Technology Strategy Board
Driving Innovation

Results of competition: Emerging energy technologies - Feasibility Studies

Total available funding for this competition was £3m from the Technology Strategy Board and EPSRC.

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
AOPC Limited (lead) Cranfield University	Oxy-hybrid power cycle with advanced heat recovery network	£150,040	£56,272
Project description (provided by applicants)			
The project independently proves the concept of an invention and its Technology Readiness Level. The invention is a new oxy-hybrid turbine cycle that intrinsically produces a pure stream of carbon dioxide ready for use or compression and piping to storage. In order to meet the UK's 80% CO2 emission reduction target by 2050, and recognising the UK's continuing reliance on gas fired power generation, a substantial technology evolution is required over current technologies. This project will exploit an advanced heat recycle method in an oxy-hybrid turbine for electricity generation. This technology is capable of minimising the energy and capital cost penalties associated with the introduction of CCS in power plants. This innovative cycle will be more efficient and economic than combined cycle plants. The plant can also be fitted with a further unit operation to improve load range with more power output and efficiency. The project report will include the recommended next steps in the development of the cycle.			

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
C-Tech Innovation Limited (lead) EA Technology Limited Versarien Technologies Limited	Improved domestic air source heat pump for both space heating and hot water	£200,000	£150,000
Project description (provided by applicants)			
EA Technology, C-Tech Innovation and Versarien are three UK SMEs who have come together with the support of funding from the Technology Strategy Board to develop the next generation of technology for air-source heat pumps for domestic application Air-source heat pumps show considerable promise, but there is scope for further improvement. The project team has extensive experience in the design and performance evaluation of heat pumps and also brings insight into new and more efficient thermodynamic cycles and components for heat pump systems. The project team will take an existing design of air-source heat pump and modify it in order to increase its efficiency, especially for providing domestic hot water. The team will also design new heat exchanger and radiator components for the system to maximise its performance. The prototype system will be assembled and tested in a laboratory before being evaluated in a test house under realistic conditions. The project will run for 12 months and feature various dissemination activities for anyone interested to learn more.			

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Dearman Engine Company Limited (lead) Centre for Low Carbon Futures	Sub 1MW cryogenic low emission generators	£197,508	£148,131
Project description (provided by applicants)			
The Dearman engine is a technology being developed in the UK which uses liquid air as a 'fuel', both in mobile and stationary applications. It is suited to <1MW power generation and is an efficient method of converting waste heat to power. The technology is part of a major investment in capital equipment by EPSRC at the University of Birmingham, and the Dearman Engine Company (DEC) is currently developing a prototype. This project will help identify a route to market for the technology by developing business cases in a new potential market. The project will assess the business cases for the engine's application at different scales and in a variety of locations, so that the technology development can be optimised, and specific markets can be targeted for demonstration activities. We propose to carry out techno-economic analysis of the opportunities now, and under future energy system scenarios, to identify the scale and sources of value, the actors who would be in a position to capture this value, and how this value could be captured considering current or future regulatory frameworks.			

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
European Thermodynamics Limited (lead) TWI Limited	TITAN (Thermacoustic Innovative Technology for Waste Heat Recovery Application)	£189,904	£149,928

Project description (provided by applicants)

The TITAN project builds on the previous development work by ETL and UoL who have developed cutting-edge thermoacoustic technology to generate electrical power from waste heat. The TITAN project aims to take this knowledge and develop a product prototype to demonstrate the technical feasibility of thermoacoustic technology. In so doing the consortium will maximise the chances that the manufacture of these technologies will be undertaken within the UK. TITAN is a business-led consortium, with the marinised diesel engine sector acting as the initial route to market for the technology. The specific developments to be undertaken within the project relate to the following:

1. Development of a novel configuration of thermoacoustic device
2. Thermoacoustic and structural modelling to enable the design of the thermoacoustic system
3. Design and fabrication of complex heat exchanger topologies based on the modelling studies
4. Demonstration of the use of inexpensive prototype linear alternators
5. Development of feasibility of low cost regenerator material
6. Identification and adaptation of cost effective manufacturing technologies
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6. Identification and adaptation of cost effective manufacturing technologies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
GEA Heat Exchanger Limited (lead) Brunel University	Power generation and heat recovery from industrial waste heat with advanced CO2 thermodynamic power cycles	£199,571	£64,912
Project description (provided by applicants)			
In this feasibility study, a test rig of a small-scale power generation (up to 5kW) and heat recovery system will be established with heat source temperatures ranging from 100 C to 500 C, which is representative of actual industrial waste heat. The energy conversion system is based on a combined thermodynamic cycle and uses CO2 as a working fluid. Simultaneously, a detailed mathematical model for the proposed system will be developed and validated with measurements. The model will then evaluate, compare and analyse different system and component designs, heat recovery potentials and control optimisations which will eventually lead to optimal design and construction of the proposed system.			

