throughout the year and reduce costs.

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John Caunt Scientific

102229

Remote fissile material monitoring of operational reactor cores

Partner organisations
University of Liverpool

Ground-breaking new technology, based on anti-neutrino detection in particle physics research, will revolutionise the real-time remote monitoring of nuclear reactor cores.

What was the business need that motivated the project?

There has been a marked lack of detector technology that is able to easily and precisely monitor the activity of the fissile process in the nuclear reactor core.

What are the potential benefits?

This technology will save the nuclear energy sector a potential $350 million a year in reduced inspection costs with additional benefits in improved bulk fuel accounting - simulation & validation - via the opportunity to decrease operational error budgets, providing improved efficiency whilst also fulfilling the safeguards requirements set out by the IAEA.

What approach did you take to address the energy trilemma?

This project addresses all three of the main issues regarding nuclear power: cost reduction, security in supply and low carbon footprint. The function of the detector is to continuously monitor nuclear reactor cores to detect unauthorised removal of fissile materials, dramatically increasing the safeguard of nuclear materials.

What are your next steps?

Upon the successful completion of the project, the group will fully commercialize the market ready prototype. We are actively exploring suitable partnerships and funding to as part of the exploitation plan (within the project work packages).

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Tempus Energy Technology

102230

The global electricity revolution for consumers

Partner organisations

One Sightsolutions Ltd, Viriya Energy Ltd, Wireless Energy Management Systems Ltd, Sustainability First

Tempus was established to exploit a disruptive technology and business model that allows customers to benefit from demand flexibility. The project demonstrates the technology with real customers to demonstrate the value along with ecosystem partners.

What was the business need that motivated the project?

The lack of: genuine competition in the energy market and technological innovation, while also the need to find an economic solution to climate change is what motivated the project. The market is dominated by a few vertically integrated companies that serve a model whereby the system is built for peak demand, which not only occurs only half the time, but is expensive and polluting. The project seeks to unlock the value of demand flexibility (DF), whereby customers' flexible assets are used to shift their non-time critical consumption into off-peak periods.

What are the potential benefits?

DF uses under-utilised assets, such as refrigeration and HVAC to lower demand during peak periods. This lowers energy costs but also reduces network strain, reducing investment needs for physical infrastructure. DF facilitates renewable energy to cost-effectively participate in energy markets as demand is moved into periods when it is plentiful.

What approach did you take to address the energy trilemma?

DF significantly increases the amount of renewables on the grid by matching consumption to periods when renewable energy generation is high. DF provides security of supply as demand can be used to fill the gaps in capacity. DF importantly reduces costs to customers through shifting their loads to non-peak periods.

What are your next steps?

The project is creating robust flexibility schedules that work for all customer segments and with any ecosystem partner. Policy-makers and regulators need to recognise the benefits of DF so that we can design an efficient energy system. This will attract the investment needed for a secure, affordable and sustainable system.

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Notes

Further Information

For further public information on the Energy Catalyst and these Round-1 projects, go to:

https://connect.innovateuk.org/web/energy-catalyst

Innovate UK

Innovate UK is the UK's innovation agency. Innovate UK works with people, companies and partner organisations to find and drive the science and technology innovations that will grow the UK economy - delivering productivity, new jobs and exports. Our aim at Innovate UK is to keep the UK globally competitive in the race for future prosperity.

Innovate UK is the trading name of the Technology Strategy Board, which is an executive non-departmental public body sponsored by the Department for Business, Innovation and Skills, and incorporated by Royal Charter in England and Wales with company number RC000818. Registered office: North Star House, North Star Avenue, Swindon SN2 1UE.

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