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# UKERC RESEARCH LANDSCAPE: BIOENERGY

Section 1: An overview which includes a broad characterisation of research activity in the sector and the key research challenges

Section 2: An assessment of UK capabilities in relation to wider international activities, in the context of market potential

Section 3: Major funding streams and providers of *basic research* along with a brief commentary

_: Major funding streams and providers of *applied research* along with a brief commentary

_: Major funding streams for *demonstration activity* along with major projects and a brief commentary

_: Research infrastructure and other major research assets (e.g. databases, models)

_: Research networks, mainly in the UK, but also European networks not covered by the EU Framework Research and Technology Development (RTD) Programmes

_: UK participation in energy-related EU Framework Research and Technology Development (RTD) Programmes

_: UK participation in wider international initiatives, including those supported by the International Energy Agency

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## 1. Overview

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### Characterisation of the field

Bioenergy has an important role to play in meeting the UK aspirations in renewable energy supply for 2010 and 2020. Energy from biomass is complicated since several feedstocks (e.g. dedicated bioenergy crops such as willow, or food crops such as rape, sugar beet and wheat) may be utilised in different conversion processes (combustion, fermentation, gasification) resulting in several energy outputs including ***heat, power*** and ***liquid transport fuels*** (called here biofuels). It is important that this mixed portfolio of bioenergy supply is maintained at this time, ensuring the development of competitive and secure bioenergy and a firm research base for future large-scale deployments. Currently, including biogas from waste, bioenergy contributes more than 80 % of all UK Renewable Energy (BERR, 2007)[1] with several large-scale commercial deployments already in progress including bioethanol production and the use of biomass in co-firing and dedicated combustion.

Deployment is being encouraged by a large number of Government incentives including Renewable Obligation Certificates (ROCs) for co-firing, energy crop planting grants and capital programme incentives and these may extended further. Research to develop high yielding feedstocks and improvement of inefficient conversion processes and environmental sustainability is also developing, enabling us to identify clear short-term research priorities for the UK.

There are powerful, long-term environmental, political and economic drivers for the further development of the UK (and international) bioenergy sector. Bioenergy development in the UK has been impeded in the past largely by the persistent low cost of crude oil and associated policy and development barriers. The economic situation has undoubtedly changed and at $70 per barrel, many bioenergy operations begin to approach a commercial . We have entered a period of sustained high fossil oil prices, with a seemingly long-term upward trend and in the future a move towards a more 'bio-based' economy where bio-based products (including bioenergy) are seen to have a higher value. Much advanced research will be necessary to make this move to biofuels, bio- polymers and bio-oils as well as other products, over the next two , within the appropriate framework of environmental and economic sustainability.

Current emphasis on the use of food crops (first generation bioenergy crops) to generate bioethanol and biodiesel has highlighted the potential environmental costs and poor energy balance of these [14] and these must be addressed through a move towards second generation perennial lignocellulosic and other more efficient systems and a reconsideration of biomass use for heat and power compared to liquid biofuels.

Despite strong multilateral interests in bioenergy R&D within the UK, split broadly between the Government departments and the Research Councils (where EPSRC leads the energy portfolio), there are international investments across the full spectrum of research, and combined UK R&D activities must be considered to be lagging behind international leaders in this field. There is clear strategic vision in Europe through the and the United [19], which is being matched by considerable resource investments, not least

at the biology end of the R&D spectrum, for example from the BP Energy Bioscience Institute now up and running in the .

*Land use will be a limiting factor for bioenergy in the UK.* The Biomass Task in a recent review concluded that a reasonable assumption for the UK would be up to 1 million hectares of UK land dedicated to specialist bioenergy crops by 2020, although in response, the UK Biomass Strategy believes 350,000 ha is more , whilst a recent Europe wide study has suggested that the UK should move towards the use on 1.6 m hectares by , but a requirement of 740,000 hectares is estimated as necessary to fulfil 50 % of the RTFO current targets For liquid transportation fuel. These land-use scenarios should be viewed with caution – they do not consider the large step-changes that may occur in biosciences and second generation crops over the coming decades. Although it is difficult to predict the prevailing socio-economics conditions we would point to three clearly identifiable drivers, each of which will increase the attraction of bioenergy deployment in the future.

*Most importantly*, atmospheric concentrations will continue to rise well into this Century and the pressure for low-carbon energy solutions will grow as an aid to fulfil UK and EU targets of 60 % on CO2 emissions reduction. Alongside this there will be increasing global impact of climate change.

*Secondly*, declining fossil fuel reserves and concern over energy security and long-term high fossil fuel prices will drive R&D in renewable substitutes for petrochemical.

*Finally*, land use competition will grow, making dual- or multi-use crops increasingly appealing. For example, a single crop may be grown for grain, which is harvested for food and then the remaining biomass is combusted for heat or fermented to bio-ethanol.

The research agenda must reflect this and currently is not well placed to develop integrated interdisciplinary research solutions. In this context the development of bio-refineries – based on the model of petrochemical refineries – where raw product (plantfeedstock) enters and more than one refined product is generated (including heat and power), is a logical ambition for biorenewable petrochemical . Even with this approach the UK will still require imports to fulfil even the current commitment to the Biofuels Directive (RTFO) for 5% by volume of liquid transportation fuels derived from biological sources by 2010, where progress towards these targets was reported recently by the .

*A further factor* that is likely to increase the economic favourability of bioenergy is the decentralisation of power generation through microgeneration (small combined heat and power units serving individual homes, businesses or communities). This will help to alleviate the need to transport biomass from point of production to large regional power stations. Microgeneration is currently a small contributor to the UK energy economy, but with careful development could become a very major one by 2030. No clear strategy currently exists in the UK to capture bioenergy from biomass 'waste' including municipal solid waste (MSW) and agricultural waste and this should be an important future priority and has been recently addressed in the UK Biomass [14].

**Research Challenges**

Considerable recent effort in the and has addressed the question of future research challenges within Bioenergy, with the

publication of the Department of Energy Roadmap for , recent roadmaps for lignocellulosic-to- and the EU Biomass Action and Biofuels in the European Union Vision for . In general, it seems likely that over a timescale of 10-20 years and beyond, there will be a move from an 'oil-based' to a 'bio-based' economy where natural resources, particularly those from green plants, can be used more effectively. Many of these bio-processing routes are inefficient and still remain costly, both in necessary energy inputs and for environmental impacts, including greenhouse gas mitigation potential and other negative effects. Bioenergy from biomass can be considered a 'low quality high volume' bioresource, whilst bio-polymers, oils and other products may be considered as 'high quality low volume'. The future long-term research challenge will be to optimise the biorefinery to ensure both types of output are possible, as appropriate.

In the longer-term, artificial photosynthetic systems, hydrogen from biomass and the use of microbial and other biological systems should be considered as having future potential. A report of UK R and D priorities for current funding agencies in the UK was made in April , although this was focussed mostly on short-to-medium term applied research requirements.

**Short term Research Challenge (5 years)**

- Quantify environmental impacts of bioenergy production systems using whole life cycle analysis tools
- Developing and assessing supply chains based on biorefining (bringing together biochemical and thermochemical processes)
- Improve the efficiency of bioethanol production at pre-processing, hydrolysis and fermentation steps, using biological research
- Improve deployment of CHP in the UK linked to microgeneration
- Identify optimum land-use strategies for the UK biomass resource and likely future use of arable, set-aside and marginal land in a changing climate with consequent impacts on ecosystem services
- Develop and deliver new cultivars from past and current research and breeding of dedicated energy crops.
- Develop a UK strategy to capture energy from waste
- Improve public engagement in bioenergy decision making and understand public perceptions on use of GM technologies for bioenergy
- Assess the impact of bioenergy imports, including life-cycle analysis for both co-firing in power production and as raw and finished material for liquid transportation fuels and commitments to RTFO.

**Medium term Research Challenge (10 years)**

- Improve total yield and develop new genotypes of a range of bioenergy crops, including oil seed crops, woody lignocellulose and grasses
- Improve understanding and manipulation of carbon partitioning in green plants
- Identify new and novel crops and microbes; identify new or improved products and new bacteria/yeasts from genomic research
- Develop technologies for second generation biofuels, including woody and grass lignocellulose as feedstock and aviation fuels
- Understand advanced conversion routes including gasification of lignocellulosic resources

**Long-term Research Challenge (20 years)**

● Develop systems for large-scale production of second generation biofuels, advanced conversion and deployment of biorefining complexes
● Develop novel artificial photosynthesis systems and other synthetic biology approaches for capturing solar energy

● Continue to improve feedstock quantity and quality, conversion efficiencies and environmental sustainability in a changing climate.

**References**


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[14] Biomass Strategy, 2007

[15] Bioenergy Funders Forum Research priorities – 2007.

[16] Biofuels Progress Report, 2007

[17] much bioenergy can Europe produce without harming the environment? - English - EEA

[18] BP Energy Bioscience Institute

[19] , USA Bioenergy Centres, 2007


**2. Capabilities assessment**

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Independent analysis suggests that the UK has research strength in basic bioscience and also in engineering, but these skills to date have not been fully applied to the bioenergy industry. They could provide valuable future capability to develop new engineering control systems linked to bioprocessing, but this still represents an unknown market for the UK. High level computing and systems biology will also be necessary for the industry to develop from a strong research base. The global biomass and bioenergy market is expanding rapidly and UK expertise could be deployed to benefit from these developments.

**Table 2.1 Capability Assessment**

| UK Capability | Area | Market potential |
|---|---|---|
| **High** | Basic bioscience | Global Potential |
| | Research in plant genomics, breeding and agronomy | Global Potential |
| | Engineering solutions for future technologies | Global Potential |
| | Environmental impact and life cycle analysis of new energy systems. | Global Potential |
| **Medium** | Demonstration and deployment of existing technologies | Global potential |
| | Development of co-firing technologies and clean coal solutions | Global potential |
| **Low** | Developing the 'whole-chain' for utilisation of biomass from diverse sources. | UK – relevant |
| | Improved technologies for utilisation of energy from waste. | Global Potential |
| | Development of the biorefinery concept for R and D and second generation biofuels. | Global Potential |

## 3. Basic and applied strategic research

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Here we summarise the organisations funding basic and strategic applied research (Table 3.1) and follow this with a summary of the main UK research providers – mostly university groups and research institutes (Table 3.2).

University based bioenergy research covers basic bioscience, crop science, bioenergy policy, engineering solutions and both wet and dry biomass conversion and processing as well as socio-economic and environmental considerations for large-scale bioenergy deployment. An increased expertise in environmental impact is also apparent with emphasis on water resources and the GHG mitigation potential of different bioenergy chains and life cycle analysis (LCA), where they may be considerable overlap between several current projects and where UKERC is attempting to provide synthesis.

