UKERC

UKERC ENERGY RESEARCH LANDSCAPE: WIND ENERGY

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1. Overview

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Characterisation of the field

The last two decades have seen the generation of electricity from wind energy transformed into a major industry. Large-scale commercialisation of wind energy in the UK started with onshore wind farms typically using 300kW wind turbines. The technology of multi-MW turbines has been developed and deployed rapidly to the extent that as of end 2012 there was a total of 8.445GW onshore and offshore installed capacity in the UK[1]. The UK has the largest amount of installed offshore wind in Europe, with a total of 20 windfarms and 2.948GW installed capacity, 58.9% of all offshore installations, as of end 2012[2].

Decades of experience in offshore structures and operations in the gas and oil industry has put the UK in a good position to exploit its offshore wind resource, and to engage in overseas developments.

Deployment of wind energy is rapidly accelerating in the UK, with 1.3GW installed in 2011 and 1.9 GW in 2012. At the end of 2012 the installed capacity would provide approximately 6% of the UK's total electricity consumption in a normal year[3].

This rapid deployment is expected to continue. As of June 2012 there was a total of 6.856GW wind capacity operational in the UK. In addition there was 4.174GW under construction, 5.129GW consented, and 11.985GW planned, so that as of June 2012 in the UK there was a total of over 28GW wind generation capacity operational, under construction, consented, or in planning[4].

Wind energy is likely to be the biggest contributor to achieving the UK Government's legal commitment to meet 15% of total energy demand from renewable sources by 2020 (this compares with renewables meeting only 1.5% in 2005). The Government believes this might be achieved with renewables meeting around 30% of electricity demand.

Offshore wind is a priority sector for investment by the UK's Green Investment Bank, which has up to £3 billion funding available for a portfolio of green infrastructure projects[5].

The Government's Microgeneration Strategy promoted the installation of low carbon and renewable onsite energy technologies, known as 'microgeneration', and from April 2010 small-scale (less than 5MW) low carbon electricity generation has been incentivised by the Feed-In Tariff Scheme. The tariffs have been revised several times and in the case of small-scale wind generation, tariffs are significantly lower since December 2012.

Small wind turbines have been used for battery charging in remote power supplies, where a grid connection is not available or would be prohibitively expensive, and wind turbines have also been developed for mains connection in domestic applications.

A wide range of disciplines participate in wind energy research, from science and engineering to the environmental, geological and social sciences, providing vital information on the impact of building, operating and decommissioning wind turbines.

[1] EWEA report, Wind in power: 2012 European statistics
[2] EWEA report, The European offshore wind industry: key trends and statistics 2012
[3] EWEA report, Wind in power: 2012 European statistics
[4] renewableUK report, Wind: State of the industry 2012
[5] Green Investment Bank: Offshore wind

The amount of publicly-funded wind energy R&D carried out in the UK declined substantially from the 1980s, and by 2002, the direct publicly funded wind energy R&D budget was £2.2m. The volume of applied R&D in the UK is now rising, prompted by the drive for efficiency improvements and overall cost reduction. Key players include industry, universities and research institutions.

The UK Government agencies have increased funding to cut the costs of offshore wind power and accelerate its deployment around the UK. Of particular note are the £40M initiative announced jointly in 2008 by the Energy Technologies Institute and the Carbon Trust, and the £30M initiative for offshore wind innovation announced in 2011 by the Department of Energy and Climate Change.

Research Challenges

Wind energy R&D is required to support the following aspects:

- Improve the efficiency and reliability of wind turbines
- Reduce the cost of energy production (esp. offshore)
- Facilitate the optimum siting of machines
- Reduce the impact on existing electricity infrastructure

A UKERC-sponsored wind energy road-mapping meeting was held in March 2009 and the resulting list of research topics, and an updated commentary written in December 2012 is available on the UKERC website[6]. Its primary aim was to identify priority areas for UK wind energy research, and a detailed list was compiled. Particular attention was drawn to the need for i) improved offshore resource modelling and wake models; ii) seabed modelling and understanding of scour; iii) turbine technology and modelling issues; iv) integration issues; and v) the need for UK experimental facilities.

The Low Carbon Innovation Co-ordination Group (LCICG) have developed Technology Innovation Needs Assessments (TINA's) to identify key priorities for various technologies, including offshore wind[7]. This 2012 report summarises key needs in five sub-areas; turbines, foundations, collection and distribution, installation, and operation and maintenance. The LCICG analysis draws on the DECC report '2050 Pathways Analysis'[8] (2010), the UKERC report 'The cost of offshore wind in UK waters'[9] (2010), and analysis by the Carbon Trust, as well as expert interviews.

[6] Record of the UKERC-supported Wind Energy Research Road Mapping meeting David Infield, January 2013

[7] Technology Innovation Needs Assessment (TINA) - Offshore Wind Power, LCICG, February 2012

[8] 2050 Pathways Analysis, DECC, 2010

[9] Great expectations: The cost of offshore wind in UK waters, UKERC, 2010

2. Capabilities Assessment

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The UK capabilities in wind energy cover the whole range of technologies, from the design and manufacture of wind turbine generators, blades and towers; to resource prediction, monitoring, control, grid integration technologies, foundations, and onshore/offshore wind farm development and construction.

The market potential for onshore/offshore developments is high both in the UK and internationally. There are many international organisations involved in wind energy research, and these are investing and collaborating with UK programmes such as through the EU Framework Programmes, and the IEA.

Table 2.1 UK Capabilities

UK Capability	Area	Market potential
High	Wind farm development and exploitation	**High** Potential in the UK onshore/offshore in the short-medium term. High potential for European and global operations. Several UK companies are active abroad, particularly in the USA.
	Grid Integration	**High.** Global potential for integration in strong and weak networks. UK industry has a high level of capabilities, backed up by research expertise.
	Wind power prediction	**High**. Software tools and consultancy in this area are highly marketable. The UK has significant research and commercial expertise which has lead to a global lead in providing prediction tools and consultancy.
	Direct drive generators and power converters	**High.** Global potential in the short-medium term for supply of generators and converters to wind turbine manufacturers**.**
	Monitoring and Control	**High**. Global potential market in the medium term for advanced control system designs that utilise measurements of loading and dynamic behaviour as input in order to mitigate fatigue loading. UK companies and academic research groups are at the forefront of developments in this field.
	Small wind turbines	**Medium**. The UK market for domestic building mounted wind turbines is new but may develop quickly, with UK manufacturers already in a strong position to supply. There is high export potential to countries with similar urban requirements e.g. New Zealand. There is a large market for domestic wind turbines in the USA, where the requirement is characterised by larger machines on towers separate from the building.

	Blade materials technology and lifetime prediction	**Medium**. There is a global market for advanced blade design related to the need to build larger wind turbines with high structural integrity, lifetime and safety. The UK capability is high in blade materials research, condition monitoring, and lifetime prediction
Medium	Resource assessment	**High** Software tools and consultancy for resource assessment and wind farm siting are highly marketable, and already well developed in the UK.
	Offshore wind technologies including connection and foundations	**High**. The UK market potential is high in the short-medium term. This is a growing market given the planning difficulties with onshore wind sites, and the potential for higher wind regimes offshore. Many European countries have operational offshore wind farms (Denmark, UK, Holland, Sweden, Ireland), and other countries are expressing intent (Germany, France, Spain, Belgium, and the USA).
	Wind turbine design and manufacture	**Medium**. The market and deployment of wind turbines is accelerating world-wide. There is a significant advantage in siting wind turbine and blade manufacturing close to local markets. European and global suppliers are well-established. Increased demand is attracting new players particularly in China which provides a large market for technology transfer, training and software sales.

3. Basic and applied strategic research

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The Research Councils UK (RCUK) Energy Programme aims to position the UK to meet its energy and environmental targets and policy goals through world-class research and training. Led by the Engineering and Physical Sciences Research Council (EPSRC), the RCUK Energy Programme brings together the work of EPSRC and that of the Biotechnology and Biological Sciences Research Council (BBSRC), the Economic and Social Research Council (ESRC), the Natural Environment Research Council (NERC), and the Science and Technology Facilities Council (STFC).

To date, the SUPERGEN initiative has been the primary delivery mechanism for sustainable energy research funded by the Research Councils' Energy Programme.

The SUPERGEN Wind Consortium consists of seven academic research groups with expertise in wind turbine technology, aerodynamics, hydrodynamics, materials, electrical machinery & control, and reliability & condition monitoring. The Consortium has the active support of 19 industrial partners, including wind farm operators, manufacturers and consultants.

The principle research objective is to achieve an integrated, cost-effective, reliable & available Offshore Wind Power Station, and research is focussed on engineering solutions to:

- Improve the efficiency and reliability of wind energy
- Reduce the cost of energy production
- Facilitate the siting of machines
- Reduce the impact on existing infrastructure

The EPSRC funds the Centre for Doctoral Training in Wind Energy Systems at the University of Strathclyde, the E-Futures Doctoral Training Centre for Interdisciplinary Energy Research at the University of Sheffield, and the Industrial Doctoral Centre for Offshore Renewable Energy (IDCORE) at the University of Edinburgh. The EPSRC Centres for Doctoral Training (CDT) represent a new approach to training PhD students, and aim to create new working/training cultures, build relationships between teams in industry and forge lasting links with industry.

The EPSRC also funds individual university-based research projects through its "Responsive mode" grant programme, as well as PhD research studentships and MSc's through training grants.

In January 2013, EPSRC announced its intention to renew the Wind SUPERGEN consortium in the Hub model.