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
IQE Silicon Compounds Limited (lead)	Ultra High Efficiency Solar Cells Using SiGeSn (HESCUS)	£199,215	£129,490
Project description (provided by applicants)			
This project aims to address the need for ever higher efficiency solar cells for terrestrial energy generation and also for space power applications. The project intends to extend already leading-edge technology and add a novel semiconductor material (SiGeSn) to better enable matching of the absorption wavelengths of the sub-cells of the device to the solar spectrum. By doing this it is anticipated that the conversion efficiency of such a device can be increased from ~39% to close to 50% for a 4J multi-sun terrestrial cell, and from ~28% to ~35% for a 1-sun 4J AM0 space solar cell, greatly enhancing power generated per unit area for both application areas.			

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
KCT Power Limited (lead) SgurrEnergy Limited Cluff Geothermal Limited University of Glasgow	Novel thermodynamic cycles	£186,216	£89,699

Project description (provided by applicants)

Today, a steam-based power plant may be most efficient at one time of day or night or season, but an organic-based plant may be more efficient at another time. This is because local temperatures for any given plant change constantly throughout the day and season. These temperature changes influence the plant's heat and cooling sources, and this is what determines how much power the plant can generate. Therefore the plant's design point is only most efficient for the less than 10% of the year when local temperatures exactly match design point.

The solution would be the ability to constantly reconfigure the plant to better match changing temperature conditions. This is currently thought impossible, but by using a working fluid mixture of ammonia and water to absorb the heat the power plant generates, we can do exactly that. We have found that an Ammonia-water working fluid solution of, say, 95% ammonia behaves as a completely different fluid than, say, 50% ammonia. We can alter the mixture during operation as needed in order to maximize the overall efficiency of the plant by matching the working fluid to the changing heat and cooling source parameters.

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Latent Power Turbines Limited (lead) C-Tech Innovation Limited	Power generation and cooling using LP Turbines	£124,666	£93,499
Project description (provided by applicants)			
LP Turbines operate according to a novel thermodynamic cycle supported by mathematical modelling and research evidence from Lancaster University. LP Turbines can generate electricity by extracting heat from their environment; even if the environment is at or BELOW room temperature. They can do this because LP Turbines are small "canned wind turbines", not conventional heat engines. They generate electricity by extracting kinetic energy (KE) from air circulating inside a hollow metal ring. The KE is locally amplified by placing the turbine inside a Venturi constriction in the ring. Replacement heat is then added through the metal walls of the ring. UK companies have expressed interest in using LP Turbines for a wide range of different low grade heat recycling purposes, including: (i) Replacing cooling towers with LP Turbines to harness waste heat currently dumped into the atmosphere (ii) Cooling London Underground tube stations (iii) recycling waste heat produced by industrial food production. (iv)			

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Nova Innovation Limited (lead)	ANSIS: Active Network, Synthetic Inertia and Storage	£197,640	£148,230

Project description (provided by applicants)

The Technology Strategy Board has funded a feasibility study by Nova Innovation into the integration of energy storage with renewable energy supply and local demand at a site with limited grid capacity. The objectives of the study are to maximise the utilisation of local renewable resources and to meet local demand within the constraints of the local grid. The solution will benefit the network operator and the project owner and provide a model that can be adopted by other renewable generators across the UK and worldwide. The technology developed also has wider applications - for example, in maximising the efficiency and control of variable frequency drives.

The project involves: detailed design of an electrical control system; selection and sizing of appropriate storage technology; design, build and test of the integrated system. The technology will be assessed in a real-world tidal power project - the world's first combined energy storage and tidal power system. This model has considerable scope for expansion, given the remote location of the global marine energy resource.

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Progressive Energy Limited (lead) Net Power Europe Ltd	Novel thermodynamic cycles utilising waste BOS gas from an integrated steel production process	£156,895	£117,671

Project description (provided by applicants)

Carbon dioxide pollution is widely acknowledged to be the single greatest challenge facing humanity. Two major contributors to this are power generation and industrial processes, including steel production. There is a clear need to find new ways of reducing the pollution; current methods of 'carbon capture' are costly, which represents a barrier to widespread adoption.