The dedicated UK bioenergy research community is small compared to the USA and other EU members and in general, in the past, bioenergy research was funded largely from DEFRA and DTI and focussed on crop science, feedstock supply, and technological innovations for combustion and conversion and whole-chain developments with some consideration of the environmental impacts of deployment. In contrast to many other nations, the UK has not previously developed a firm single-focus strategy for bioenergy - identifying preferred feedstocks, land-use options, conversion pathways and end products, but rather has used directed strategic science to provide consistent support for Government Policy for maximised GHG mitigation and has thus focussed on heat and power bioenergy, rather than liquid transportation fuels research. As a consequence, the liquid biofuels research area was until recently quite diffuse but in the long-term, this may be seen as advantageous, providing a flexible base from which to develop appropriate solutions. But for now, few university departments have large groups working together to address this interdisciplinary problem, however this is changing with major new funding initiatives being used to develop critical mass.

The Crop Improvement Networks funded by DEFRA are internationally competitive with involvement of BBSRC Institutes in partnership with universities including Southampton. Similarly research at Aston University on Pyrolysis and more recently in leading the SUPERGEN Biomass and Bioenery partnership and several other European activities is also central to UK expertise. The RELU projects on bioenergy and sustainability (coordinated by Rothamsted Research) and anaerobic digestion (coordinated by Southampton) and the TSEC-BIOSYS project (coordinated by Imperial College), add to UK critical mass. SUPERGEN II on Bioenergy and recent calls from BBSRC in Bioenergy (April 2007) and EPSRC on improving the efficiency of solar energy conversion (August 2007), add momentum in this area. The BBSRC call alone is valued at £20 million over 10 years providing a reasonable injection of funds for feedstock research. Glamorgan has a long-term interest and capability in biohydrogen production and in general the UK has extensive expertise in plant science but this has not been applied to bioenergy problems. Research on greenhouse gas mitigation potential at Aberdeen University forms part of several international projects. CEH has extensive experience of likely water use by bioenergy crops. Many groups may be working on

bioenergy topics but if these are not core to their activity it may be difficult to identify all expertise and so care should be taken when interpreting the information below.

**Table 3.1: Research Funding**

| Programme | Funding Agency | Description | Committed Funds | Period | Representative Annual Spend |
|---|---|---|---|---|---|
| Towards A Sustainable Energy Economy | NERC/ EPSRC | **A whole-systems approach to analysing bioenergy demand and supply: mobilising the long-term potential of bioenergy. A multidisciplinary consortium to address gaps in the whole system.** The project uses a whole systems approach bringing together a an interdisciplinary group to analyse the policy, environmental and crop science (feedstock) issues determining the supply and demand for bioenergy in the UK and identifying optimal chains for future development. | £2.2M | 2005-2009 | £500,000 |
| - Rural Economy and Land Use, Research Councils UK | BBSRC/ESRC/NERC | **Social, Economic and Environmental implications of increasing rural land use under energy crops.** This project integrates social, economic, hydrological and biodiversity studies in an interdisciplinary approach to develop a scientific framework for Sustainability Appraisal (SA) of the medium and long term conversion of land to energy crops. The project will provide scientific tools for updating Best Practice Guides and Environmental Impact Assessments, Strategic Environmental Assessments or SAs involving projects, policies or programmes where increased planting of energy crops is proposed or anticipated.<br><br>**Integrated systems for farm diversification into energy production by anaerobic digestion: implications for rural development, land use & environment.** This project examines the potential for development of anaerobic digestion (AD) on farms, and the contribution that this could make to rural development and diversification of agricultural practice by | £859,000 | 2006-2008<br><br>2007-2010 | £285,000 |

| Programme | Funding Agency | Description | Committed Funds | Period | Representative Annual Spend |
|---|---|---|---|---|---|
| | | enhanced land use planning for bioenergy production. The research is set in the context of a rapidly developing European agenda aimed at both strengthening the rural economy and protecting the environment. Coordinated by University of Southampton. | | | |
| | EPSRC | **The SUPERGEN Biomass, Biofuels and Energy Crops Consortium**. The project will carry out research into renewable energy generation from biomass - any plant material which can be used as a fuel, such as wood, agricultural waste and vegetable oils. The conversion processes will be studied for production of bio-fuels that can be used to generate renewable energy more efficiently using thermochemical routes for conversion. The results will be used to create computer models for designing and maximising the efficiency of the thermal processes, and to identify the ideal specifications of biomass fuels for different processes. The performance, cost, and socio-economic benefits of the full range of bio-energy systems will be considered.<br><br>**SUPERGEN II for Biomass.** The project continues the bioenergy consortium focussing on all aspects of the thermal processing of biomass with three additional partners in comparison with SUPERGEN I | £2.9M<br><br>£6.4 M | 2003-2007<br><br>2007-2010 | £75,000<br><br>£1.1 M |
| | EPSRC | **The UK Sustainable Hydrogen Energy Consortium** The project will target many of the forefront fundamental, multidisciplinary research challenges in the production, storage, distribution and utilization of hydrogen. In addition, the project will study the feasibility and acceptability of sustainable hydrogen as an energy carrier through a range of socio-economic projects, ranging from the public awareness and acceptability of hydrogen, impact analyses and regulatory | £3.5 M | 2003-2007 | £900,000 |

| Programme | Funding Agency | Description | Committed Funds | Period | Representative Annual Spend |
|---|---|---|---|---|---|
| | | issues. | | | |
| crops – genetic improvement | DEFRA | Underpinning and strategic research to deliver improved grass and tree crops for bioenergy, with high yield and pest and disease resistance. Two networks have been initiated. The first BEGIN aims to produce improved willow genotypes with high yield and improved pest and disease resistance. The second is for the improvement of the grass Miscanthus. | £3.5 M | 2003-2008 | £800,000 |
| Bioenergy | DEFRA | Support for research on bioenergy | On-going | On-going | £200,000 |
| building in Bioenergy | BBSRC | A research initiative called in 2007 to fund a Bioenergy research centre, projects grants and networks for feedstock research to improve the efficiency of bioenergy crops. | £20 M | 2007-2017 | £2 M |
| and biological solar energy | EPSRC | A research initiative on solar energy conversion | £3 M | 2007-2010 | £1 M |
| | EPSRC/NERC/ESRC | A project for networking and development of the research atlas and roadmap for UK Bioenergy Research. Contribution to TSEC. Analysis and synthesis of on-going research. | £290,000 | 2005-2009 | £45,000 |
| Mode | BBSRC | The Plants and Microbial committee of BBSRC research topic 'Fossil carbon substitution: biomass to biosynthesis | Limited to date | 2005- | Limited to date |
| Mode | EPSRC | Energy | variable | 2002-current | variable |
| Waste Consortium Programme | EPSRC | A cluster on waste, water and land management | £1.6M | 2004-2008 | £400,000 |
| TOTAL | | | | | |

**Table 3.2: Key Research Providers**

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| of Biological Sciences - University of Aberdeen | School of Biological Sciences is actively engaged in research on the GHG mitigation potential of bioenergy crop systems | • GHG mitigation and carbon balance of bioenergy crop systems.<br>• Member of TSEC-BIOSYS. Environmental sustainability. | 2 Faculty | Biology |
| University, Institute of Energy Technologies | Long-term interest in SRC forestry | • SRC forestry – practical application | 1 Faculty | Biology/forestry |
| Forest Research, Forestry Commission, Edinburgh and Alice Holt, Surrey | Research on modelling yield in SRC bioenergy trees, biofuel as a source of renewable energy and GHG balance of bioenergy cropping systems. | •SRC Yield Models in development<br>• Woodfuel as a resource<br>• Member of TSEC-BIOSYS<br>•Climate change programme to predict the effects of future climates on woodfuel resource in the UK. Environmental sustainability.<br>• Policy development and advice to central Government.<br>• Member of SUPERGEN BIOMASS II | 4 Principal Investigators | Forestry |
| University, Energy and | Expertise in the improved efficiency of | • Pyrolysis products and | | |

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| Resources Research Institute | biomass combustion and characterisation of emissions. | their characterisation.<br>• Gasification of biomass<br>• Emissions | 2 Faculty | Environmental Engineering |
| University, Waste Incineration Centre | SUWIC is one of the leading international research centres for the thermal treatment of wastes. The centre has a worldwide reputation for innovative investigations into combustion, gasification and pyrolysis of biomass/waste and the associated electrical power generation systems. | •Member of SUE – Waste management<br>•Member of the SUPERGEN Bioenergy consortium<br>•Dioxin Research NEtowrk for emissions. Environmental Sustainability.<br>•Expertise in Energy from waste streams and use of both MSW and SS. | 13 Faculty | Chemical and Process Engineering |
| University, CEH, NERC | CEH – UK-leading on the Sustainable economies research programme with central UK funding to NERC.<br><br>Director of UKERC, with overall responsibility for the horizontal theme 'Environmental Sustainability | •Director or UKERC.<br>•Core funding for Sustainable economies. | 3 Principal Investigators | Environmental Science |
| , Wallingford, NERC | Hydrological expertise to assess the current and future impacts of large-scale bioenergy cropping systems on water resources. | •Member of TSEC-BIOSYS.<br>•Expert in environmental assessment. Expert in land-use. | 1 Principal Researcher<br>5 Researchers | Environmental/Ecological Science |
| University, Chemical Engineering and Applied | Professor Bridgwater established the Bio-Energy Research Group in 1986, | •Expert in fast pyrolysis, - at R and D level. | 6 Faculty | |

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| Chemistry<br><br>University Bioenergy Group | since when it has grown to 14 members with an aggregated research income of over £6m. The current focus of the research is on fast pyrolysis of biomass and solid wastes for production of liquid bio-fuels and chemicals. There is also work on advanced gasification and bio-energy system analysis, design and evaluation including, economic assessment. | • Coordinator of the SUPERGEN I and II Biomass consortium, including development of the British Biomass and Bioenergy Forum.<br>• Member of two European networks for Bioenergy<br>• Leader of IEA Task 34 | | Chemical Engineering and Applied Chemistry |
| University, Sustainable Environment Research Centre | Two research units - the Wastewater Treatment Research Unit and the Hydrogen Research Unit. The aims are: To produce high quality scientific research in the field of sustainable environment in particularly acting as an umbrella body for the Wastewater Treatment Research Unit and the newly approved Hydrogen Research Unit. To advance knowledge and provide trained scientists and engineers to meet the needs of industry. To enhance the standing of the University of Glamorgan both nationally and internationally | • Expertise in dark fermentation reactions for hydrogen production<br>• Member of TSEC-BIOSYS consortium<br>• Member of SUPERGEN Fuel cells consortium<br>• Member of the SUPERGEN Sustainable hydrogen economy consortium<br>• Expert in biohydrogen production including anaerobic and aerobic digestion. | 7 Faculty | Bio-engineering |
| of Grassland and | Focus is on breeding and improvement of exotic grasses as bioenergy crops, | • Coordinator of DEFRA crop improvement network for | 3 Principal | Biology |