Table 3.1: Research Funding

Funding Stream	Funding Agency	Description	Committed Funds	Period	Representative Annual Spend
RCUK Energy Programme	Research Councils UK (RCUK)	The Research Councils UK (RCUK) Energy Programme, is investing more than £625 million (2011 onwards) in wide-ranging energy research towards a low carbon future. This builds on an investment of £839 million over the previous eight years. Within the RCUK Energy Programme, the RCUK Wind Energy Research Programme is led by the Engineering and Physical Sciences Research Council (EPSRC), together with research by the other Research Councils and the UK Energy Research Centre (UKERC), and via collaborative projects with other institutes such as the British Geological Survey, Plymouth Marine Laboratory, Proudman Oceanographic Laboratory and Scottish Association for Marine Science.		2011 on	
EPSRC Wind Energy Programme	EPSRC	The EPSRC Wind Energy Programme is aimed at research to improve efficiencies, reliability, handling intermittency of supply and environmental issues together with public perception and acceptability. The EPSRC wind energy project portfolio currently consists of 8 projects worth £14.25 million.	£14.25M (total EPSRC funding)	2010 to 2014	
Wind Energy Doctoral Training Centres	EPSRC	The Wind Energy Doctoral Training Centre at the University of Strathclyde is meeting the needs of the wind energy industry by providing PhD graduates with the skills necessary to lead future developments in wind energy systems. Students will gain competencies in core aspects of wind energy systems engineering and understand the socio economic impact of wind energy systems. Research studentships are awarded to engineering and physical science graduates to undertake a 4-year PhD. Ten studentships were awarded in 2009, and a further ten studentships were	£5.8M (included in total EPSRC funding above)	2010 to 2014	

		awarded to start in October 2013.			
Renewable Energy Doctoral Training Centres	EPSRC	The Renewable Energy Doctoral Training Centres include wind energy in their portfolio: The E-Futures DTC for Interdisciplinary Energy Research at University of Sheffield covers a broad range of energy-related topics, covering conventional and renewable energy generation, conservation and efficiency, environmental science, and management issues in the energy supply chain. The Industrial Doctoral Training Centre for Offshore Renewable Energy (IDCORE) The Universities of Edinburgh, Strathclyde and Exeter together with the Scottish Association for Marine Science and HR-Wallingford formed a partnership in 2011 to deliver the RCUK-EPSRC and ETI funded IDCORE, which includes wind energy in its portfolio. Thirteen PhD students started in 2012 and up to fifteen studentships are available for entry in 2013. EPSRC funds 13 energy research centres for doctoral training, covering a broad porfolio of energy topics. These represent over £60 million of investment by the RCUK-EPSRC and over 600 early career researchers. EPSRC funds a Network of Energy Centres for Doctoral Training to promote collaboration on training programmes and research projects.	£13.5M (total) £3.4M approx. related to wind energy (included in total EPSRC funding above) £6.5M	2011 to 2015 2009 to 2018 2011 to 2020	
EPSRC Wind Power Research	EPSRC	The Supergen Wind Energy Technologies Consortium consists of 6 Universities and 1 Research Laboratory, with the active support of 18 Industrial and Research partners. The objective of the research is to achieve an integrated, cost-effective, reliable & available Offshore Wind Power Station. To achieve this the project has four themes with wide-ranging topics: • The Wind Farm, including the offshore wind resource, wakes and aerodynamics, radar and the environment, optimisation of farm performance, and multiple wake	£4.8m (included in total EPSRC funding above)	3/2010 to 3/2014	

		impacts on machines • The Wind Turbine, including aspects of drive train dynamics, rotor-wind field interaction, turbine blade and tower materials, fault detection, and subsea turbine foundation • The Connection, including new offshore nacelle and substation equipment arrangements, offshore control schemes, connection to shore, integration of energy storage • The Wind Farm as a Power Station, including array performance, wind farm control, operation as a power station, integrated monitoring, operation research for the farm, integrated wind farm economics, and connection technology			
UKERC Energy Research Centre	UKERC	UKERC undertakes interdisciplinary research into sustainable future energy systems, and aims to inform UK policy development and research strategy. An example is the report by UKERC on "The Costs and Impacts of Intermittency", dealing largely with the intermittency inherent in wind generators. The report was targeted at non-specialists and policy makers, but also provides information for energy experts.			
Research Base Funding	EPSRC	These include grants awarded to institutions for individual projects. Three projects were in progress as of January 2013.	£0.38M (included in total EPSRC funding above)	On-going	

Table 3.2: Key Research Providers

Name	Description	Sub-topics covered	No of staff	Field
Energy Technology Partnership	The Energy Technology Partnership (ETP) is an alliance of twelve independent Scottish Universities, engaged in energy-related RD&D, with capability and research	• Generators and variable speed drives • Offshore wind turbines • Integrating wind power into the national grid • Environmental impact		Electrical and Electronic Engineering, Mechanical Engineering

	strengths across a wide spectrum of technologies, including the Wind Energy Theme	• Domestic wind turbines design		
The University of Aberdeen	The Research programme in Energy Technologies within The Department of Engineering includes offshore wind farm arrays, power transmission and distribution systems	• DC offshore grid network • Interconnecting offshore wind farms • Multiterminal HVDC	3 academic staff 3 researchers	Electrical and Electronic Engineering
University of Bristol	Aerospace Engineering has started a large project in High Performance Ductile Composite Technology (HiPerDuCT)	• Composite technology • Materials for wind turbine blades	4 academic staff 4 researchers	Mechanical, Aeronautical and Manufacturing Engineering
Department of Engineering, University of Cambridge	Within the Department of Engineering, The Geotechnical and Environmental Research Group has wide interests, including offshore geotechnics, construction processes, and fundamental mechanics of soils.	• Monopile foundations for offshore wind farms in shallow waters read more • Offshore wind farms for deep-water sites read more	3 academic staff 3 researchers	Civil Engineering
Cranfield University	The School of Applied Sciences has an Industrial Doctorate Centre in Composites Manufacture.	• Composites Manufacture •	2 academic staff 2 researchers	Engineering and Technology
Durham Energy Institute	The Durham Energy Institute is a multidisciplinary centre linking several departments,	• Reliability and condition monitoring of offshore wind turbines • Analysis of reliability of	4 academic staff 10 researchers	Electrical and Electronic Engineering

	and covering six technology areas. This includes includes Wind Research within the Energy Conversion, Transmission and Distribution theme.	drive trains and electrical converters • Medium and small wind turbine converters		
University of Edinburgh	The Institute for Energy Systems (IES) leads the innovative IDCORE Engineering Doctoral Centre in Offshore Renewable Energy (together with the Universities of Exeter and Strathclyde)	• Offshore renewable energy	5 academic staff Up to 14 researchers (all offshore energy technologies)	
Aerospace Sciences Research Division, University of Glasgow	The Fluid Dynamics research group integrates seven core research themes, including Wind Turbines	• Modelling of unsteady flows on wind turbines • Rotor design using computational fluid dynamics	1 academic staff	Mechanical, Aeronautical, and Manufacturing Engineering
Institute of Petroleum Engineering, Heriot-Watt University	The EcoWatt2050 consortium includes Heriot-Watt University and the Universities of Edinburgh, Aberdeen, Strathclyde, Swansea and the Highlands and Islands, the National Oceanography Centre (Liverpool) and with Marine Scotland Science (MSS)	• Quantifying the balance between energy extraction and environmental change • Criteria in marine spatial planning and policy development.	3 academic staff 3 researchers	Environmental Sciences
Imperial College London	Several departments are active in energy research, Aeronautics, The Centre for Energy Policy and Technology (ICEPT), Electrical and	• Energy policy and issues related to the development of wind power • Aerodynamics • Renewable energy integration and flexible	9 academic staff 9 researchers	Engineering and Technology

	Electronic engineering, and Mechanical Engineering.	transmission		
Lancaster University	Two departments are active in the energy field, Engineering, and Mathematics and Statistics	• Condition monitoring of distributed generation systems • Time-series analysis of non-statioary energy data	2 academic staff 2 researchers	Engineering and Technology Physical Sciences and Mathematics
University of Liverpool	Energy Technology is one of three key research themes in in the Electrical and Electronic Engineering Department	• Control of induction generators in variable speed wind turbines	1 academic staff 1 researcher	Electrical and Electronic Engineering
Centre for Renewable Energy Systems Technology, Loughborough University	The Centre for Renewable Energy Systems Technology (CREST) provides research, demonstration and training in renewable energy technologies	• Network integration • Remote condition monitoring • Resource assessment and wind turbine micro-siting • Small wind turbine aerodynamics and design • Wind Power Forecasting • Wake Modelling • Climate Change Impacts	8 academic staff 7 researchers	Electrical and Electronic Engineering
Centre for Mathematical Modelling and Flow Analysis, Manchester Metropolitan University	The Centre for Mathematical Modelling and Flow analysis (CMMFA) is a centre for excellence in computational fluid dynamics (CFD) and specialises in the development and application of computational hydraulics.	• Computation of hydrodynamic flows and current induced scour around offshore turbine mounts read more	2 academic staff	Computer Science and Informatics
Composite Materials Group, University of Manchester	The Composite Materials Group conducts research on composites and new materials,	• Reduction of fatigue damage in blade and tower structures by materials selection, structural	6 academic staff	Mechanical Engineering

	applicable to wind turbine blades and towers. It is one of ten research groups within the School of Materials, University of Manchester	modification, or design • Fabrication and assembly of large blades • Condition monitoring, failure prediction and prevention • Large wind turbine designs, alternative designs and manufacturing technologies • Multi-functional blades, materials and structures		
Electrical and Electronic Engineering, The University of Manchester	The School of Electrical and Electronic Engineering links fundamental research with developments in industry. Research in wind energy is carried out in two groups, The Electrical Energy and Power Systems Group, and the Power Conversion Group.	• Optimisation of power system operation with large-scale penetration of renewable energy resources • Lightning protection of wind turbines • VSC-HVDC integration of offshore windfarms • Generator fault detection by spectral analysis of machine electromechanical signals • Control, machine design and power electronic converters for wind turbines	6 academic staff	Electrical and Electronic Engineering
School of Electrical, Electronic and Computer Engineering, Newcastle University	The School of Electrical, Electronic and Computer Engineering at Newcastle University contains four groups. The Power Electronics, Drives and Machines Group carries out research into motor design, novel electromagnetic devices, power semiconductor devices and circuits, and	• Emulation of fast transients for design of grid-connected converters • Novel generators for wind power applications • Regulation of power from wind farm sites sited in rural weak grid locations	2 academic staff	Electrical and Electronic Engineering