One technology which offers the potential to reduce carbon emissions from power generation is NET Power's Allam Cycle, which takes in coal as a fuel and efficiently produces electricity with carbon capture and storage (CCS). This approach improves the efficiency by more than 50% compared with current methods.

This project seeks to develop the coal-fired application of the technology to both cost-effectively demonstrate its operation and achieve industrial CCS. The test plant will trial a way for steel producers such as SSI to reduce the harmful and costly emissions from their plants, helping the environment and allowing their plants to stay open, safeguarding thousands of jobs.

Results of competition: Emerging energy technologies - Feasibility Studies

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
Renewable Technical Services Ltd (lead) TWI Limited	Non contact microphone array for structural health diagnostics combined with active noise and vibration cancellation for wind turbine nacelle machinery (CMDRIVE)	£200,000	£175,000

Project description (provided by applicants)

The project goal is to establish the feasibility of the innovative use of a non-contact microphone array for structural health diagnostics by vibration detection combined with active noise and vibration cancellation, for all the rotating machinery within an onshore wind turbine nacelle. Novel time and phase reversal techniques for received microphone signals will be investigated experimentally to investigate the possibility of high volume coverage for both vibration detection and cancellation.

The array could potentially achieve a step function reduction in wind farm levelised electricity cost through a combination of several cost benefit factors.

(1) Machinery lifetime extension, reduced maintenance costs and avoidance of lost revenue through reduced forced downtime and scheduled downtime

(2) Generation of increased revenue through turbine operation at higher wind speeds, increasing the capacity factor: made safely possible through reduced machinery vibration and environmentally possible through reduced noise emission

(3) Reduced noise issue costs. Benefits under all headings are estimated to total £35k per MW year, which is ~25% of an onshore turbine OPEX +CAPEX.

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Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Renovagen Limited (lead)	Renovagen transportable solar generator - PoC	£101,435	£60,861
Project description (provided by applicants)			
Renovagen Limited is developing a transportable solar power plant capable of producing 10 times more power than existing solutions. Our vision is to drive a simultaneous reduction in off-grid energy costs and carbon footprint in a number of different industries - including military, government and disaster relief, telecommunications, construction and events.			

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Stopford Projects Limited (lead) Liverpool John Moores University	Assessing the feasibility of using microwave induced plasma torrefaction for the production of an energy dense, carbon neutral fuel from wood pellets	£199,681	£65,761

Project description (provided by applicants)

There is a real need to de-carbonise energy production in the UK and elsewhere in order that governments meet their obligations set by the Kyoto Protocol and meet renewable energy generation targets. Using sustainable sources of wood as a fuel is one such method of reducing the CO2 emissions associated with energy production. However, wood has a high moisture content, low energy density, has variable combustion properties and there are considerable costs incurred modifying existing power plants for co-firing. As a result the energy sector is looking increasingly to torrefaction to produce an energy dense and renewable "biocoal" from wood.

Torrefaction is low temperature heating of wood in the absence of oxygen to produce a char-like fuel that, once made into pellets, has properties similar to coal. However, the economics of existing torrefaction technology has yet to be proven on an industrial scale and we believe that our microwave induced plasma torrefaction (MPT) technology is a more cost effective way to torrefy wood. The overall objective of our project is to develop a prototype MPT demonstration reactor for cost effectively converting wood pellets to biocoal.

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Sustainable Engine Systems Limited (lead) Thermacore Europe Ltd Northumbria University TWI Limited	Thermal management controller for domestic micro-generation systems	£188,371	£122,934
Project description (provided by applicants)			
This project is concerned with the development of a novel thermal management controller (TMC) for micro-Combined Heat and Power (micro-CHP) systems. Stirling-engine based units for providing heat and electricity for individual houses are increasingly of interest and several units are entering the marketplace. However, their economic operation and their ability to satisfy user heat demands could be much improved by a more sophisticated thermal management system that combines highly effective storage of heat with the ability to release such stored energy in amounts and at times to accurately meet the needs of the consumer. Using phase change materials with high thermal conductivity (instead of a large water storage tank) and an innovative 'heat pipe' for controlling heat release, the partners believe that their TMC will accelerate the take-up of domestic micro-CHP, as well as having applications at the larger scale.			

Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Swanbarton Limited (lead)	EXSTORM: EXploiting Storage Through an Open Market	£180,733	£135,550
Project description (provided by applicants)			
While it has been understood for some time that installing electricity storage units around the periphery of the electricity distribution network would help the network to cope with the increased demands of heat pumps, electric cars and solar energy generation, there has not been a business arrangement that would encourage anybody to actually install such storage. Swanbarton has identified a way for storage units to become profitable investments for householders and businesses, by integrating them into local energy markets, where households or business units etc can buy and sell electricity among themselves, rather than with a remote energy supply company. Swanbarton's research will contribute to products which will enable this.			

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Weatherite Manufacturing Limited (lead) University of Birmingham	MOF based adsorption system for integrated energy storage and power generation	£219,936	£65,952
Project description (provided by applicants)			
The ability to store energy is a key component to ensure national security of energy supply in the UK. The proposed technology in this project will contribute to the solution of this critical issue by providing means for effectively storing waste heat, transporting and integrating it to existing infrastructure. There is a huge amount of waste heat that costs UK billions and cause adverse environmental effects. This project proposes a new way in which waste heat can be stored, transported and integrated to existing infrastructure to provide for heating, cooling and power generation. Practically, the development of a new "heat battery" where heat can be stored for an indefinite period of time without the need for expensive thermal insulation and effectively used to suit the end user energy requirements. The thrust of the proposed technology is to exploit the superior water adsorption characteristics of MIL101Cr Metal Organic Framework (MOF) material (5 times that of the best commercially available zeolite) to store and transport waste heat in the form of heat of adsorption.			

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Williams Grand Prix Engineering Limited (lead) University of Sheffield	Grid integration of multiple flywheel energy storage systems	£145,175	£86,582
Project description (provided by applicants)			
The project will look at optimising efficiency, fatigue life, and cost of multiple-flywheel energy storage systems for grid applications. Energy system operators/owners have a need for energy-storage in order to stabilise grids against fluctuating power demand and supply. This is particularly relevant when incorporating renewable energy sources into islanded, remote or 'weak' micro grids. Williams' already well developed and innovative flywheel energy-storage technology is ideally suited to this application, due to its fast response, high power, low maintenance, and twenty year life. Through this project, supervisory control strategies for a scalable multiple flywheel system will be developed to optimise system efficiency and flywheel fatigue life. Optimal grid tie inverter arrangements (numbers and ratings), in terms of efficiency and cost, will also be investigated to further improve the complete energy storage solution.			

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Xanthella Ltd (lead) University of St Andrews	Solar collection and processing for more cost effective algal biofuel production	£176,032	£74,370
Project description (provided by applicants)			
Algae hold great promise for the large scale production of carbon-neutral biofuels that avoid many of the problems of terrestrial biofuels (such as palm oil) in that they require only about 10% of the space of terrestrial crops and can use waste water for growth and their nutrients. Current production systems are, however, uneconomic against both fossil and first generation biofuels and require significant step wise improvements to redress this. This feasibility study, led by Xanthella - a biotechnology company based in Oban - in collaboration with physicists from the University of St Andrews, aims to deliver a step change in the performance-cost ratio of algal photo bioreactors (PBRs) operating under solar illumination for the production of carbon neutral biofuels. This will be achieved through the development of an innovative solar light collection component for use in Xanthella's internally-lit photobioreactor designs.			

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Results of competition: Emerging energy technologies - Feasibility Studies

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Participant organisation names	Project title	Proposed project costs	Proposed project grant
Zyba Limited (lead) Wychwood Water Systems Ltd Maryport Marina North West Fairlead Maritime Limited University of Bath	C-Cell PoC - A step change wave energy device for providing efficient and affordable marine renewable energy system	£197,274	£117,941
Project description (provided by applicants)			
Zyba has invented a new wave energy paddle ("CCell") that extracts energy from ocean waves. The innovative curved compound shape of CCell makes for a strong yet light structure, with superb wave energy absorption properties. In laboratory tests it extracts significantly more energy than comparable alternatives. This project will develop numerical tools to improve our understanding of the interactions between the ocean waves and paddle structure through a detailed program of numerical and laboratory studies. These tools will be used to optimise the device for a range of conditions, culminating in the design of an integrated system for desalinating sea water using reverse osmosis ("RO"). A shortage of fresh water is a global problem, with a growing market for RO equipment on arid island communities. The project includes three UK SMEs and two universities, with results to be disseminated in academic papers and conferences. If successful it will lead to sea trials.			