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| Environmental Research, BBSRC, Institute, Wales. | with associated projects on willow and poplar as bioenergy trees in Wales. Emphasis on the whole-chain and integration with end users. Underpinning research on quality traits in grasses.<br><br>Also undertakes underpinning research on cell walls and developing high throuput technologies for cell wall phenotyping | *Miscanthus* improvement.<br>• Coordinator of 'poplar for Wales' project.<br>• Member of the SUPREGEN Biomass consortium | Researchers | |
| of Southampton, School of Biological Sciences | Emphasis on underpinning research on bioenergy trees, particularly using genomics and latest biotechnological tools. Work on biodiversity and spatial supply of biomass. Expert on bioenergy tree response to future climates including water and .<br><br>UKERC Research partner for research and networking on bioenergy, including Environmental Sustainability. | • Member of the TSEC-BIOSYS consortium.<br>• Joint contractor in the DEFRA Crop improvement network for SRC.<br>• Coordinator of EU project 'POPYOMICS'<br>• Department of Energy research on poplar tree genomics for carbon sequestration.<br>• Responsible in TSEC-BIOSYS for developing the bioenergy resources in the UK | 1 Faculty | Biology and Biotechnology |
| of Southampton, School of Civil Engineering | Expertise in anaerobic digestion of wet biomass for energy | • Leader of the EPSRC SUE Consortium on energy from waste<br>• Leader of CROPNET, a Sixth Framework Programme Consortium | 3 Faculty | Civil and Chemical Engineering |

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| | | for crop solutions to anaerobic digestion of wet biomass<br>• Extensive expertise in waste to energy technologies<br>• Coordinator of RELU Biogas | | |
| campus of Cranfield University, Institute of water and Environment | Expertise on understanding the hydrological implications of bioenergy cropping systems. Use of bioenergy trees on landfill and other strategic applied research. | • Modelling expertise | 1 Faculty | Environmental Engineering |
| Research, BBSRC Institute | UK focus for SRC willow research on breeding and improvement and also on underpinning research on pest and disease resistance. Crop science expertise including in grasses and holder of National willow collection and several long-term trials of bioenergy crop species. | • Member of TSEC-BIOSYS.<br>• Coordinator of DEFRA Crop Improvement Network on SRC.<br>• Coordinator of RELU project on bioenergy crops.<br>• Member of the SUPERGEN Biomass consortium. | 4 Faculty | Biology |
| Research Group, ICCEPT, Imperial College, University of London | Research focus on techno-economic, environmental and policy issues related to biomass energy systems applied to the heat, electricity and transport sectors. The group is composed of an inter-disciplinary team of experienced researchers. Work is carried out for a range of government research councils, | • Expertise in policy analysis and authors of several authoritative documents contributing to policy.<br>• Coordinator of TSEC-BIOSYS.<br>• Expertise in all aspects of liquid bioethanol | 3 Faculty | Environmental Technology<br><br>Environmental Policy |

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| | government and international organisations, non-government organisations and industry. | production in the UK and EU.<br>• International trade in bioenergy | | |
| Porter Alliance | The Porter Alliance is an interdisciplinary group coordinated from Imperial College and including four major Research Institute partners and three individual investigators covering all aspects of bioenergy research.<br><br>ICCEPT<br><br>Partners ar Rothamsted, IGER, John Innes, Southampton, York and Cambridge | • Feedstock research – improving feedstock quality and yield.<br>• Microbiology – improved processing and novel microbiology<br>• Fundamental plant science<br>• Chemical engineering and systems analysis<br>• Environmental sustainability and developing a sustainability analysis tool | Over 100 researchers and many PIs are captured by The Porter Alliance.<br><br>New RAs and PhDs will begin research on October 2007 | Biology<br>Chemical Engineering |
| of Surrey, Centre for Environmental Strategy, | Research is clustered around two themes: Environmental Systems Analysis and Environmental Policy and Risk Management | • economics and ethics<br>• management and policy-making<br>• systems analysis<br>• energy<br>• of educational software | 10 Faculty | Environmental Science |
| University, Institute of sustainability, energy and environmental management | This centre carries out research on a wide range of problems relating to energy, electricity generation, solid, liquid and gaseous pollutants. A key area of its research portfolio is in the field of sustainable and integrated | • Renewable energy<br>• Large scale combustion modelling using CFD and experimental validation<br>• Investigation and characterisation of fine | 7 Faculty | Environmental Engineering |

| Name | Description | Sub-topics covered | No of staff | Field |
|---|---|---|---|---|
| | waste management, particularly that of Municipal Solid Waste. The centre seeks to stimulate and support industry through technology transfer, research, advice and technical support. | particulate emissions<br>• Biological processing of solid wastes | | |
| Innes Centre | JIC is an independent, international centre of excellence in plant science and microbiology. The scientific research at the Centre makes use of a wide range of disciplines in the biological and chemical sciences, including cell biology, biochemistry, chemistry, genetics, molecular biology, computational and mathematical biology. | • Fundamental plant science<br>• Cereal genetics and genomics<br>• Development of *Brachypodium* as a model bioenergy crop | Up to three PI scientists | Biology<br>Crop Science |

## 4. Applied research (inc RDA support)

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This section gives details of the Applied Research Funders (Table 4.1) and those engaged in providing Applied Research (Table 4.2). Applied research on bioenergy in the UK is largely funded by DTI, DEFRA, The Carbon Trust with some input from other agencies including Forestry Commission

The DTI as part of the New and Renewables Energy Programme supported bioenergy research in the past through grants to business and research organisations with 50 % matched funding projects. This focussed on equipment and feedstocks to ensure increased yield and efficiency in bioenergy production. Recently this scheme has been followed by the Technology Programme where the emphasis will be on low carbon technologies, particularly the biorefinery concept. In recent years The Carbon Trust has increased the funding to bioenergy projects through a mixture of smaller research grants and large directed initiatives, particularly the 'Biomass Heat Accelerator' programme to overcome barriers associated with bioenergy chains in the UK

and to improve efficiency and is planning to fund a large Bioenergy project in the near future (2007). Applied bioenergy research is undertaken in the UK by a mixture of Government-funded departments and research organisations, particularly Forestry Commission, Forest Research, Rothamsted and IGER, with some additional input from a selected number of universities including partners in the Tyndall Centre. This is complemented by some industrial partners who through necessity in an emerging industry have committed resources to research. Several small companies are focussed on feedstock supply and management, such as TV Energy in the south of England. Engineering companies such as Talbott's and other involved in large scale deployment are listed in section five, below.

**Table 4.1: Research Funding**

| Programme | Funding Agency | Description | Committed Funds | Period | Typical Annual Spend |
|---|---|---|---|---|---|
| and Renewables Energy Programme | DTI | Past research on fuel supply systems for energy crops, and agricultural and forestry residues, including - Target of doubling energy crop yields (based on SRC willow) from current yields of 8 oven dry tonnes (ODT) per hectare. - Equipment development for reduced costs and increased efficiency.<br><br>Energy crop production work supported by DTI is coming to a conclusion. Future projects to be funded on a responsive basis through the Technology Programme, and taking account of the Innovations Review, but energy crops unlikely to be a priority.<br><br>The New and Renewable Energy R&D Programme is now being delivered through the Collaborative R&D Business Support Product. Open competitions for funding under this product happen twice a year. | | -2006 | |
| Technology Programme | DTI | A new DTI Technology Innovation Programme was announced in April 2006.Technology priority areas include emerging Energy Technologies (**Low Carbon Energy Technologies, including development of the biorefinery concept**); Sustainable Production & Consumption (Energy Efficiency Technologies); Bioscience & Healthcare (Exploitation of Plant and Microbial Bioscience for Industry, Safety Biomarkers for Pharmaceutical Development); Advanced Materials (Materials for Extended First Use and Re-use); Information & Communication Technology (Data, | £80 M in total | 2006- | Unknown |

| Programme | Funding Agency | Description | Committed Funds | Period | Typical Annual Spend |
|---|---|---|---|---|---|
| | | Scientific and Medical Visualisation for innovative products and services). | | | |
| Research, Carbon Trust | The Carbon Trust | The Carbon Trust is an independent company funded by Government. Their role is to help the UK move to a low carbon economy by helping business and the public sector reduce carbon emissions now and capture the commercial opportunities of low carbon technologies. It supports the development of low carbon technologies through R&D grants, with several of these placed within the Bioenergy sector in recent years. Other activities of the trust with specific relevance to Bioenergy are given below. | £672,000 | 2003-2007 | £150,000 |
| Vision | The Carbon Trust | The overall aim of this Carbon Trust project is to develop a pragmatic life cycle methodology that will allow a systematic estimation of carbon inventories in different industrial sectors that supports the incorporation of the carbon intensity of the full supply chain. This will involve both environmental and economic aspects of carbon footprints and embodied carbon, enabling estimation of "carbon added" and "valued added" at each stage in the supply chain. | £1.05M | 2005-2008 | £330,000 |
| Heat Accelerator | The Carbon Trust | The broad aim of BHAP is to help make the UK biomass heat market self-sustaining by reducing costs and addressing supply chain risks. The project aims to work with existing and new sites to develop benchmarks from robust case studies, identify and demonstrate cost reductions, and raise awareness amongst end users and other stakeholders. | £5.0 M | 2006-2011 | £1.0M |
| Centre | NERC/EPSRC/ESRC | Trans -disciplinary research related to climate change, with some limited desk-studies on low carbon economy related to bioenergy. | ~£200,000 | 2001-2006 | £40,000 |
| SEERAD | Scottish | Currently reviewing priorities in the area, and reviewing | NA | 2006- | NA |

| Programme | Funding Agency | Description | Committed Funds | Period | Typical Annual Spend |
|---|---|---|---|---|---|
| | Executive | ways forward for biofuel development in Scotland. SEERAD has indirect investments through 'GREEN grain', co-funded with Defra and HGCA (genetic reduction of nitrogen emissions and growing costs of wheat production whilst enhancing the value of wheat grain for the bioethanol industry amongst others). | | | |
| Agency | Environment Agency | Funds small-scale hydroelectric and biomass energy. Developing BEAT, a computer-based predictive tool for potential environmental impacts and mitigation responses to aid decision-making on biomass developments from an environmental perspective, especially for environmental impact assessment (EIA) scoping. | ~£50,000 | 2004-ongoing | £10,000 |
| DEFRA Science | Environment Agency | DEFRA has now provided significant funding to develop BEAT as the definitive comprehensive LCA tool | £206,000 | 2006-2007 | £206,000 |
| DEFRA Science | DEFRA | Assessing biomass miscanthus and SRC willow and poplar varieties: the way forward | £40,000 | 2006 | £40,000 |
| DEFRA/ Research | Forestry Commission /DEFRA | Co-funding, with DTI/Defra/DARD, the project 'Yield Models for Energy Coppice Poplar and Willow- Phase IV.' Other activity is highly applied, near market, e.g.: - extraction, drying and chipping of woodfuel from plantations- ash recycling - medium to large-scale recovery, baling, handling of residue from logging. | ~£2M | 1999-2006 | £385,000 |
| Energy Centre | DEFRA | Established in May 2006, the 'Biomass Energy Centre' as an expert centre for advice to growers, technologists and developers in bioenergy. | ~£25,000 | 2006- | £25,000 |