	advanced control strategies.			
Power and Wind Energy Research (PaWER) Group, Northumbria University	The PaWER Group is part of the Energy Systems and Advanced Materials Research Group, and carries out research in the areas of power-electronics applications in power networks, electric machines and drive systems, and renewable energy.	• FACTS • Power quality • Embedded generation and active control of power distribution networks. • Control of doubly-fed generators for wind power applications.	3 academic staff	Electrical and Electronic Engineering
Robert Gordon University	The School of Engineering offers research in wind generation	• Transient stability of wind generators	1 academic staff 1 researcher	Engineering and Technology
Energy Research Unit (ERU), STFC Rutherford Appleton Laboratory	The Energy Research Unit covers a broad range of topics in wind energy research including composite materials, condition monitoring, wind power output prediction, and energy storage	• Composite materials • Blade condition monitoring, including thermoelastic stress and acoustic emission • Damage detection and characterisation using thermoelastic stress and thermography measurements • Wind power prediction • Energy storage • Integration into electrical networks	4 wind energy researchers, plus access to other STFC specialists as required	Mechanical Engineering, Electrical and Electronic Engineering, Computer Science and Informatics
The Acoustics Research Centre, University of Salford	The Acoustics Research Centre key research areas include remote acoustic sensing of metrological conditions, audio signal processing and transducer design	• Advanced signal processing methods applied to acoustic wind profiling for use in wind farm assessment	1 researcher	Computer Science and Informatics

Communications and Services Research Group, University of Stirling	The Communications and Services research group has a wide ranging interest in communications network technologies, including the programmability of Wireless Sensor Networks in wind farms.	• Distributed sensors for proactive condition monitoring of wind turbines	2 academic staff 1 researcher	Computer Science and Mathematics
Department of Electronic and Electrical Engineering, University of Strathclyde	Wind energy related research and training is carried out in three Centres: Industrial Control Centre, development and implementation of advanced control systems addressing linear and non-linear problems Institute for Energy and Environment including the Renewable Energy Technology Group, researching advanced technologies and strategies to support renewable energy and electric vehicles UK Wind Energy Research - Doctoral Training Centre combining training and research to enable PhD students to lead future developments in wind energy systems.	• Wind turbine dynamics and associated control device technology and simulation • Wind turbine modeling • Design and implementation of advanced control systems for wind turbines • Integrated design of rotor, drive-train and control system • Embedded generation • Distributed Sensors for Proactive Condition Monitoring of Wind Turbines	20 academic staff 20 researchers	Electrical and Electronic Engineering
Fluids and Vehicles	The Turbulence Research	• Wind flow modelling for	4 academic staff	Mechanical,

Engineering, University of Surrey	Group is concerned with fundamental aspects of turbulent flows of engineering and meteorological interest. The Department of Chemical and Process Engineering runs an MSc Renewable Energy Engineering Course that includes a modules on Wind energy Technology	resource assessment • Wind flow over hills • Wind turbine wake-wake interactions for large wind turbines		Aeronautical and Manufacturing Engineering
School of Engineering, University of Warwick	Within the School of Engineering, research related to wind energy is within two groups: Energy Conversion - Power Electronics, Applications & Technology in Energy Research (PEATER) Sensors - Advanced Imaging and Measurement	• semiconductor switching devices, MOSFET and IGBT technologies for power electronic converters • wireless monitoring of offshore wind towers and blades • condition monitoring power electronics for reliability • development of large future energy networks	20 academics 13 research fellows	Electrical and Electronic Engineering

4. Applied Research and Development

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The main funding for applied research in wind technologies in the UK is provided by UK Government agencies.

The Department of Energy and Climate Change (DECC) supports and demonstrates key later-stage innovative technologies relating to energy supply and efficiency.

The Technology Strategy Board (TSB) supports collaborative medium-size research and development projects using technology-specific research calls.
The Energy Generation and Supply Knowledge Transfer Network (EG&S KTN), provided by the Technology Strategy Board (TSB), provides an effective way for industry and academia to collaborate online, network and share knowledge with other innovators.
The Low Carbon Funding Landscape Navigator, provided by the TSB, is a fully searchable database which helps identify the latest funding opportunities in the Low Carbon area, find partners and help with consortia building.

The Energy Technologies Institute (ETI) is a public-private partnership that invests in developing full-system solutions to long-term energy challenges.

The Carbon Trust offers a wide range of support for low-carbon innovation mainly in the pre-market arena.

The Research Councils UK (RCUK) Energy Programme, described in Section 3.1, provides funding for basic strategic and applied research.

Funding is provided for sustainable development projects (which can include wind energy) by the Regional Development Agencies (RDAs) in England (until they were abolished on 31 March 2012), The Welsh Government, the Scottish Enterprise, and the Highlands and Islands Enterprise.

The European Union (EU) coordinates a Strategic Energy Technology Plan (SET Plan) that supports the development of energy technologies necessary for meeting the EU's 2020 targets and 2050 vision. There are significant R&D activities by international companies; however this is generally commercial and consequently is difficult to identify and quantify.

Table 4.1: Research Funding

Programme	Funding Agency	Description	Committed Funds	Period	Representative Annual Spend
Innovation funding for low-carbon technologies, Department of Energy	Department of Energy and Climate Change (DECC)	In the UK Renewables Roadmap (July 2011), DECC announced funding of up to £30M for offshore wind innovation. DECC is funding two schemes from this budget: the Offshore Wind Accelerator, managed buy			

and Climate Change		the Carbon Trust; and the Offshore Wind Component Technologies Development and Demonstration Scheme (3 calls for proposals)- See Section 5.			
Delivering innovation, Technology Strategy Board	Technology Strategy Board (TSB)	The Technology Strategy Board (TSB) is a business-focused organisation dedicated to promoting technology-enabled innovation across the UK. The activities of the TSB are jointly supported and funded by the Department for Business, Innovation and Skills (BIS), the Department for Energy and Climate Change (DECC), other government departments, and the research councils. The TSB invests in research and development; builds partnerships to address major societal challenges; and runs a wide range of knowledge exchange programmes to help innovation flourish. The TSB energy programme will commit up to £35m per annum to help the UK energy industry. The TSB is a member of the Low Carbon Innovation Coordination Group (LCICG), is a sponsor of the Energy Technologies Institute and, in addition works closely with other funding agencies such as the Department for DECC, the Research Councils, and the Carbon Trust to develop a coordinated Energy R&D programme for the UK. Current funding of up to £11.2M is for developing the offshore renewable energy supply chain, including £10M by the TSB and DECC for developing the offshore wind supply chain, and £1.2M with the Natural Environment Research Council to establish knowledge transfer partnerships. The TSB's offshore renewable energy catapult (and forum) will focus on technologies applicable to offshore wind, tidal and wave power and is expected to go live in 2013.	£25.5M (offshore renewables) £11.2M	2007 to 2012 2012 onwards	

		Current TSB publications can be found in TSB publications Archived publications can be found in GOV.UK publications			
Carbon Trust Technology Innovation	Carbon Trust	The Carbon Trust funds projects to identify and help accelerate emerging low carbon technologies. The Applied Research Scheme offered grants up to £500k to projects which develop new low carbon technologies that will benefit the UK. Since 2002, total funding of £700k has been awarded to 6 wind projects, 4 of which concerned small or building-mounted wind turbines. The Carbon Trust currently has identified 5 innovation programmes for targeted support. The Offshore Wind Accelerator (OWA) brings together nine nine international energy companies (with 36GW licensed wind generation capacity) in a joint industry project to work towards reducing the cost of offshore wind by at least 10% by 2015, and accelerate deployment of offshore wind on a path towards full commercialisation. The project comprises RD&D activities in foundations; wake effects; access, logistics and transportation; and electrical connection, cable installation and transmission systems. The Offshore Wind Accelerator is two-thirds funded by industry and one-third funded by the UK Department of Energy and Climate Change (DECC) and Devolved Administrations.	Applied Research: £700k Offshore Wind accelerator: up to £10m	2002 onwards 2008-2014	
Energy Technologies	Energy	Established in 2007, the Energy Technologies Institute	£13.7M	2009	

Institute - Offshore Wind	Technologies Institute (ETI)	(ETI) is a private sector organisation funded equally by member companies and the UK Government. It aims to make a major contribution to the achievement of UK energy and climate change goals. Offshore wind is one of ETI's nine Technology Programmes. The Carbon Trust and the Energy Technologies Institute (ETI) announced plans for a £40m joint initiative to cut the costs of offshore wind power and accelerate its deployment around the UK. Four projects to receive funding totalling around £14m were announced in 2009, and a further three projects were announced in 2010 - 2011: • NOVA (Novel Offshore Vertical Axis Demonstrator) (£2.8M / 2 years), design of a low maintenance, vertical axis offshore turbine. • Helm Wind (£2.5M / 2 years), design of a low cost offshore turbine and array interconnection; • Deep Water (£3.3M / 2 years), design of a floating 5MW deepwater turbine; • Condition Monitoring (£5.1M / 3 years), developing condition monitoring systems for reduced electricity generation costs; • Offshore Wind Test Rig (two projects, £26.53M / 3 years), designing and implementing an indoor test rig at Narec capable of testing complete drive trains and nacelles up to 15MW (see Section 6). • Offshore Renewable Industrial Doctorate Centre (ETI £5.1M; EPSRC 1.4M) to train up to 50 students in the research and skills needed to accelerate the development of renewable energy technologies.	£31.53M	2010 to 2012	
Scottish Enterprise - Energy	Scottish Enterprise	Offshore wind has been identified as a key strategic priority by Scottish Enterprise and the Scottish Government. Scottish Enterprise and Highlands and	responsive	2012 to 2013	