**Table 4.2: Key Research Providers & Developers**

| Name | Description | Sub-topics covered | No of staff | Sector |
|---|---|---|---|---|
| International Ltd | Leading supplier of low carbon fuels, particularly biodiesel. R and D into low carbon fuels and analysis of market opportunities. Work with growers to provide contract for rape and SRC for bioenergy sector. | • Biodiesel supply<br>• Fiscal incentives for biofuels<br>• Carbon certification | 30 with a turn-over of £250 M | Chemical Engineering<br><br>Agriculture |
| Energy Associates | North Energy has been pioneering the use of agricultural and forestry-derived woodfuel for heating systems in the UK. We see woodfuel production as a way to strengthen the rural economy by creating and safeguarding jobs. Forestry wastes, slabwood from sawmills and specially grown energy crops are a potential source of income, as is industrially derived clean wood waste. | • Woodfuel supply chain<br>• Heating systems<br>• Non-technical problems<br>• Integrated renewable energy systems | 10 | Advice and consultancy<br><br>Project management |
| Energy Solutions | Future Energy Solutions, as part of Technology, is Europe's leading sustainable energy consultancy, helping public and private sector organisations across the world find answers to the growing challenges of sustainable energy, climate change and related environmental issues. | • Biomass co-firing expertise<br>• Technology assessments<br>• Low carbon management<br>• Feasibility studies | 15 | Advice and consultancy<br><br>Project management |
| Research, Forestry Commission | Provide Yield models of SRC poplar and willow. Management of the new 'Biomass energy Centre'. Research on boilers and technologies for | • Forestry | | Applied research<br><br>Engineering |

| Name | Description | Sub-topics covered | No of staff | Sector |
|---|---|---|---|---|
| | combustion | | | Advice and consultancy |
| Rothamsted Research and IGER as BBSRC Institutes (see links above) | Undertake a large portfolio of applied research on crop agronomy and demonstration | • agriculture | 4 | Applied research<br><br>Advice and consultancy |
| non-food crops centre | The Centre disseminates scientific and technical information on non-food crop issues as widely as possible in order to increase knowledge and understanding, to initiate and facilitate technology uptake and to meet the government's and society's wider objectives for sustainable development. | • Dissemination of information<br>• Bioenergy<br>• Non-food products from plants | 10 | Advice and consultancy<br><br>Information dissemination |
| Energy | To promote and facilitate practical sustainable energy solutions and provide education for communities, businesses, organisations and individuals within the Thames Valley and beyond."<br><br>TV Energy operates in Berkshire, Buckinghamshire, Oxfordshire, Surrey and northern Hampshire. | • Best practice for SRC deployment<br>• Project management<br>• Biomass supply | 11 across the whole company, 4 dedicated to bioenergy | Advice and consultancy<br><br>Agriculture<br><br>Applied research |
| Farmers' Union - Bioenergy | Representing farmers and growers in England and Scotland. 2006 – appointment of bioenergy tsar to head policy and information in this area. | • Policy analysis and dissemination<br>• Best practice<br>• Agricultural and landscape implications for bioenergy deployment | 3 | Agriculture<br><br>Policy |

| Name | Description | Sub-topics covered | No of staff | Sector |
|---|---|---|---|---|
| | | • Grower and farmer representation | | |

## 5. Development and Demonstration Funding

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DTI supplies the largest source of development and demonstration funding. A new 'Technology Programme' was announced in April 2006 (see 4 above) and this should provide considerable funds for developments in bioenergy, subject to restrictions imposed by the responsive mode of funding. . The 'New Opportunities' lottery fund has also funded several bioenergy projects within the Renewable Energy theme, within environment. Few demonstration projects in bioenergy are currently funded although those that are, tend to be from EU and pan-European programmes. Some DTI projects are listed here. Several commercial large-scale bioenergy projects are currently in development for deployment and these have been summarised here. This is a fast-moving area and new projects are likely to be forthcoming over the next few months and these tables should be interpreted with this in mind. They cover a range of end uses including liquid biodiesel and bioethanol as well as large scale biomass combustion facilities for heat and power.One of the largest uses of biomass currently in the UK is in the co-firing market where biomass is co-combusted with coal at power stations such as Drax and Didcot, providing ROCs to the company. It is estimated that approximately 1 million tonnes of dry biomass is utilised in this way each year currently and this amount is set to increase. Up to half of co-fired biomass imported.

**Table 5.1 Development and Demonstration Funding**

| Name | Funding Agency | Description | Number of projects | Committed Funds | Period | Representative Annual Spend |
|---|---|---|---|---|---|---|
| Grants Scheme | DTI | The DTI's Capital Grants Scheme funds demonstration projects that help reduce the costs and risks involved in such developments, Biomass: approximately £66 million has been provided to help encourage the efficient use of biomass, particularly energy crops, for energy production by stimulating the early deployment of biomass-fuelled heat and electricity-generation projects. Of this, the New Opportunities Fund provided approximately £33 million for energy crops power generation and around £3 million for small-scale biomass/combined heat and power projects | 5 projects announced in April 2006 | £66 M of which £18.74 M committed to bioenergy projects in 2006 | 2006- | ~£4M |
| Crops Scheme | DEFRA | Energy Crops Scheme (ECS) provides establishment grants for SRC & miscanthus, and aid to help SRC growers set up producer groups. It closed in June 2006 but it is | Large number of grants between 2002-2006 | Programme £29M | 2002-2006 | |

| Name | Funding Agency | Description | Number of projects | Committed Funds | Period | Representative Annual Spend |
|---|---|---|---|---|---|---|
| | | anticipated as part of the new rural development plan, the scheme will be extended. | | | | |
| Carbon Buildings Programme | DTI | Funding available as a replacement to the DTI Blue Skies fund for household, communities or business projects for microgeneration technologies including biomass | Initiated April 2006 | NA | 2006- | NA |
| Energy Deployment | New Opportunities Lottery Fund | Project support in renewable energy deployment projects | 7 | £21 M | 2003-2005 | ~£7M |

**Table 5.2: Major Demonstration Projects**

| Name | Description | Sub-topic | Total Project Cost | Public Sector Funder | Public Sector Funding | Period |
|---|---|---|---|---|---|---|
| Sugar | 55,00 tonnes per annuum (70 million litres of bioethanol) plant being constructed in Wissington, Norfolk. | • Bioethanol production at commercial scale | | | £20 M capital cost of plant | Construction initiated in January 2006 |
| International Ltd | Biodiesel plant at Immingham on the east coast of England. The plant will initially process 100,000 tonnes/114 million litres of biodiesel per year and is expected to begin by the end of 2006. Preliminary planning and design work for a second phase to double our biodiesel production capacity at Immingham to 200,000 tonnes/228 million litres per year. | • Biodiesel production at commercial scale | | | unknown | Construction completed by end of 2006 |
| Power Resources | 38 MW straw burning power plant in Ely, Cambridgeshire. Largest straw burning power station in the world generating over 270GWh from 200,000 tonnes of biomass each year. | • Straw burning bioenergy plant | | | £60 M | Commissioned in 2000 |
| Biomass | Co-firing project for Didcot with 30,000 tonnes per year of dedicated bioenergy crops required for co-firing | • Co-firing with biomass<br>• Bioenergy projects including technical | | | unknown | Deliveries of biomass to Didcot estimated for 2009 |

| Name | Description | Sub-topic | Total Project Cost | Public Sector Funder | Public Sector Funding | Period |
|---|---|---|---|---|---|---|
| | | deployment | | | | |
| Corp at Wilton 10 | 30 MW biomass burning boiler, Wilton 10, that will operate following construction in 2007, when 300,000 tonnes of biomass per year will be required, supplied from four sources ALL from within the UK – energy trees (55,000 tonnes by 2011), sawmill waste (80,000), small roundwood (80,000) and recycled wood (80,000) | • Biomass combustion | | | £60 M project, with £10M supplied from DEFRA Bioenergy Capital Grant Scheme | Construction completed by mid 2007 |
| fuels \| Drax | Co-firing at Drax with dedicated bioenergy crops and imported biomass, with a requirement for 20 tonnes per hour aiming at 9 % of fuel supply. | • Biomass co-firing | | | unknown | Developing co-firing from 2005 |
| Spirit Fuels | Wessex Grain company to develop wheat grain as a source of bioethanol in the UK. Plant in development in Somerset for 141 million litres bioethanol (100,000 tonnes) by 2007. | • Bioethanol production | | | £50 M | Construction completed in 2007 |
| woodfuel burning power station | 44MW plant requiring 220,000 tonnes biomass wood burning power station in development at Lockerbie, Scotland, with 45,000 tonnes from dedicated SRC trees. | • Woody biomass combustion | | | £90 M | Construction completed by Dec 2007 |
| Miscanthus as a | Deployment of Miscanthus as a commercial bioenergy crop in the | • Miscanthus | | | unknown | On-going |

| Name | Description | Sub-topic | Total Project Cost | Public Sector Funder | Public Sector Funding | Period |
|---|---|---|---|---|---|---|
| bioenergy crop | UK | feedstock supply | | | | |
| Fuels Ltd | Leading supplier of energy crops, particularly willow, to the UK, interfacing with energy producers and primary fuel producers to provide logistics and specification fuel for renewable energy production | • Research and demonstration on SRC willow | | | unknown | On-going |
| | Small to medium scale deployment of bioenergy boilers for domestic and commercial use. Demonstration project at Harper Adam Agricultural College CHP. Eccleshall Biomass Project will be a 2 MW plant supplied by Miscanthus. | • Biomass combustion technology<br>• Microturbine generation | | | Several case studies DTI funded project. | On-going 2005-<br><br>2007 for Eccleshall plant |
| Coppice Resources Limited | Company dedicated to development of SRC, dealing with all aspects of feedstock supply and management for bioenergy deployment. | • Agriculture<br>• SRC specialists<br>• Commercial deployment of bioenergy and interaction with several research projects | | | unknown | On-going |
| Port Talbot bioenergy plant | 13.8 MW bioenergy plant to be supplied by woody biomass. | • Biomass combustion for power | | | £33M | Construction completed in 2008 |

| Name | Description | Sub-topic | Total Project Cost | Public Sector Funder | Public Sector Funding | Period |
|---|---|---|---|---|---|---|
| | | • CHP | | | | |
| Energy Ltd | CHP for 7 MW heat and & MW power plant in Somerset, supplied by SRC and woody biomass in a pyrolysis plant. | • Pyrolysis plant – first commercial plant in the UK | | | £2M | Construction completed in 2007 |
| Bronzeoak | Bronzeoak in Castle Cary, Somerset to build a 7MWe and 1.5MWth CHP plant to fuel a wood products facility with electricity and heat as well as supplying heat for curing feedstock | • Biomass combustion<br>• CHP | | | £3.8M | Complete in 2007 |
| Roves Farm | Roves Energy in Sevenhampton, Wiltshire - to build a 2.5Mwe and 5MWth combined heat and power plant (CHP) fuelled by up to 5000 hectares of locally grown energy crops | • Biomass combustion<br>• CHP | | | £0.96M | Complete in 2007 |
| Peninsula Power | 23 MW combustion plant supplied by energy crops grown in Devon. | • Biomass combustion | | | £11.5 | Complete in 2007 |
| Waste-to-energy plants | DTI figures suggest that 24 watse-to energy plants were operational in 2005 | • Waste-to-energy | | | unknown | On-going |
| BP and Associated British Food | 420 M litres of bioethanol at Saltend, Hull, providing potentially the largest bioethanol plant in Europe. | • Bioethanol from low-grade wheat feedstocks | | | £200 M partnership | 2009 commission |