		Islands Enterprise are planning a series of Research and Development funding calls that will offer funding support for projects that have the potential to reduce the cost of producing energy from offshore wind. A Market Foresighting Report identified opportunities in addressing the following aspects of offshore wind projects: •Remote condition monitoring and control •Novel offshore operation and maintenance approaches •Alternative drive train design integration •Support structures for challenging sites The first of three funding calls for offshore wind (December 2012 to March 2013) addresses the high costs of access and operations and maintenance offshore, using alternative methods such as remote working, and higher levels of turbine reliability. Prototyping for Offshore Wind Energy Renewables Scotland (POWERS) offers funding to support the capital costs associated with the full scale production (and not individual component parts) of next generation wind turbine prototypes in Scotland.			
HI-Energy Projects	Scottish Highlands and Islands Enterprise	Highlands and Islands Enterprise supports HI-Energy – Renewable Energy in the Highlands and Islands of Scotland. Among the key R&D projects supported are: • the European Marine Energy Centre (EMEC) in Orkney, where wave and tidal energy converters are verified and tested. • the PURE hydrogen project in Unst, Shetland; and	responsive	2010 onwards	

		• the Talisman Beatrice Wind Farm Demonstrator project which consists of two 5MW machines, the world's first deep water offshore wind turbines installed in waters over 40m deep; • the Glendoe 100MW Hydro Scheme			
COWRIE - Data Management & Stewardship for UK Marine Renewables	The Crown Estate	COWRIE provides authoritative information about offshore windfarm development in the UK, and is the source for environmental data and information generated under The Crown Estate's second Licensing Round for offshore renewables, and submitted by developers under the terms of their licence agreements. COWRIE has also identified and funded research projects to fill gaps in knowledge about environmental issues such as the effect on birds, the effects of underwater noise, and the electromagnetic effects of cables. Data and reports generated within COWRIE-funded research projects are also available in the catalogue. The COWRIE data catalogue is free to use, although some services require registration.	£450k (6 projects)	2003-2006	

Table 4.2: Key Research Providers

Name	Description	Sub-topics covered	No of staff	Sector
BAE Systems	BAE Systems Advanced Technology Centre (ATC) brings military aerospace stealth technology to wind turbines, including the £1.2M DTI-funded project Stealth Technology for Wind Turbines (2005-2007) led by BAE SYSTEMS ATC, together with University of Sheffield, University of Manchester, and Vestas.	• assessment of radar interaction with wind turbines and technical solutions to minimize the effects • application of stealth technology to wind turbine blade design	<10	R&D Science and Engineering
Centre for Environment, Fisheries & Aquaculture Science (Cefas)	Cefas is a diverse applied marine science centre. Two of the six key themes are: - observing and modelling the marine environment - assessing human impacts on the marine environment	• observing and modelling the marine environment • assessing human impacts on the marine environment	1	R&D science and engineering
Centre for Sustainable Energy (CSE)	One of CSE's six work areas, Delivering Renewable Energy, works with regional government and local authorities, helping to ensure local planning policy encourages deployment of renewable energy technology.	• Information and training course • community benefit and ownership studies • feasibility studies for renewable energy applications	<5	Social Science Research
Condor Wind Energy	Condor Wind Energy is a leader in two-bladed wind turbine technology	• Offshore wind turbine design and manufacture		R&D science and engineering Manufacturing
Converteam – GE Energy Power Conversion	GE Energy Power Conversion is well established in power conversion technology for the wind energy	Converteam supplies complete electrical systems solutions:	10-20	R&D Science and Engineering

	business, and through Converteam provides a range of Permanent Magnet Generator (PMG) and Power Converter products to the wind energy market. Converteam led a DTI project to design a high power (8MW) direct-drive superconducting generator, in partnership with Zenergy Power, a developer and supplier of high temperature superconductor (HTS) technology. GE Energy Power Conversion together MTS and NAREC with is designing, developing and commissioning an indoor wind test rig for the Energy Technologies Institute.	• converters (both Doubly Fed and Fully Fed, both Low Voltage and Medium Voltage) • generators (low, medium and standard speed) • power quality solutions at wind farm level • grid connection solutions for offshore wind farms • online monitoring and predictive maintenance • SCADA systems both at turbine and at farm levels		
e-on UK	E-on is a leading power and gas company - generating electricity, and retailing power and gas	• Own and operate 3 offshore wind farms • Involved in proposed offshore projects (Rampion, Humber Gateway, London Array) • Wind-farm feasibility study (ETI's Helm Wind)		Electricity and Gas
Fugro Renewable Services	Fugro Renewable Services provides a complete range of geoconsultancy services, along with design, engineering and marine construction support.	Offshore wind turbine foundation studies • Geotechnical investigations including insitu testing and engineering • Meteorological mast installation, including turnkey design and construction • Wind turbine foundation installation (particularly monopiles) • Wind turbine erection • Cable landfall installation • Wind turbine operational support	50+	R&D Science and Engineering

GL Garrad Hassan	GL Garrad Hassan is the world's largest renewable energy consultancy, employing over 240 full time staff working in the wind energy and marine renewables industries around the world, and recognised as the leading independent authority. GL Garrad Hassan provides technical advice and analysis for wind farm development, and works with manufacturers, investors, project developers, and operators.	• Resource assessment and wind power prediction • Micro-siting of wind turbines, and wind farm design • Software products for the design and performance analysis of wind turbines and wind farms • Design of wind turbines and wind turbine components • Financial modelling • Strategic studies • Technical advisor to owners and lenders • Asset management and operational services • Independently developed generic SCADA system • Control algorithm design and prototype implementation	100+	Consulting Engineers
QinetiQ Ltd	QinetiQ is a leading international defence and security company, with capabilities in wind farm impact assessment. QinetiQ provides a range of services and technical solutions from the early planning stages of wind farm development through to technology innovation and services for reliable turbine operations.	• Lubricants • Energy and Environment Consulting • Wind Turbine Technology • Condition Monitoring for Wind Turbines • Wind Farm Radar Impact Assessment • Stealth Wind Turbines	50+	Consulting Engineers
Ricardo-AEA	Formerly AEA Technology, the Ricardo-AEA Energy and Climate Change Consultancy offers consultancy worldwide on how to reduce emissions, improve the security of energy supplies and adapt to climate change in an economic way.	• Feasibility studies and technology assessment	<10	Consulting Engineers

Senergy Econnect	Senergy Econnect provides expert advice on all aspects of the grid connection and regulation of renewable energy, delivering innovative solutions from initial concept, to design, construction and commissioning. Senergy's Technical Services service offers a cost effective, comprehensive and rapid approach for assessing the connection of renewable energy sources, including wind farms, to the electricity grid.	• Conceptual design and feasibility studies for onshore and offshore wind farms • development of tools for the grid integration of distributed generation, demand side management and active network management • development of an online software tool producing electrical grid connection reports	10-20	Consulting Engineers
Talisman Energy (UK) Ltd	The Beatrice Wind Farm Demonstrator Project is an ambitious renewable energy development. In July 2007, two 85-metre high, 5MW wind turbines were installed adjacent to the Beatrice oil field, in water depths up to 45m, and 25 kilometres off the east coast of Scotland. (see DOWNVIND project in Section 8.1)	• Deep water offshore wind turbine construction • Assessment of viability and sustainability • Review economic and environmental impacts		R&D Science and Engineering
Tata Steel	Tata Steel has strong relationships with the supply chains for both the onshore and offshore energy industries, and is constantly developing new materials solutions and innovative products.	• Research into steel products and life time extension • Tubular steel and plates for onshore and offshore wind turbine towers and foundations • Electrical steels for generators • Components for transmissions and bearings	10-20	R&D Science and Engineering
The Engineering Business Ltd	Established in 1997, the Engineering Business (EB) designs, builds and supplies engineering solutions for the offshore oil and gas, submarine	• Development of offshore wind turbine installation systems and vessels	10-20	Consulting Engineers

	telecom, defence and offshore renewables industries. EB's core products include subsea trenching systems, pipe and cable laying equipment, and specialist offshore handling systems.			
Windpower Ltd	Windpower Ltd develops large-scale vertical axis offshore wind turbine technology. In January 2009 a £3m feasibility study NOVA, based on the Aerogenerator's innovative rotor was commissioned by the Energy Technologies Institute.	• vertical axis offshore wind turbine technology • project services for onshore wind developments		Consulting Engineers

5. Development and Demonstration Funding

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There are limited new demonstration projects in the UK. Public funding is mainly aimed at research or exploitation.

Table 5.1 Demonstration Funding Programmes

Programme	Funding Agency	Description	Committed Funds	Period	Representative Annual Spend
ETF 3rd Offshore Wind Demonstration Call (DECC)	Department of Energy & Climate Change (DECC)	The Environmental Transformation Fund (ETF) allocated funds of up to £400 million for the period 2008/09 to 2010/11, providing funding for the development of low-carbon energy and energy efficiency technologies in the UK via Defra, BERR, Carbon Trust, EST and others. The range of these programmes is wide and includes the Offshore Wind Capital Grants Programme. The first two ETF calls in the offshore wind sector were launched in 2009 and about £18m of grants were awarded to: Siemens – to develop a new power convertor for their next generation offshore turbine; Vestas – to design and develop advanced manufacturing processes, testing and certification for a large multi-megawatt offshore blade Clipper – to develop their 72m offshore blade for a 10MW offshore turbine and to develop a new gearbox design for use in 10MW offshore turbines Artemis – to develop a new hydraulic transmission system for larger offshore turbines. Mitsubishi– to develop design and supply chain capability for a new design of offshore turbine. Burntisland Fabrications– to develop advanced manufacturing for a jacket foundation and;	Technology development and demonstration £18m £7m	 2009 onwards 2010 onwards	

		Teeside Alliance Group – to develop advanced manufacturing processes for monopile foundations. In the UK Renewables Roadmap, published in July 2011, DECC announced funding of up to £30m for offshore wind innovation. DECC expects to fund two schemes from this budget: the Offshore Wind Accelerator and the Offshore Wind Component Technologies Development and Demonstration Scheme (OSW Components Scheme) with up to £15m allocated. The first and second calls for the Scheme were launched in November 2011 and May 2012 respectively. The 3rd Offshore Wind Demonstration Call for component/technology development in the offshore wind sector was launched in November 2012, with an indicative Capital budget of up to £7m. The third call is funded and managed by DECC, and the Technology Strategy Board are participating in the appraisal process.			

Table 5.2: Major Demonstration Projects

Name	Description	Sub-topics covered	Total Project Cost	Public Sector Funder	Public Sector Funding	Period
The Beatrice Wind Farm Demonstrator Project	In this ambitious renewable energy development, two 85-metre high, 5MW wind turbines were installed adjacent to the Beatrice oil field, in water depths up to 45m, and 25-kilometres off the east coast of Scotland. (see DOWNVIND project in Section 8.1).	• Deep water offshore wind turbine construction	€41M	EU, DTI, Scottish Executive	€3M, £3M, £3M	July 2007

Gunfleet Sands 3 Demonstration Project	Dong energy is testing two next generation 6 MW Siemens offshore wind turbines at the Gunfleet Sands site in South East England. The new turbines are being installed in January 2013 and the project is expected to be fully operational during Spring 2013. An Environmental Statement for Gunfleet Sands 3 Demonstation Project is available.	• Testing high capacity wind turbines for Round 3 Projects • Verification of performance, reliability and functionality				2010 to 2013
Blyth Offshore Wind Demonstrator Project	The 100MW demonstrator project was funded in 2010 by the Department of Business, Innovation and Skills (BIS) and operated by Narec. The site will accommodate up to 3 arrays (each with 5 turbine pods) at water depths of 35m, 45m and 55-60m, enabling demonstrators to test new turbine prototypes and subsea foundation technologies to be utilised in Round 3 sites.	• Testing turbine prototypes for Round 3 application • Subsea foundations in depth up to 60m • Offshore anemometry		BIS	£18.5M	

6. Research Facilities and Other Assets

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There are a number of laboratories and test facilities with Universities and Research Providers (described in Table 3.2). Generally these are at small scale and are for the use of their own researchers and their collaborators, but in some cases facilities can be provided for external commercial use.

Table 6.1: Research Facilities

Name	Description	Type of asset	Scale of operation	Annual Operating Budget
Narec Test facilities	Narec (National Renewable Energy Centre) has invested over £150 million of UK Government, private sector & European Union funding to create integrated testing & research facilities at Blyth. Narec is an independent centre for the development, testing and commercialisation of next generation technologies for the global wind energy industry. • Blade Test Facility (up to 70m, with a 100m facility under construction) • Electrical network low voltage test laboratory including G83 testing (EnergyLINK laboratory) • High voltage up to 1200kV test laboratory for performance testing under extreme conditions (Clothier laboratory) • Drive train test facilities rated at 3MW and 15MW (funded by ETI) • 100MW Offshore Wind Demonstrator Platform	• Laboratory • Major item of equipment • Offshore Test facility	Large	

Hunterston Offshore Wind turbine Test facility	SSE (Scottish and Southern Energy plc) is developing an offshore wind turbine testing facility at Hunterston. The first phase of construction began in 2012 / 2013, and when complete it will be used to develop and test up to three wind turbine prototypes for the next generation of offshore wind turbines	• Test Facility	Large	
European Offshore Wind Deployment Centre (EOWDC)	The European Offshore Wind Deployment Centre is being developed at Aberdeen by Vattenfall, Technip and Aberdeen Renewable Energy Group (AREG). The test centre provides for eleven offshore wind turbines and foundations, subsea cables between the wind turbines, an export cable for connection to the electricity transmission network, scour protection around foundations	• Offshore Test Facility	Large	
Orbis Energy	The ORBIS centre in great Yarmouth provides incubation space, including conference and exhibition space, for a combination of Small to Medium Sized Enterprises (SME's) and larger established companies. The centre is one of a number of regional initiatives aimed at stimulating and capturing regional economic benefit from the Offshore renewables sector.	• Centre • Office space for companies in the offshore renewable supply chain		
Energy Technology Centre - Scottish Enterprise Technology Park	The Energy Technology Centre provides experimental facilities for developing and testing a range of small scale renewable energy systems, including small and micro wind turbines, buildings for experimental assessment of building-mounted wind turbine performance, and	• Laboratory/centre • Test facility	Small	

	test rigs with variable speed drives for bench testing generators, controllers and inverters			

7. Networks

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The manufacture of wind turbines and the development of wind farms are well established commercially, and there are strong trade associations. One network existed solely to identify research needs and to promote coordinated activities between academic research and industry, but is now dormant due to lack of funding.

Table 7.1 Networks

Network	Date Established	Description	Membership	Activities
RenewableUK	1978	RenewableUK (since March 2010, the new name for the British Wind Energy Association - BWEA) is the trade and professional body for the UK wind and marine renewable industries. As at March 2013, it has 606 corporate members, and offices in London, Cardiff and Belfast, and is one of the largest renewable energy bodies in the UK. Its activities cover all aspects of wind energy, and its mission has expanded to include wave and tidal energy.	623 corporate members including large international companies. Membership interests cover a wide range of disciplines from research, consultancy, and manufacturing, to financing, insurance, development, operation, and associated services.	• Promotes the use of wind power in the UK, both onshore and offshore • Promotes the understanding of wind energy and represents the industry to Government, regional bodies, and local authorities throughout the UK, and to the business community, the media, and the public • Involvement in all issues affecting the industry including financing, planning and electrical infrastructure • Researches and finds solutions to current issues, and provides a central focus for information • Co-ordinates the compilation of statistics and intelligence on every aspect of wind energy in the UK
Renewable Energy Association	2001	The Renewable Energy Association (REA) (since 2005, the new name	REA's corporate membership consists of	• The main objective is to secure the best legislative and

		for the Renewable Power Association) represents the full range of renewable technologies and applications, including wind, and promotes the use of sustainable energy in the UK.	over 950 companies ranging from sole traders to major multinationals. A wide variety of organisations is represented including generators, project developers, fuel and power suppliers, equipment producers and service providers. The Solar Trade Association is affiliated to the REA	regulatory framework for expanding renewable energy in the UK. • The REA undertakes policy development and provides input to government departments, agencies, regulators, NGOs and others. • The REA also provides information, knowledge transfer and networking via conferences, seminars, workshops, training, publications and newsletters. Information is provided on technical, legal, commercial and environmental matters.
The Offshore Wind Energy Network (OWEN)	1999	The Offshore Wind Energy Network (OWEN) was a joint industry / academia collaboration, promoting research on all issues associated with development of the UK's offshore wind resource, and encouraging co-operation and partnership between commercial organisations and researchers. OWEN was funded by EPSRC until 2005, and co-ordinated by the Energy Research Unit at STFC Rutherford Appleton Laboratory. It was greatly aided by the active encouragement and participation of the BWEA (now RenewableUK).	OWEN had over 200 members from universities and research institutes, and wind energy, coastal construction, and offshore industries. Note : OWEN effectively ended in 2005, however the website is maintained as an historical archive.	• Co-ordinated network members to identify research required to enable and promote the development of the UK's offshore wind resource • Provided a forum for knowledge transfer, dissemination, and discussion, by organising workshops on key technical issues • Provided a central focus for information, including research funding bodies, offshore wind research projects, technical papers, and data sources.

8. UK Participation in EU Activities

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The table below lists EU Framework projects with UK participation. The projects are presented in order of FP7-Energy, FP5-SustDev, and FP5-EESD, with the most recent first. Project details are available by searching in CORDIS projects or CORDIS Search (beta)

8.1: EU Framework Programme Participation

Project	Objectives	Action Line	Type of Action	Uk Participants	Co-Ordinator and Partners	Total Funding	EU Funding	Duration	Annual Spend
SUPRAPOWER SUPerconducting, Reliable, lightweight, And more POWERful offshore wind turbine	SUPRAPOWER has the objectives to: reduce turbine nacelle mass, size and cost of offshore wind turbines by means of a compact superconducting generator. - reduce O&M and transportation costs and increase life cycle using an innovative direct drive system. - increase the reliability and efficiency of high power wind turbines by means of drive-train specific integration in the nacelle.	FP7-ENERGY	Collaborative project	University of Southampton	Tecnalia 9 Partners	€5.40M	€3.89M	2012-12-01 to 2016-11-30	

INNWIND.EU Innovative Wind Conversion Systems (10-20MW) for Offshore Applications	Innovative design of a 10-20MW offshore wind turbine and hardware demonstrators of some of the critical components: - light weight rotor - low weight, direct drive generator - standard mass-produced integrated tower	FP7-ENERGY	Collaborative project	University of Bristol, University of Strathclyde, University of Sheffield	Technical University of Denmark - DTU 27 partners	€19.53M	€14M	2012-11-01 to 2017-10-31	
ACTIVEWINDFARMS Active Wind Farms: Optimization and Control of Atmospheric Energy Extraction in Gigawatt Wind Farms	The major ambition of the present research proposal is to employ optimal control techniques to control the interaction between large wind farms and the Atmospheric Boundary Layer, and optimize overall farm-power extraction	FP7-IDEAS-ERC	ERC Starting Grant		Prof. Johan Meyers, Katholieke Universiteit Leuven (KU Leuven)	€1.50M	€1.50M	2012-10-01 to 2017-09-30	
EDWTGT - Evaluation and Development of Wind Turbine Generator	This project is a collaborative scheme of research exchanges and networking. It will	FP7-PEOPLE	International research staff exchange scheme	University of Sheffield	University of Newcastle	€0.39M	€0.39M	2012-09-01 to 2016-08-31	