## 6. Research Facilities and Other Assets

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Many facilities exists at laboratory-level across the UK, for example, plant biology and microbiology facilities, CFD testing, pyrolysis, combustion, fermentation and other test facilities. Those are not listed here. Below is given a summary of UK-national resources that should have the highest priority for funding and maintenance since without them, UK research may in future be hindered and because these resources are utilised by many members of the research community.

**Table 6.1: Research Facilities**

| Name | Description | Type of Asset | Turnover | No of staff |
|---|---|---|---|---|
| Research Trials | Several long-term experimental trials of miscanthus, willow and poplar and some other potential bioenergy crops exist in the UK. No central register or ability to fund these trials is currently available but a recent DEFRA project is addressing this question using NIAB as a contractor. Since they provide unique insight into long-term ecological adaptation, this should be seen as an urgent priority for future funding. | | NA | 10 from four research providers |
| Breeding Programmes and germplasm collections | Genetic improvement of feedstock requires a continual supply of new germplasm in which to identify genetic variation. Currently, collections in willow, poplar, miscanthus, oil seed and wheat are available in the UK. | | NA | 6 |
| Genomic and other resources | Some plant genomic resources exists that are relevant to bioenergy crops including spotted microarrays for gene expression, proteomic and metabolomic databases. | | NA | 6 from several sources |
| Woodfuel and Yield Modelling tools | Forest Research have developed an extensive dataset of yield from two rotations of SRC poplar and willow . By 2006 these will become available as GIS and tools part of output from TSEC. | | NA | 3 |

## 7. Networks and co-ordination activity:

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Numerous networks in bioenergy extant to the UK have developed in recent years and future effort should be focussed to ensure clear purpose for UK networks, avoiding unnecessary overlap and providing better integration.

The various public funders of bioenergy R&D work together through the Bioenergy Funders' Forum to co-ordinate their research investments. The Forum was initiated by MAFF in 1999 and has been led by MAFF/Defra since. It conducted an analysis of requirements in 2001, and this has formed the foundation of co-ordination since, particularly in relation to burden sharing between Defra, DTI and the Forestry Commission. This exercise has been repeated and published on the web in 2007. As such the BFF provides a very useful network for funders. UK Bioenergy networks to integrate findings have been limited and this could be considered a weakness, particularly given new consortium-based projects in Bioenergy within RELU, SUPERGEN and TSEC. SUPREGEN was the first consortium project to kick-off and as such has lead the way in developing a Bioenergy Forum British Bioenergy News which in future will be co-edited by TSEC and UKERC researchers. Within the BEGIN Genetics Improvement Programme, there is a stakeholder group that meets once each year, providing a forum for discussion between growers and researchers and in 2007, UKERC hosted the first Bioenergy UK Network meeting, which will hopefully be an annual event with wide participation. UK participation within European networks has been present but with only a very limited number of groups appearing in several networks. Current EU networks are shown below. EPOBIO represents an exciting new approach for an EU network with partnership with the USA. The focus of EPOBIO is on harnessing the economic potential of green plants for non-food crops. UK contributed to several sessions at the May 2006 EPOBIO workshop and this network is lead by the UK. The Renewable Energy Association (REA) acts as a network for industrial interests and organises an annual Bioenergy meeting for the industry.

**Table 7.1: Bioenergy networks in the UK and EU**

| Network | Established | Description | Membership | Activities |
|---|---|---|---|---|
| Funders Forum | 1998 | A cross- department group of funders from the UK. Produced a research priority document in 2000 and are currently working alongside UKERC to produce an updated version in 2006 | DEFRA (leading), DTI, NERC, BBSRC, Environment Agency, English Nature, EPSRC | • Meetings and report on funding priorities.<br>• Identification of cross-cutting areas |
| NoE | 2005 | EU Network of Excellence for Integrating activities to achieve new synergies in research to build a Virtual Bioenergy R&D Centre that will spearhead the development of a competitive bioenergy market in Europe. | Eight EU partners | • Collaborative projects and synergies identified in bioenergy<br>• Networking including meetings and joint activities<br>• Virtual Centre for Bioenergy in the EU |
| Net | 2005 | ThermalNet consists of three technologies: pyrolysis ( ), gasification (GasNet) and combustion (CombNet) and is funded through Altener in the Intelligent Energy for Europe Programme operated by DG TREN. | Many EU members | • Develop collaborative projects<br>• Act as an information point for three technologies |
| -BIO | 2005 | EPOBIO brings together world-class scientific and industrial expertise to identify areas for further investment in plant science research in order to realise the economic potential of plant-derived raw materials with long-term benefits to society | 12 European and 2 USA partners | • Three flagship areas identified as cell walls (biomass and bioethanol), plant oils (biodiesel) and plant polymers<br>• Desk studies and |

| Network | Established | Description | Membership | Activities |
|---|---|---|---|---|
| | | | | workshops and input to FP7 |
| -Net | 2006 | A network of national government agencies and ministries responsible for coordinating and funding national research efforts into bioenergy. The goal of this network is to strengthen national bioenergy research programmes through enhancing cooperation and coordination between national agencies. Through collaboration, the individual national programmes will produce higher quality results, while through coordination, they will seek to complement each other, avoiding duplication. | DTI for UK plus The Netherlands, Sweden, Finland, Austria, Germany | • Coordination and collaboration between national programmes in member states<br>• Issue of draft call in biomass for combustion |
| | 2005 | The EUBIONET II - European bioenergy network will analyse current and future biomass fuel market trends and biomass fuel prices. It will also collect feedback on the suitability of CEN 335 solid biofuel standard for trading of biofuels. Estimation on techno-economic potential of the biomass will be given until 2010 based on the existing studies and experts opinions. | 16 European partners with Jiri Klemes Manchester University for the UK | • Emissions trading<br>• Policy framework to develop bioenergy in Europe<br>• Special condiseration of wood fuel supply chains |
| | 2005 | A Network dedicated to improved understanding of biomass co-firing practices and principles through networking and cooperation. The UK is not a partner in this network. | | • Promote cooperation between European researchers working on co-firing.<br>• Promote uptake of innovative technologies that increase the amount of co-firing |
| MICROCHEAP | 2004 | This co-ordination action intends to bring together industrial | EU-wide network | • Improve |

| Network | Established | Description | Membership | Activities |
|---|---|---|---|---|
| | | specialists and research experts to focus entirely on renewable micro-CHP technology. It will co-ordinate and steer research in this field and highlight the most promising technologies with the highest potential for market penetration in existing and future market conditions | with one UK member | coordination of research in micro CHP<br>• Develop state of the art review of micro CHP<br>• Provide database of on-going research in micro CHP |
| Energy Association | 2001 | The Renewable Energy Association was established in 2001 to represent British renewable energy producers and promote the use of sustainable energy in the UK. The REA's main objective is to secure the best legislative and regulatory framework for expanding renewable energy production in the UK. The biomass trade association – British Biogen was incorporated into REA after its inception. | In excess of 100 members, mostly from industry | • Resource group to consider primary biomass<br>• Resource group to consider Renewable transport fuels<br>• Resource group for bioenergy |
| Renewables Bioenergy Network | 2006 | A network of individuals and organisations established by Scottish Renewables to coordinate activities and share information. | 200 members for the whole renewables sector | • Advice and consultancy<br>• Project development<br>• Project register |

## 8. UK participation in EU Framework Programmes (main programmes) – CORDIS

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UK participation in the EU Fourth, Fifth and Six Framework Programmes has been extensive with projects funded from Energy, Environment, Agriculture work programmes and encompassing coordinated actions, standard research projects, networks of excellence and human exchanges. Dry biomass rather than wet biomass has been the focus most projects in the past but recently there has been an increased interest in biomass for liquid biofuels within Framework Six. Within Framework seven, there is considerable emphasis on the biorefinery concept and on developing research to support liquid biofuels, particularly through biological conversion routes.