Technologies	bring together leading scientists and engineers in the UK, Italy and China.		(IRSES)						
EERA-DTOC EERA Design Tools for Offshore Wind Farm Cluster	The European Energy Research Alliance (EERA) together with industry partners propose an integrated and validated design tool combining state-of-the-art wake, yield and electrical models.	FP7-ENERGY	Collaborative project	University of Strathclyde, The Carbon Trust, Renewable Energy Systems Ltd,	Technical University of Denmark - DTU 22 partners	€4M	€2.90M		
CLUSTERDESIGN A Toolbox for Offshore Wind Farm Cluster Design	The objective of the project is to develop a toolbox for an integrated offshore wind farm cluster, including advanced wake models, turbine load models, grid interconnection models and by incorporating the cluster as a virtual offshore power plant.	FP7-ENERGY	Collaborative project	Imperial College	3E N.V.	€5.21M	€3.58M	2011-12-01 to 2016-05-31	
TOP WIND - European Wind Energy Technology	TOP WIND follows on from the WINDSEC project.	FP7-ENERGY	Support Actions	GL Garrad Hassan	European Wind Energy Association	€1.03M	€0.90M	2011-02-01 to 2014-01-	

Platform	The main aim is to increase the effectiveness of the European Wind Energy Technology Platform (TPWind), over the 2010 to 2013 period, developing relationships, and reducing fragmentation of EU R&D activities.				(EWEA) 3 partners			31	
OPTIWIND Optimum Power Extraction of Wind Energy by Small to Medium Scale Wind Turbines	This project deals with distributed energy production by small to medium wind turbines in the 10kW-100kW range. The focus of the project is to optimise the MPPT controller for small to medium wind turbines.	FP7-INFRASTRUCTURES	Research for SMEs	Windcrop Ltd, Gendrive Ltd	UK Intelligent Systems Research Institute 8 partners	€1.49M	€1.16M	2012-11-01 to 2014-10-31	
HIPRwind High Power, high Reliability offshore wind technology EU description: HIPRWIND	The project addresses critical issues of offshore WT technology such as extreme reliability, remote maintenance and grid integration with particular	FP7-ENERGY	Collaborative project	National Renewable Energy Centre (NAREC), TWI Ltd	FRAUNHOFER-GESELLSCHAFT 19 partners	€19.83M	€11.02M	2010-11-01 to 2015-10-31	

	emphasis on floating wind turbines, where weight and size limitations of onshore designs can be overcome.								
DEEPWIND Future Deep Sea Wind Turbine Technologies	The objectives are: - to explore the technologies for development of a floating offshore turbine with a vertical axis rotor - to develop design tools for evaluation of very large wind turbines - evaluation of the overall concept with floating offshore horizontal axis wind turbines.	FP7-ENERGY	Collaborative project		Technical University of Denmark - DTU	€4.18M	€3M	2010-10-01 to 2014-09-30	
ORECCA Off-shore Renewable Energy Conversion platforms EU description: ORECCA	The project objectives are to create a framework for knowledge sharing and to develop a research roadmap for activities in the context of offshore renewable energy (RE). The project will stimulate	FP7-ENERGY	Coordination Action	Offshore Wave Energy Ltd, The University of Edinburgh, North Highland College, IT Power Ltd	Fraunhofer-Gesellschaft + 27 Partners	€1.80M	€1.60M	2010-03-01 to 2011-08-31	

	research activities, leading towards innovative, cost efficient and environmentally benign offshore RE conversion platforms.								
WINGY-PRO Increasing efficiency of wind power plants for the production of energy EU description: WINGY-PRO	A determining factor for increasing the profitability of offshore wind is the installation of wind turbines with high power capacity and low weight. The project aim is to demonstrate a large transversal flux generator in an existing wind turbine.	FP7-ENERGY	Collaborative project (generic)	Converteam Technology Ltd	Universitaet Bremen, Bremer Centre for Mechatronics + 5 Partners	€4.32M	€2.48M	2009-11-01 to 2013-10-01	
PULSE STREAM 1200 Full scale demonstration prototype tidal stream generator	The project aims to demonstrate an innovative tidal energy converter at full scale in UK waters where there is an abundant resource and clear incentives for early commercial development; the	FP7-ENERGY	Collaborative project (generic)	It Power Ltd, Bosch Rexroth Ltd, Gurit (UK) Ltd, Pulse Tidal Ltd	IT Power Ltd + 7 Partners	€13.9M	€8.0M	2009-11-01 to 2013-10-31	

	selected site has potential for further commercial development. The main project objective is to test a certified, high performance, tidal flow technology ready for commercial deployment.								
TWENTIES Transmission system operation with large penetration of wind and other renewable electricity sources in networks by means of innovative tools and integrated energy solutions. EU description: TWENTIES	The Project consortium aims to remove several barriers which prevent wind electricity from contributing more to the electric system. The full scale demonstrations aim to prove the benefits of novel technologies coupled with innovative system management approaches.	FP7-ENERGY	Collaborative project (generic)	University of Strathclyde, Areva T&D UK Ltd	Red Electrica De Espana S.A.U. + 27 Partners (including 6 Transmission System Operators, 2 generator companies, 5 manufacturers, and research organisations)	€56.8M	€31.8M	2010-04-01 to 2013-03-31	
ROOF-CAPTURE Innovative design for wind energy capture in urban environments	The project aims to develop a retro-fittable roof-mounted module that will	FP7-SME	Research for SMEs	The UK Materials Technology Research Institute Ltd,	Torclad Ltd + 7 partners	€1.39M	€1.05M		

	accentuate the low pressure zone over a flat roof parapet and link it to high-pressure static air beneath using a tapered duct.			Eclectic Energy Ltd					
SAFEWIND Multi-scale data assimilation, advanced wind modelling and forecasting with emphasis to extreme weather situations for a secure large-scale wind power integration EU description: SAFEWIND	The integration of wind generation into power systems depends on the forecasting of expected power output. The project aims to reduce large prediction errors and to predict extremes (gusts, shears) at local scale and at European scale, in order to avoid unexpected loads on turbines.	FP7-ENERGY	Small or medium-scale focused research project	University of Oxford, ECMWF (European Centre For Medium-Range Weather Forecasts), SONI (System Operator For Northern Ireland)	ARMINES (Association Pour La Recherche Et Developpements Des Methodes Et Processus Industriels) + 19 Partners	€5.62M	€3.99M	2008-05-01 to 2012-04-30	
NORSEWIND Northern seas wind index database EU description: NORSEWIND	NORSEWIND is a programme designed to provide a wind resource map covering the Baltic, Irish and North Sea areas. The project will acquire data using traditional	FP7-ENERGY	Collaborative project (generic)	Oldbaum Services Ltd, GL Garrad Hassan, Scottish Enterprise, Nautilus Associates Ltd, BP Alternative Energy International	Oldbaum Services Ltd + 15 Partners	€6.74M	€3.94M	2008-08-01 to 2012-07-31	

	Meteorological masts, ground based remote sensing instruments (LiDAR & SoDAR) and Satellite acquired SAR winds.			Ltd, University of Strathclyde					
MARINA PLATFORM Marine renewable integrated application platform EU description: MARINA PLATFORM	The MARINA project is dedicated to bringing offshore renewable energy applications closer to the market by creating new infrastructures for both offshore wind and ocean energy converters.	FP7-ENERGY	Collaborative project (generic)	University of Edinburgh	Acciona Energia S.A. + 16 Partners	€12.76M	€8.71M	2010-01-01 to 2014-06-30	
NIMO Development and demonstration of a novel integrated condition monitoring system for wind turbines EU description: NIMO	NIMO seeks to practically eliminate catastrophic failures and minimise the need for corrective maintenance by developing and successfully delivering and implementing an integrated condition monitoring system for the continuous	FP7-ENERGY	Collaborative project (generic)	TWI Ltd, University of Birmingham, Technical Software Consultants Ltd	TWI Ltd + 14 Partners	€5.89M	€3.40M	2009-10-01 to 2012-09-30	

	evaluation of wind turbines.								
SIWT Self installing wind turbine	The project plans to demonstrate installation of a complete wind turbine, substructure and suction pile foundation offshore in one piece.	FP6-SUSTDEV	Specific Targeted Research Project		SUCTION PILE TECHNOLOGY BV	€7.98m	€1.50m	2007-01-17 to 2009-01-16	
DOWNVIND - Distant Offshore Windfarms with No Visual Impact in Deepwater Reports of Overall Beatrice Project : Reports EU description: DOWNVIND	The project objective is to make the step change advances in techniques, technologies, and processes needed to enable development of large capacity windfarms offshore in deepwater.	FP6: SUSTDEV-1.1.1: S-M Cost-effective supply of renewable energies	Integrated Project	Talisman Energy, Nautilus Associates, SSE Generation, University of Aberdeen, University of Strathclyde	Talisman Energy UK Ltd 17 Partners	€46.18 m	€6m	September 2004 - September 2009 60 months	
UPWIND - Integrated Wind Turbine Design Project website: Final reports EU description: UPWIND	UpWind looks towards wind power tomorrow; towards the design of turbines (8-10MW) standing in huge on- and offshore wind farms.	FP6: SUSTDEV-1.2.6 New and advanced concepts in renewable energy technologies - Other RES	Integrated Project	University of Salford, University of Edinburgh, Qinetiq Ltd, GL Garrad Hassan, STFC Rutherford Appleton Laboratory, Smart Fibres	Risø National Laboratory - DTU, Denmark 40 Partners	€22.62 m	€14.57 m	March 2006 – February 2011 60 months	

				Ltd					
ANEMOS - Development of a next generation wind resource forecasting system for the large-scale integration of onshore and offshore wind farms (ANEMOS)	The ANEMOS project aims to develop advanced forecasting models. Emphasis is given to complex terrain, extreme weather conditions, as well as to offshore prediction for which no specific tools currently exist. The prediction models are implemented in a software platform and installed for online operation of wind farms by the end-users participating in the project.	FP5: Cleaner Energy Systems, including Renewable Energies	Cost sharing contracts	STFC Rutherford Appleton Laboratory	ARMINES (Association Pour La Recherche Et Developpements Des Methodes Et Processus Industriels) 21 Partners	€4.28m	€2.5m	2002-10-01 to 2006-09-30 48 months	
ANEMOS.PLUS - Advanced tools for the management of electricity grids with large-scale wind generation EU description: ANEMOS.PLUS	The FP5 project ANEMOS (ENK5-CT-2002-0665) has successfully developed research on new forecasting techniques for a wide range of end-user requirements. The aim of the ANEMOS.PLUS	FP6: SUSTDEV-1 Sustainable energy systems,SUSTDEV-1.1.7 Grid issues	Specific Targeted Research Project	System Operator For Northern Ireland (SONI)	ARMINES (Association Pour La Recherche Et Developpements Des Methodes Et Processus Industriels) 22 Partners	€5.65m	€2.6m	January 2008 – June 2011 42 months	

	proposal is to fully integrate the forecasts and their uncertainty into the management and decision support tools.								
EWIS: European wind integration study EU description: EWIS	A Consortium of Transmission System Operators, representing the four main synchronous electricity systems in Europe, aims to identify and investigate the impacts of introducing a large number of wind power plants into the electric power systems in Europe.	FP6: SUSTDEV-1 Sustainable energy systems,SUSTDEV-1.1.7 Grid issues	Specific Support Action	National Grid Electricity Transmission Plc	Elia System Operator Sa, Belgium 15 Partners (Transmission System Operators, TSO, representing 13 European countries)	€4.04m	€4.04m	June 2007 – October 2009 28 months	
TOPFARM - Next generation design tool for optimisation of wind farm topology and operation EU description: TOPFARM	Establishment of large wind farms requires enormous investments putting greater emphasis on optimal topology design and control. The design tool will consider load aspects, as well as optimisation of the	FP6: SUSTDEV-1.1.1 Cost-effective supply of renewable energies	Specific Targeted Research Project	Cambridge Environmental Research Consultants Ltd, GL Garrad Hassan	Technical University of Denmark - DTU 9 Partners	€3.28m	€1.7m	December 2007 – November 2010 36 months	

	power output.								
SEEWIND South-East Europe wind energy exploitation - research and demonstration of wind energy utilisation in complex terrain and under specific local wind systems	The project aim is investigation of performance at different locations in SE Europe, with mountainous and complex terrain, characterization of local wind systems, and more efficient and reliable operation of large scale wind turbines.	FP6-SUSTDEV	Specific Targeted Research Project		Energie-werkstatt Consulting GmbH	€9.66m	€3.70m	2007-05-20 to 2010-05-19	
DESIRE - Dissemination strategy on electricity balancing for large scale integration of renewable energy EU description: DESIRE	DESIRE will disseminate practices which will integrate renewable electricity supplies such as wind power into electricity systems using combined heat and power. This will improve the economic competitiveness of both CHP and wind power, and allow the proportion of renewable electricity that can	FP6: SUSTDEV-1.1.2 Large scale integration of RES into energy supplies	Specific Support Action	University of Birmingham	Aalborg University Denmark 10 Partners	€1.64m	€1.2m	June 2005 – May 2007 24 months	

	be absorbed by the system to increase.								
POWWOW - Prediction of Waves, Wakes and Offshore Wind POWWOW Final Report	The purpose of this Action is to co-ordinate the activities of European and national projects in the fields of short-term forecasting of wind power, offshore wind and wave resource prediction, and offshore wakes in large wind farms, and will start work on future roadmaps.	FP6: SUSTDEV-1.2.6 New and advanced concepts in renewable energy technologies - Other RES	Coordination action	University of Edinburgh	Risø National Laboratory - DTU, Denmark 15 Partners	€1.25m	€1.05m	October 2005 – Septembe r 2008 36 months	
WINDSEC Wind energy technology platform secretariat EU description: WINDSEC	WindSec, the Platform Secretariat, will optimise the activities of the European Wind Energy Technology Platform (TPWind), and develop its infrastructure.	FP6: SUSTDEV-1.1.1 Cost-effective supply of renewable energies	Specific Support Action	GL Garrad Hassan	European Wind Energy Association, Belgium 3 Partners	€0.82m	€0.69m	March 2007 – March 2010 36 months	
REMAP - Action plan for high-priority renewable energy initiatives in Southern and Eastern	The objectives of the REMAP project are to: - Compile a solar and wind energy resource atlas for	FP6: POLICIES-3.2 The development of tools, indicators and operational parameters for assessing	Specific Support Action	Energy For Sustainable Development Ltd	Observatoire Méditerranéen De l'Energie, France 11 Partners	€0.51m	€0.39m	January 2007 – December 2008 24 months	

Mediterranean area REMAP Final Report	the area. - Identify and prioritise potential demonstration sites for wind and concentrated solar thermal projects. - Proposing a credible financing scheme. - Produce an action plan to progress a few projects. - Disseminate the results.	sustainable transport and energy systems performance							
OFFSHOREM&R Advanced maintenance and repair for offshore wind farms using fault prediction and condition monitoring techniques	Main objective of the project is to lay the foundations for condition depending maintenance and repair (M&R) strategies for wind energy converters (WEC) in offshore wind farms.	FP5-EESD	No contract type		ISET University of Kassel	€2.29m	€1.15m	2005-12-05 to 2014-12-04	
WISE Wind energy SODAR evaluation	The general aim of the proposed project is the application of the SODAR technique (Sound Detection and Ranging) for reliable wind speed measurements.	FP5-EESD	No contract type	University of Salford	Energy Research Centre of The Netherlands	€1.07m	€0.56m	2002-01-01 to 2004-07-01 30 months	

SAFESHIP Reduction of ship collision risks for offshore wind farms	The objective is to reduce the risks of ship collisions with offshore wind farms and thereby to reduce associated costs, and to accelerate acceptance of construction permits by licensing authorities.	FP5-EESD	No contract type		E-Connection Project B.V.	€1.06m	€0.60m	2003-01-20 to 2005-01-31	
CLOWEBS-2000 - Klasorden 42 MW; A Demonstration of Cost-Optimised Large Scale, Offshore Wind Energy In The Baltic Area	The aim of the project is to demonstrate the economic advantages and technical viability of a large-scale offshore wind farm using the largest wind turbines available, and built using installation techniques and contracting methods developed by the offshore oil and gas industries.	FP5: Cost effective wind turbine components	No contract type	NEG Micon UK Ltd, Amec Civil Engineering Ltd.	Vindkompaniet I Hemse AB 5 Partners	€32.35 m	€5.0m	2000-01-01 to 2002-12-31 36 months	
ESTONIA 20 MW WIND - 8 X 2.5 Mw Wind Turbines With Crane-free Erection to be Implemented	The project aims to carry out all the research, development and engineering	FP5: Wind energy optimisation	No contract type	GL Garrad Hassan	Nordex GMBH 6 Partners	€23m	€2.32m	2001-10-01 to 2004-09-30	

in Estonia	necessary for the implementation of 8 pcs. 2.5 MW wind turbines, erected and commissioned without the need of cranes.							36 months	
ROWED - Reliability Assured Low Cost offshore Wind Energy Demo Project	The objective of this project is to gain experience with a 10MW offshore wind farm 2km off the Dutch coast, to demonstrate availability comparable with onshore installations and to verify the low cost tower design.	FP5: Cost effective wind turbine components	No contract type	GL Garrad Hassan	KEMA 5 Partners	€14.6m	€2.5m	2005-05-26 to 2015-05-25 120 months	
LOWCOST 2BLADE 2MW - Development of a low-cost 2Mw two-bladed wind turbine	The project aims to decreasing the cost of wind power using a two-bladed design, by realising a compact sub-critical teetering hub and yawing system.	FP5-EESD	No contract type		Nordic Windpower AB	€4m	€2m	2002-01-04 to 2012-07-03	
HYBRILA - Hybrid Renewable Energy Project Supplying Electricity to an	Build a 8.52 MW hybrid renewable energy system. Demonstrate new	FP5: Optimising power quality, by means of energy storage, for stand-	No contract type	Gilbert Gilkes and Gordon Ltd,	Automated Systems and Controls Limited, Ireland	€9.99m	€2.05m	2002-01-01 to 2006-06-30	