The -NET provides an extensive database of all FP V, VI, and VII bioenergy projects

**Table 8.1 Participation in EU Framework Programmes**

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| Bioenergy NoE | EU Network of Excellence for Integrating activities to achieve new synergies in research to build a Virtual Bioenergy R&D Centre that will spearhead the development of a competitive bioenergy market in Europe. The NoE comprises approximately 150 researchers and over 40 doctoral students from all eight partner | FP6 | DG research | Aston University | , Finland<br><br>7 Partners | €8.05m | €8.05m | 2004 - 2009 | €1.61m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | institutions. Activities include collaborative projects and synergies identified in bioenergy, networking including meetings and joint activities | | | | | | | | |
| Thermal Net | ThermalNet consists of three technologies: pyrolysis ( ), gasification (GasNet) and combustion ( ). Activities include developing collaborative projects and acting as an information point for three technologies. | | Intelligent Energy – Europe Programme | Aston University | Pyne: Aston University Combnet: Procede Group Bv Gasnet: University Of Vienna | Through Altener in the Intelligent Energy-Europe Programme operated by DG TREN. | € | New call in 2006 | |
| EPOBIO | POBIO brings together world-class scientific and industrial expertise to identify areas for further investment in plant science research in order to realise the economic | FP6 | Specific Support Action | For Novel Agricultural Products (Cnap) York, Uk Cpl Scientific Publishing Services Ltd (Cpl) Newbury, Uk British Sugar Plc (Bs) | University Of York 11 Partners | €1.48m | €1.40m | 2005 - 2007 | €0.64m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | potential of plant-derived raw materials with long-term benefits to society. Three flagship areas were identified: cell walls (biomass and bioethanol), plant oils (biodiesel) and plant polymers. Activities include desk studies and workshops and input to FP7. 12 European and 2 USA partners. | | | Peterborough, Uk | | | | | |
| ERA-Net | A network of national government agencies and ministries responsible for coordinating and funding national research efforts into bioenergy. The goal of this network is to strengthen national bioenergy research programmes through enhancing cooperation and coordination | FP6 | | Dti | | Maximum €3m for an ERA-NET | | 2002 - 2006 | |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | between national agencies. Through collaboration, the individual national programmes will produce higher quality results, while through coordination they will seek to complement each other, avoiding duplication. Activities include issuing of draft call in biomass for combustion. | | | | | | | | |
| EUBIONETII | The EUBIONET II - European bioenergy network will analyse current and future biomass fuel market trends and biomass fuel prices. It will also collect feedback on the suitability of CEN 335 solid biofuel standard for trading of biofuels. Estimation on techno-economic potential of the biomass will be | | Intelligent Energy - Europe | 16 European Partners With Jiri Klemes Manchester University For The UK | Vtt, Finland | Supported by the European Commission under the Baltic Sea Region INTERREG III B Neighbourhood Programme | | 2005 - 2006 | |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | given until 2010 based on the existing studies and experts opinions. Sub-topics covered include: emissions trading and policy framework to develop bioenergy in Europe with special consideration of wood fuel supply chains | | | | | | | | |
| MON-CHP: Optimised Biomass Chp Plant for Monaghan Integrating Condensing Economiser Technology | Build a 28 MW optimised biomass fired CHP plant in Monaghan, Ireland. Demonstrate a bubbling fluidised bed boiler with high plant availability of 92% and innovative integrated condensing economiser technology. Demonstrate the production of energy from spent mushroom compost (a world first). | FP5: Optimisation of CHP systems | No contract type | Emvertec Limited, Integrated Energy Systems Limited, Mccarron Poultry Limited | South Western Services Co-Operative Society Ltd.<br><br>5 Partners | €46.39m | €2.98m | 2001-05-01 to 2006-02-28<br><br>58 months | €0.62m |
| BIODIEPRO: | The project will | FP5: Cost | No contract | Argent Group Europe | Argent Group Europe | €17.44m | €3.15m | 2003-01- | €1.05m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| Demonstration of the Production of Biodiesel from Tallow and Recovered vegetable Oil | demonstrate an environmentally sensitive solution for the safe disposal of animal by-products, increase the knowledge of biodiesel production and investigate the potential in the fuel supply sector. It will be necessary undertake first life cycle analysis of biodiesel produced from RVO and tallow. | effective components for biomass and waste | type | Limited | Limited<br><br>4 Partners | | | 01 to 2005-12-31<br><br>36 months | |
| CO-PRODUCTION BIOFUELS: Integrated biomass utilisation for production of biofuels target action h and j | The goal of the proposal is to develop a novel cost energy effective production system for co-production of bio ethanol and electricity. | FP5: Economic and Efficient Energy for a Competitive Europe | Cost sharing contracts | Tmo Biotec Limited | Elsam A/S<br><br>6 Partners | €13.59m | €6.45m | 2002-12-01 to 2006-03-31<br><br>40 months | €1.93m |
| BGGE: 13 MW CHP Plant Based on Biomass Gasifier with Gas Engines | The partners will demonstrate and optimise a novel CHP plant based on biomass gasification on a full scale (13 | FP5: Biomass (including waste) conversion systems | No contract type | Energy Power Resources Ltd. | FLS Miljoe A/S<br><br>5 Partners | €6.00m | €2.10m | 2001-06-01 to 2004-05-31<br><br>36 | €0.70m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | MW thermal input). In this plant two biogas fuelled engines produce electricity (4 MWe) from gasified biomass. While the district heat (8 MWth) is produced in various heat exchangers. | | | | | | | months | |
| BIONORM: Pre-normative work on sampling and testing of solid biofuels for the development of quality management (BIONORM) | The aim of the BioNorm project is to work out a quality assurance system for solid bio fuels to help to develop the bio fuel market. This will be based on extensive work on sampling (i.e. investigations of the sampling errors and the sample reduction errors) and the testing of physical-mechanical fuel characteristics (i.e. moisture content & bulk density, ash melting behaviour, particle | FP5: Economic and Efficient Energy for a Competitive Europe, Cost effective components for biomass and waste | Cost sharing contracts | Forestry Constracting Association Ltd., Signalsfromnoise.Com Ltd, Green Land Reclamation Limited | Universitaet Stuttgart<br><br>37 Partners | €5.67m | €3.43m | 2002-01-01 to 2004-12-31<br><br>36 months | €1.14m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | size distribution & particle dimensions, durability and raw density of pellets & briquettes) and chemical fuel characteristics (i.e. sulphur & chlorine content, major & minor elements). The results of this work will contribute to the work of CEN TC 335 "Solid Biofuels". | | | | | | | | |
| TYREPYRO: Tyre Pyrolysis Process for Cement Manufacturing and Tyre-to-energy Plants | The aim of this project is to demonstrate a patented tyre pyrolysis process with energy and by-product recovery, first in a cement plant and subsequently in a full scale 17 MWe tyre-to-energy power plant. Scrap tyre is undesirable for landfill, but has very high calorific value, and is due to | FP5: Biomass (including waste) conversion systems | No contract type | Energy Power Resources Ltd., Bpi Projects Ltd. | FLS Miljoe A/S<br><br>4 Partners | €5.29m | €1.85m | 2002-02-01 to 2005-05-31<br><br>40 months | €0.56m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | the high natural rubber content a renewable energy source. | | | | | | | | |
| FORENERGY: Forest Energy - A Solution for the Future Power Needs | The main objectives of the project are to: conduct high level research on the development of the renewable and clean bio-energy technology; develop the complete energy chain from the forest to the consumer; develop an energy system producing renewable energy to the market price (fuel price <8Mwh); develop an CO2 emission neutral energy system; keep other emissions at a lower level than the regulation require. | FP5: Biomass (including waste) conversion systems | No contract type | Shotton Paper Co Plc | Timberjack Oy<br><br>7 Partners | €4.92m | €1.72m | 2001-05-01 to 2004-04-30<br><br>36 months | €0.57m |
| BIOFEAT: Biodiesel fuel processor for a fuel cell | The BIOFEAT project will develop, design, build and test a biodiesel fuel | FP5: Cleaner Energy Systems, | Cost sharing contracts | Johnson Matthey Plc (Trading As Synetix) | Politecnico Di Torino<br><br>7 Partners | €4.75m | €2.60m | 2003-01-01 to 2006-06-30 | €0.74m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| auxiliary power unit for a vehicle | processor for a vehicle auxiliary power unit (APU) utilising a PEMFC or SOFC. An APU enables electrical power, which is used for control, lights, air conditioning etc., to be generated independently from the traction power train. | including Renewable Energies | | | | | | 42 months | |
| HIAL: HIAL-biofuels for chp plants - reduced emissions and cost reduction in the combustion of high alkali biofuels | The scientific objective of this proposal is to understand the influence of fuel composition and combustion conditions on the release of alkali metals, S and Cl to the gas phase considering different combustion systems. The technical objective of this proposal is to apply the understanding of the alkali chemistry to | FP5: Cleaner Energy Systems, including Renewable Energies, Biomass (including waste) conversion systems | Cost sharing contracts | City University | Forschungszentrum Juelich Gmbh<br><br>7 Partners | €2.87m | €1.81m | 2001-12-01 to 2004-11-30<br><br>36 months | €0.60m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | develop primary measures for grate firing to achieve SO2 emissions below 200 mg/Nm3 without the need for installation of flue gas desulphurisation unit (FGD). | | | | | | | | |
| BIO-STIRLING: Small-Scale Chp Plant Based on a Hermetic Four-Cylinder Stirling Engine for Bi | An efficient utilisation of biomass for energy with a minimum of environmental impact can be obtained, when biomass is used for small-scale combined heat & power (CHP) production in villages close to biomass production sites as well as in the wood processing industries. The main objective of this proposal is to develop a small-scale biomass fired CHP plant based on a 70-100 kWel | FP5: Biomass (including waste) conversion systems | No contract type | University Of Bradford | Technical University Of Denmark<br><br>6 Partners | €2.50m | €1.10m | 2000-07-01 to 2003-06-30<br><br>36 months | €0.37m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | hermetic Stirling engine & to erect a pilot plant where comprehensive test runs will be performed with solid biomass fuels. This new development will be based on the experiences already obtained with a 30 kWel Stirling engine that has been in operation for more than 700 hours. The further technological development is essential in order to extend the area of application & cover the large market potential of biomass CHP plants. The aim of the project is to develop a technology with high overall & electric (>20%) efficiency & low operating & maintenance requirements to achieve production | | | | | | | | |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | costs. | | | | | | | | |
| GASASH: Improvement of the economics of biomass/waste gasification by higher carbon conversion and advanced ash management - target action H | The project will focus on optimisation and improvement of biomass/waste derived fuel gasification process and utilisation of gasification ashes in order to improve the overall feasibility of biomass/waste derived fuel based energy production. | FP5: Cleaner Energy Systems, including Renewable Energies | Cost sharing contracts | Emc Environment Engineering Ltd. | Technical Research Centre Of Finland<br><br>8 Partners | €2.40m | €1.20m | 2002-11-01 to 2005-10-31<br><br>36 months | €0.40m |
| BIFIC: Biomass/waste fbc with inorganics control (BIFIC) | The primary technical objective of the project is to establish the feasibility to use a broad range of biomass and waste materials and possible mixtures as fuel in FBC installations (fuel flexibility), minimising at the same time strain on the environment through optimised operating | FP5: Cleaner Energy Systems, including Renewable Energies | Cost sharing contracts | Cinar Ltd, Wykes Engineering Company Limited, Cre Group Ltd | Tps Termiska Processer Ab<br><br>7 Partners | €2.28m | €1.14m | 2001-02-01 to 2004-01-31<br><br>36 months | €0.38m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | conditions. | | | | | | | | |
| BIOWARE: Clean energy recovery from biomass waste and residues (BIOWASTE) | The project centers on reduction of the main pollutants and PM emissions from bio-waste combustion by a cost effective one-step combined dry gas cleaning and particle removal system based on ceramic filter candles. The main innovation of the system is the introduction of a selective catalytic process in the candle medium to reduce NOx. | FP5: Cleaner Energy Systems, including Renewable Energies, Biomass (including waste) conversion systems | Cost sharing contracts | Conversion And Resource Evaluation Ltd. | Centro De Investigaciones Energeticas, Mediambientales Y Tecnologicas<br><br>7 Partners | €1.96m | €1.31m | 2001-11-01 to 2005-07-31<br><br>45 months | €0.35m |
| MBF: Mixed Bio-Fuel 38Mwe Power Plant Project | FLS miljoe and EPR are planning to develop design, build own and demonstrate the operation of an innovative 38 MWe 'Mixed Bio-Fuel' power plant in the UK. The objective of the eligible part of | FP5: Biomass (including waste) conversion systems | No contract type | Energy Power Resources Ltd. | FLS Miljoe A/S<br><br>2 Partners | Not given | €1.50m | 2000-01-01 to 2004-06-30<br><br>54 months | €0.33m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | the project is to demonstrate 3 innovative features. The first innovation is the supply and handling systems for Miscanthus, the short rotational crop, which will be used as a biofuel for the first time in UK. The second innovation is an upgraded biomass firing system to burn the combination of Miscanthus, poultry litter, sludge and natural gas. | | | | | | | | |
| BIOSOD: Development of an autonomous Biomass-Solar Thermally Driven Distillation System | Not given | FP5: Biomass (including waste) conversion systems | No contract type | Thermomax (Gb) Ltd. | Austro Control Keg<br><br>7 Partners | €1.71m | €0.85m | 2003-01-01 to 2004-12-31<br><br>24 months | €0.43m |
| BIOGAS BY BIOAUGMENT: Optimised Biogas | The project aims to demonstrate the use of bio-augmentation to improve energy | FP5: Biomass (including waste) | No contract type | Rivacross Biotechnology Limited | Centro Para A Conservaçao De Energia | €1.60m | €0.50m | 2000-01-01 to 2002-12-31 | €0.17m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| Production and Resource Recovery through Bio-Augmentation in a Joint Plant Treating Poultry and Pig Waste | and resource recovery in a joint biogas plant for co-digestion of the 8.000 tonnes of poultry litter and 44.000 tonnes of pig slurry generated annually in those farms. | conversion systems | | | 3 Partners | | | 36 months | |