Irish Local Authority	variable speed 850 kW wind turbines with increased efficiency, lower impact on the electricity network and lower costs; a 1 MW hydro Power plant; a 250 kW hydro power plant, and a 470 kW landfill gas power plant.	alone renewable and hybrid systems and for transport		Vestas - Celtic Wind Technology Ltd	5 Partners			54 months	
ADCON-DEMOWIND - Demonstration of Six Advanced Control Technology 1.3MW Scale Wind Turbines Operating at three Sites with Distinctly Different Environmental Conditions	The specific aims of the project are to: - Develop a family of 1.3MW wind turbines derived from a pre-commercial 1.3MW prototype, to cover the complete range of viable wind conditions in the EU. - Develop rotors for the complete range of wind conditions.	FP5: Cost effective wind turbine components	No contract type	GL Garrad Hassan	Corporación Energía Hidroeléctrica De Navarra, S.A., Spain 5 Partners	€6.31m	€2.2m	2001-12-01 to 2004-05-31 30 months	
RECOFF Recommendations for design of offshore wind turbines (RECOFF)	The project aims at the provision of recommendations for a standard for design of offshore	FP5-EESD	Cost-sharing contracts		Risø National Laboratory - DTU	€1.60m	€0.80m	2001-01-01 to 2004-08-31	

	wind turbines.								
OS2500/78 - Demonstration of a large scale, Second Generation, off Shore Wind Turbine, complying with new grid requirement	The key objective of this project is to demonstrate an innovative wind turbine which is designed specifically for off shore and other applications where penetration levels are likely to be very high.	FP5: Wind energy optimisation	No contract type	Neg Micon UK Ltd	NEG Micon UK Ltd 4 Partners	€4.89m	€1.5m	2000-01-01 to 2002-12-31 36 months	
OPTIMAT BLADES - Reliable optimal use of materials for wind turbine rotor blades	The project aims to provide acurate recommendations for the optimised use of materials within wind turbine rotor blades, to achieve improved reliability, and to predict residual strength and life.	FP5: Economic and Efficient Energy for a Competitive Europe	Cost sharing contracts	STFC Rutherford Appleton Laboratory	Not Given 17 Partners	€4.39m	€2.4m	2002-01-01 to 2006-04-30 52 months	
WINDPLUS - High Wind Energy Penetration in Hybrid Wind-Diesel Systems, and Innovative Approach Using Back-To-Back Power Electronic	The WINDPLUS project will contribute to the Implementation of up-to-date power electronics in wind-diesel energy systems	FP5: Hybrid Systems	No contract type	Scottish Power Technology	Vergnet Wind Turbines 6 Partners	€4.39m	€0.7m	2000-01-01 to 2002-10-31 34 months	
OPTIWIND - Optimised 2 MW	Demonstrate the durability,	FP5: Wind energy optimisation	No contract type	Vestas Celtic Wind	Midas Energy Limited, Ireland	€4.0m	€1.4m	2003-02-01 to	

Wind Turbines In High Wind Speed Area With Smooth Grid Integration	reliability of large scale (2MW) variable speed wind turbines with improved performance in a high wind speed area. The innovation relates to optimised reactive power control, rapid reaction to wind turbulence and management of active oscillations and harmonics.			Technology Limited	3 Partners			2006-03-31 38 months	
MEGAWIND - Development of a MW scale wind turbine for high wind complex terrain sites MEGAWIND Results	The project addresses the installation of large capacity turbines in mountainous complex terrain. The challenges are to: - transport and erect MW-size machines in areas of limited infrastructure - reduce costs by means of design optimisation and tailoring.	FP5: Cleaner Energy Systems, including Renewable Energies, Wind energy optimisation	Cost sharing contracts	University of Newcastle Upon Tyne	Centre For Renewable Energy Sources, Greece 10 Partners	€3.54m	€2.0m	2001-01-01 to 2005-06-30 54 months	

CONMOW - Condition monitoring for off-shore wind farms	The objectives are to : - Develop new algorithms for data processing. - Improve condition monitoring techniques and demonstrate the benefits. - Implement procedures and techniques to change from preventive and corrective maintenance to condition based maintenance.	FP5: Cleaner Energy Systems, including Renewable Energies	Cost sharing contracts	Loughborough University, Pall Europe Ltd.	GL Garrad Hassan 8 Partners	€1.97m	€1.07m	2002-11-01 to 2007-04-30 54 months	
EZXS WTB - Wind Turbine (350 KW) For Sites with Difficult Access	The project proposed to develop a novel wind turbine of about 350 kW rated power, for sites that are difficult to access with cranes and heavy equipment. The project aims at a full-scale demonstration of the wind turbine at two different sites,	FP5: Wind energy optimisation	No contract type	GL Garrad Hassan, Future Wind Partnership Ltd	Energy Research Centre of The Netherlands 5 Partners	€1.69m	€0.69m	2000-01-01 to 2002-12-31 36 months	

	one in Ireland and one in Austria.								
HONEYMOON - A high resolution numerical wind energy model for on and offshore forecasting using ensemble predictions	The project will address how dynamic implementation of code modules rather than static implementation can cut development and test-times down. The new forecast model is based on the structure of the DMI-High Resolution Limited Area Model HIRLAM.	FP5: Cleaner Energy Systems, including Renewable Energies	Cost sharing contracts	E.On UK Plc, Powergen Renewables Development Limited	University College Cork, National University of Ireland, Cork 10 Partners	€1.25m	€0.89m	2003-01-01 to 2004-12-31 24 months	
ENDOW - Efficient development of offshore windfarms	The major objectives are to evaluate wake models in offshore environments and to develop and enhance existing wake and boundary-layer models, accounting for complex stability variations. This will produce a design tool to assist planners and developers in	FP5: Economic and Efficient Energy for a Competitive Europe, Cost effective wind turbine components	Cost sharing contracts	GL Garrad Hassan. Robert Gordon University	Risø National Laboratory - DTU 9 Partners	€1.20m	€0.7m	2000-03-01 to 2003-02-28 36 months	

	optimising offshore wind farms.								
FIRMWIND - Towards high penetration and firm power from wind energy	The project proposes energy management of the distribution system including generation plant, consumer loads, storage devices and the import/export link. The analysis will combine methods used by utilities with design techniques used for autonomous 'wind-diesel' systems.	FP5: Cleaner Energy Systems, including Renewable Energies, Integration of new and renewable energy sources into energy systems	Cost sharing contracts	Proven Engineering Products Limited, Econnect Ltd.	Renewable Energy Systems Ltd. 6 Partners	€0.88m	€0.46m	2000-05-01 to 2003-04-30 36 months	
CLEVERFARM: Advanced management and surveillance of wind farms	The project aims to use advanced techniques for optimising and enhancing the performance of wind farms, integrate them into one system and implement the system at a number of wind farms.	FP5: Economic and Efficient Energy for a Competitive Europe	Cost sharing contracts	Renewable Energy Systems Ltd	Risø National Laboratory 8 Partners	€0.83m	€0.5m	2000-04-01 to 2003-09-30 42 months	
COD: Concerted Action for Offshore	The project aims to provide a	FP5: Wind energy optimisation	No contract type	Department of Trade and	Nederlandse Onderneming	€0.74m	€0.68m	2003-01-01 to	

Wind-Energy Deployment Project website: Final reports	harmonised European Offshore Wind Energy process for deployment, environmental impact analysis and for permission procedures for Offshore Wind Energy farms.			Industry	Voor Energie En Milieu 7 Partners			2005-12-31 36 months	
Wind Energy thematic Network	This proposal is to establish a Wind Energy Thematic Network, with the aim of ensuring that EU funded Wind Energy R&D meets the needs of the European wind industry, to maintain and increase its competitiveness in EU and external markets, and to meet European Commission and national targets for renewable energy use.	FP5: Economic and Efficient Energy for a Competitive Europe, Cost effective wind turbine components	Thematic network contracts	Renewable Energy Systems Ltd	European Wind Energy Association 9 Partners	€0.65m	€0.4m	2001-12-01 to 2005-05-31 42 months	
OWEE: Concerted Action on Offshore Wind Energy in Europe	The specific objectives are to: - exchange information within	FP5: Wind energy optimisation	No contract type	GL Garrad Hassan, Kvaerner Oil and Gas Ltd.	Technische Universiteit Delft 17 Partners	€0.47m	€0.47m	2000-05-01 to 2001-012-31	

Project website: Final reports	the EU member states, - provide an inventory of the state-of-the-art on key issues, - provide recommendations for programmes and implementation of large offshore wind farms.							20 months	
SWIIS: Small Wind Industry Implementation Strategy	The project aims to improve information and market support for small wind turbines, with capacities less than 100 kW.	FP5: Integrating renewable energy sources into the grid and stand alone systems	No contract type	Gazelle Wind Turbines Ltd, Amset Centre Ltd	Societe D'etudes Et De Developpement 9 Partners	€0.39m	€0.31m	2003-04-01 to 2005-03-31 24 months	
Innovative generator for small-scale wind mills	The objective of this project is to develop an innovative PMG generator for gear-less wind turbines.	FP5: Cleaner Energy Systems, including renewables Energies	Exploratory awards	Haro Trade and Consulting Ltd	Perm Motor Gmbh 2 Partners	€0.03m	€0.023 m	2001-10-22 to 2002-04-21 6 months	
Wind generator system for integration into the built environment	The system is conceived so that it can be integrated into the built environment.	FP5: Cleaner Energy Systems, including Renewable Energies	Exploratory awards	Pimberton Dear Chartered Designers	Micro Automation Technology S.A., Belgium 2 Partners	€0.03m	€0.023 m	2000-05-15 to 2001-05-14 12 months	

9. International Initiatives

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The IEA has an Implementing Agreement Implementing Agreement for Co-operation in the Research, Development, and Deployment of Wind Energy Systems - IEA Wind.

Table 9.1: International Activities

Name	Type	Description	UK Contact Point
IEA Wind	IEA Implementing Agreement	Founded in 1974, the IEA Wind Agreement sponsors cooperative research tasks and provides a forum for international discussion and information exchange on the planning and execution of national wind system projects. There are 20 member countries (including Australia, Austria, Canada, Denmark, Finland, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States), the European Commission, the European Wind Energy Association, and the Chinese Wind Energy Association. There are thirteen collaborative tasks, several of which are complete, while many are still active: Base Technology Information Exchange, Wind Energy in Cold Climates, Offshore Wind Energy Technology and Deployment, Integration of Wind and Hydro Power Systems, Power Systems with Large Amounts of Wind Power, Cost of Wind Energy, Labeling Small Wind Turbines, Social Acceptance of Wind Energy Projects, MexNext Aerodynamics, Comparison of Dynamic Computer Codes and Models for Offshore Wind Energy, WAKEBENCH - Benchmarking Wind Farm Flow Models, Wind lidar systems for wind energy deployment (LIDAR), Reliability Data. The activities of national programmes and of the collaborative R&D projects are reported each year in Annual Reports (UK 2011 Annual Report), which are available on the IEA website.	Richard Court, NAREC