| Era bioenergy strategy - short term measures to develop the european research area for bioenergy rtd (target actions : b, h, j) | To reach the goals set by the "White Paper" and the "Kyoto Protocol " bio energy RTD will have to be enhanced significantly. The introduction of the European Research Area (ERA) will support this. An Accompanying Measure on actions necessary for the implementation of ERA in the field of bio energy RTD should be carried out with the objectives: to develop strategies for measures to | FP5: Cleaner Energy Systems, including Renewable Energies, Biomass (including waste) conversion systems | Preparatory, accompanying and support measures | South Western Services Co-Operative Ltd.<br>Dti | Joanneum Research Forschungsgesellschaft Mbh<br><br>17 Partners | €1.42m | €1.08m | 2002-01-01 to 2003-10-31<br><br>22 months | €0.59m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | promote coordination between EU and the member states in the area of bio energy RTD policies and programmes; and to identify opportunities for short-term actions leading to the ERA for bio energy RTD. The project consists of these tasks: A "Country survey": Survey of national and EU RTD policies and programmes and B "Bio energy policies and programmes mapping". | | | | | | | | |
| INTCON: Intelligent process control system for biomass fuelled industrial power plants (INTCON) | In this proposed project a combination of neural network and fuzzy logic methods will be used to develop a control system which will have properties such that based on the | FP5: Economic and Efficient Energy for a Competitive Europe, Cost effective components for biomass | Cost sharing contracts | Cinar Ltd | Tps Termiska Processer Ab<br><br>4 Partners | €1.36m | €0.74m | 2001-12-01 to 2004-11-30<br><br>36 months | €0.25m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | load demand, the combustion process at all time will be optimised both for minimum emissions, good burn outland good control of the slogging and fouling properties. The system is modular with a number of functions, which either can be used autonomous or linked. | and waste | | | | | | | |
| TBR: Waste To Recovered Fuel | It is intended to facilitate a cost-effective system for integrated resource and waste management which will reduce costs for both the waste management and power generation industries, and the end consumer. The objective is to bring together relevant stakeholders within a discussion Forum that will adopt an | FP5: Biomass (including waste) conversion systems | No contract type | Green Land Reclamation Limited, Slough Heat & Power Limited | Borealis Polymers Oy<br><br>15 Partners | €1.28m | €0.20m | 2000-01-26 to 2003-01-25<br><br>36 months | €0.067m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | informed technical and economic position on waste recovery in general, and on the production and use of solid Recovered Fuels in particular. Debate in the Forum will be informed through the compilation of a database of existing plant performance and emissions data, collected from operational projects across the EU. | | | | | | | | |
| THERMONET: Network Cluster on Thermal Biomass Conversion Implementation | This project will establish a cluster of two Networks on thermal processing of biomass for fuels and electricity. One network will address gasification and the other pyrolysis. Each network will have its own work programme, but both will have a common focus of | FP5: Cost effective components for biomass and waste | No contract type | Aston University | Aston University<br><br>2 Partners | €1.17m | €0.80m | 2001-06-01 to 2004-05-31<br><br>36 months | €0.27m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | addressing commercialisation issues and providing support for more rapid and more effective implementation of all the technologies in the market place. | | | | | | | | |
| SFH: Sludge for heat | Not given | FP5: Biomass (including waste) conversion systems | No contract type | Energy Technology Promotion Ltd. | Energy Technology Promotion Ltd.<br><br>5 Partners | €1.14m | €0.62m | 2003-01-01 to 2005-12-31<br><br>36 months | €0.21m |
| DIPROWASTE: Enhanced Production of Methane from Anaerobic Digestion with Pre-Processed Solid Waste for Renewable Energy | To tackle the worldwide problem of depletion of natural, non-renewable fuel sources, the production of biogas from the digestion of organic waste is being developed as a renewable energy source. The principle objective of the Diprowaste project is to investigate maximising the | FP5: Cost efficient photovoltaic | No contract type | C-Tech Innovation Ltd, Sundorne Products *Llanidoes) Ltd, Bioplex Ltd. | Ingenieurbüro Dobelmann & Kroke Gmbh<br><br>6 Partners | €1.09m | €0.54m | 2003-01-01 to 2004-12-31<br><br>24 months | €0.27m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | volume, proportion and rate of methane production from anaerobic digestion of organic waste, containing varying amounts of straw, by using various pre-treatments of the material. | | | | | | | | |
| ASMICAF: Development of an innovative acidic shape-selective mineral catalyst added pelletised fuel from organic wastes | The objective of this project is the development of an innovative acidic shape-selective mineral catalyst added palletised fuel from organic wastes and to develop a prototype process for binding harmful materials in the production of briquettes from waste products by adding inorganic compounds such as CaO, MgO, MgCO3, silicates or Al2O3 and some acidic mineral catalyst. | FP5: Cleaner Energy Systems, including Renewable Energies | Cooperative research contracts | Pyromex PLC | Teccon Innovation Gmbh<br><br>7 Partners | €1.06m | €0.53m | 2003-01-01 to 2004-12-31<br><br>24 months | €0.27m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | The product will be a dry pellet with comparable combustion and gasification qualities to coal, so that it can be burned directly without any necessary adaptation of an incineration or boiler system and without the need of further waste gas treatment. | | | | | | | | |
| FERMATEC: Development of a biotechnical high yield process for ethanol production based on a continuous fermentation reactor | The FERMATEC project will provide a modular fermentation unit for continuous ethanol production. Compared with traditional units, it will decrease ethanol production costs to a minimum of 20% and increase bio-ethanol production yield to approximately 25 g EtOH/l.h. | FP5: Cleaner Energy Systems, including Renewable Energies | Cooperative research contracts | Manchester Metropolitan University, Agrol Ltd. | Tecnia - Processos E Equipamentos Industriais E Ambientais Lda<br><br>10 Partners | €0.96m | €0.48m | 2003-01-01 to 2005-08-31<br><br>32 months | €0.18m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | The main achievements of FERMATEC project will have an impact on environmental, social and economic fields:<br>• applying biotechnology to the production of renewable fuels will directly improve the quality of the environment<br>• enhancing sustainable development by using waste products and valorisation of sub products<br>• increasing ethanol production plants and updating the large number | | | | | | | | |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | of European distilleries that still use traditional fermentation processes. | | | | | | | | |
| BIOCOGEN: Biomass Cogeneration Network | The proposed thematic network intends to: provide technical and economic data and deal with the key issues in the implementation of biomass CHP in Europe | FP5: Cleaner Energy Systems, including Renewable Energies, Biomass (including waste) conversion systems | Preparatory, accompanying and support measures | Tv Energy Ltd | Centre For Renewable Energy Sources<br><br>8 Partners | €0.84m | €0.39m | 2001-12-01 to 2003-11-30<br><br>24 months | €0.19m |
| WTE-ISLE: Waste Management in Island Communities: Strategy to Integrate Waste to Energy Policies | The project aims at facilitating their penetration by: providing islands with sustainable, indigenous & renewable energy supply options based on waste management practices, in line with guidelines set by EC Waste Directives; | FP5: Biomass (including waste) conversion systems | No contract type | Isle Of Wight Council, Shetlands Islands Council | Exergia, Energy, Management, And Information Technology Consultants S.A.<br><br>14 Partners | €0.83m | €0.50m | 2002-02-01 to 2003-07-31<br><br>18 months | €0.33m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | disseminating proven methods of using solid waste as an energy supply source; integrating clean and renewable energy produced from waste into the energy supply system of islands; dealing with the waste problem of islands. | | | | | | | | |
| EU CHINA BIOTECH: Accompanying Measure to Assist Technology Transfer of EU Biomass / Biomass Waste Utilisation Technologies to China | The primary objective of the proposed Accompanying Measure is to quantify the potential for transferring EU technologies to China for the increased utilisation of biomass and biomass-derived waste materials. This would directly aid the competitiveness of European industry in the Chinese market, | FP5: Cleaner fuels by substitution and treatment | No contract type | Aston University, Emc Environment Engineering Limited | Emc Environment Engineering Limited<br><br>10 Partners | €0.73m | €0.73m | 2002-02-01 to 2003-07-31<br><br>18 months | €0.48m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | and help to stabilise levels of trans-national greenhouse gases. | | | | | | | | |
| BIOMITRE: Biomass-based Climate Change Mitigation Through Renewable Energy | The aims of BIOMITRE are to assist propagation of biomass energy technologies throughout the European Union as a cost-effective means of providing commercial renewable energy supplies, which mitigate global climate change through greenhouse gas emissions savings. | FP5: Biomass (including waste) conversion systems | No contract type | Sheffield Hallam University, The Forestry Commission | Sheffield Hallam University<br><br>6 Partners | €0.60m | €0.45m | 2003-04-17 to 2004-10-16<br><br>18 months | €0.30m |
| BIO-SME-TC: Promotion of Eu Biomass Technology in Agro-industry of High-potential Third Countries | Objective of the proposal is the promotion of EU Agro-Industry residues combustion technologies, developed by European SME, in third countries with high potential in particular China, | FP5: Cost effective components for biomass and waste | No contract type | Green Land Reclamation Limited, British Biogen Ltd. | Exergia, Energy, Management, And Information Technology Consultants S.A.<br><br>5 Partners | €0.57m | €0.51m | 2001-08-01 to 2003-03-31<br><br>20 months | €0.31m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | Turkey and Uzbekistan. Specifically, the scope of the proposal is the promotion of combustion technologies developed by small and medium European manufactures for the exploitation of process waste from cotton and rice and residues from wheat cultivation. | | | | | | | | |
| BIOTOX: An Assessment of Bio-Oil Toxicity for Safe Handling and Transportation - Target Action H | Not given | FP5: Cost effective components for biomass and waste | No contract type | Aston University | Centre De Coopération Internationale En Recherche Agronomique Pour Le Développement<br><br>3 Partners | €0.52m | €0.44m | 2003-01-01 to 2005-06-30<br><br>30 months | €0.18m |
| MOND: Accompanying measure on critical technology selection and conference for | This accompanying measure proposes as 2 year techno-economic study leading to the main aim of a Conference as a dissemination | FP5: Cleaner Energy Systems, including Renewable Energies | Preparatory, accompanying and support measures | BLC Leather Technology Center Ltd. | BLC Leather Technology Center Ltd.<br><br>4 Partners | €0.44m | €0.22m | 2002-12-01 to 2004-11-30<br><br>24 months | €0.11m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| renewable energy recovery from biomass generated within the european leather sector | platfonn for the facilitation and implementation, of renewable energy technology selection for subsequent EU based exploitation within the EU leather sector. This project is essential to overcome technical and non-technical barriers, culminating in a selection process forest practice and workshop / conference and interactive web site establishment for dissemination. | | | | | | | | |
| TAR MEASUREMENT STAN: Standardisation of a guideline for the measurement of tars in biomass producer gases (tar | In a previous EU project, a Guideline for tar measurement ("the Guideline") was developed. Although several institutes have now used this Guideline, it does not have the status of an international | FP5: Cleaner Energy Systems, including Renewable Energies | Preparatory, accompanying and support measures | Emc Environment Engineering Ltd. | Energy Research Centre Of The Netherlands<br><br>9 Partners | €0.38m | €0.35m | 2002-12-01 to 2005-11-30<br><br>36 months | €0.12m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| measurement standard) | standard yet. The objective of this project is to remove this obstacle by standardising the Guideline. The result will be a CEN Standard. As acceptance and use by others is considered to be essential, dissemination and internalisation of the Standard forms part of this project | | | | | | | | |
| TAR PROTOCOL: Development of standard method for the measurement of organic contaminants 'tars' in biomass producer gases | The objective of the project is to remove this obstacle by developing a standard measurement method (Protocol) which is accepted and used by parties working on biomass gasification and has entered the standardisation procedure at CEN. This work continues an initiative started | FP5: Economic and Efficient Energy for a Competitve Europe | Coordination of research actions | Cre Group Ltd | Energy Research Centre Of The Netherlands<br><br>15 Partners | €0.33m | €0.26m | 2000-04-01 to 2002-07-31<br><br>28 months | €0.11m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | by IEA, EU and US-DoE to develop such a Protocol and will be based on the two draft Protocols which resulted from this initiative. | | | | | | | | |
| INTEGRATE: Integration of Biomass and Waste for Energy into Local Authority Energy Systems | Objectives: To examine EU experience on the public acceptability of schemes for energy from waste and biomass residues, including comparisons of successful and unsuccessful schemes; To transfer this experience to regions where there are extensive problems with acceptance of incineration of energy from waste and biomass residues, through a workshop for appropriate local authority personnel; | FP5: Integration of new and renewable energy sources into energy systems | No contract type | Improvement And Development Agency, AEA Technology Plc | Aea Technology Plc<br><br>5 Partners | €0.19m | €0.15m | 2000-07-01 to 2001-09-30<br><br>15 months | €0.12m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | To organise a study tour of successful systems; To make recommendations on public consultation to improve acceptability of energy from waste and biomass residues; To identify local authorities interested in such schemes and willing to be monitored through public consultation. | | | | | | | | |
| Development of an innovative acidic shape-selective mineral catalyst added pelletised fuel from organic wastes | The objective of this project is the development of an innovative acidic shape-selective mineral catalyst added palletised fuel from organic wastes and to develop a prototype process for binding harmful materials in the production of briquettes from waste products by | FP5: Cleaner Energy Systems, including renewables Energies | Exploratory awards | Pyromex PLC | Teccon Innovation Gmbh<br><br>2 Partners | €0.03m | €0.023m | 2001-10-11 to 2002-04-10<br><br>6 months | €0.023m |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | adding inorganic compounds such as CaO, MgO, MgCO3, silicates or Al2O3 and some acidic mineral catalyst. | | | | | | | | |
| Small-scale total energy systems powered by biomass and wastes | Application is made for assistance in preparing a Step 2 proposal aimed at developing small-scale 'total' energy generation systems for European markets by 2005. The target development will exploit advances in gas conditioning, filtration and electro-chemistry to generate 'high-grade' energy, in the form of medium CV gas and electricity, from renewable carbohydrate feedstock (energy crops and agricultural wastes) and from selected | FP5: Cleaner Energy Systems, including Renewable Energies | Exploratory awards | Progressive Energy Technology Ltd. | Progressive Energy Technology Ltd.<br><br>2 Partners | €0.03m | €0.022m | 2000-07-06 to 2001-07-05<br><br>12 months | €0.022 |

| Name | Objectives | Action line | Type of action | Uk Participant | Co-Ordinator And Partners | Total Funding | EU Funding | Duration | Annual Spend |
|---|---|---|---|---|---|---|---|---|---|
| | domestic and commercial wastes. | | | | | | | | |
| A biomass gasification combined heat and power [chp] sheme for the production of up to 100 kwe and 250 kwth | Biomass Eng. Ltd.'s objective is to demonstrate economically viable small-scale biomass gasification CHP system. Current small-scale systems are expensive and gas clean up is expensive, due to high levels of tars and particulates. | FP5: Economic and Efficient Energy for a Competitive Europe | Exploratory awards | Biomass Engineering Ltd. | Biomass Engineering Ltd.<br><br>2 Partners | €0.03m | €0.023m | 2001-07-19 to 2002-04-18<br><br>9 months | €0.023m |
| Efficient production of secondary fuels from paper recycling rejects and low colorific sludges through integrated rushing-dewatering-pelletizing | The project aims at developing an innovative mechanical sludge treatment system with integrated crushing - dewatering - palletising based on a special screw extruder. The dewatering reaches 85 % of dry contents and > 90 % by simple steam release of pellets. | FP5: Economic and Efficient Energy for a Competitive Europe | Exploratory awards | H And S Environmental | Gesellschaft Fuer Forschung, Entwicklung, Herstellung Und Betriebkompletter Anlagen Zur Verwertung Umweltbelastender Productie Mbh<br><br>2 Partners | €0.03m | €0.023m | 2000-05-15 to 2001-05-14<br><br>12 months | €0.023m |

## 9. International Initiatives (including IEA operating agreements and UK contacts)

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IEA acts as a focus for international collaboration in the complex area of bioenergy and consequently, 10 IEA tasks are in place for bioenergy, within the IEA Bioenergy implementing agreement. The UK has a good representation from several organisations including universities, private companies and DTI. The IEA networks provide a mechanism for the exchange of expert information and advice and have been of value to the UK in developing improved technical expertise in short rotation crops for bioenergy. The UK has current active participation in most of the IEA tasks. In addition to IEA, the International Poplar Genome Consortium has acted as a focus for developing genomic resources in poplar, including the full genome sequence and its relevance to both poplar and willow as bioenergy crops. The UK is part of the leadership of PYNE, the Biomass pyrolysis network. A new international network has been proposed by FAO, May 2006, (http://www.fao.org/sd/dim_en2/en2_060501_en.htm)and the Global Bioenergy Partnership was launched in 2007.

**Table 9.1 International Actions**

| Name | Type | Description | UK Contact Point |
|---|---|---|---|
| IEA Task 29. Socio-economic drivers for implementing bioenergy | An international collaboration within the IEA Implementing Agreement on Bioenergy. | Task 29 is an ongoing initiative from 1 January 2000 with the aim to:<br><br>i) to determine the economic contribution (financial, local industry creation, infrastructure developments, etc.) resulting from the deployment of bioenergy systems<br>ii) to determine the social impact (employment, education, health, etc.) resulting from the deployment of bioenergy systems<br>iii) to encourage the exchange of information and Task results between participants and also with countries in transition (Objective 5 of the Strategic Plan).<br><br>The participating countries in the 2003-2005 period were Austria, Canada, Croatia, Ireland, Japan, Norway, Sweden and United Kingdom. | Keith Richards, TV Energy |
| IEA Task 30 Short rotation crops for bioenergy systems | An international collaboration within the IEA implementing agreement on bioenergy | The objective of the Task is to acquire, synthesise and transfer theoretical and practical knowledge of sustainable short rotation biomass production systems and thereby to enhance market development and large-scale implementation in collaboration with the various sectors involved. | Keith Richards TV Energy |
| IEA Task 32 Biomass production for energy from sustainable forestry | An international collaboration within the IEA Implementing Agreement on Bioenergy. | Biomass Combustion and Co-firing works on further expansion of the use of biomass combustion for heat and power generation, with special emphasis on small and medium scale CHP plants and co-firing biomass with coal in traditional coal-fired boilers. This is done by generating and disseminating information on technical and on non-technical barriers and anticipated solutions. Task 32 is a continuation of Task 19. | William Livingstone, Mitsui Babcock Energy Limited |
| IEA Task 33 Thermal gasification of biomass | An international collaboration within the IEA Implementing Agreement on | The objectives of this Task 33 are to review and exchange information on biomass gasification (BMG) research, development, demonstration, and commercialization, seek involvement with bioenergy industries and to promote cooperation among the participating countries to | Nick Barker, Future Energy Solutions |

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| | Bioenergy. | eliminate technological impediments to advance the state-of-the-art of thermal gasification of biomass. The ultimate objective is to promote commercialization of efficient, economical, and environmentally preferable BMG processes, for the production of electricity, heat, and steam, for the production of synthesis gas for subsequent conversion to chemicals, fertilizers, hydrogen and transportation fuels, and also for co-production of these products. | |
| IEA Task 34 Pyrolysis of biomass | An international collaboration within the IEA Implementing Agreement on Bioenergy. | PyNe - The Biomass Pyrolysis Network - a global network of active researchers and developers of fast pyrolysis, has been established to discuss and exchange information on scientific and technological developments on pyrolysis and related technologies for the production of liquid fuels, electricity and chemicals. | Tony Bridgwater, Aston University |
| IEA Bioenergy Task 36 - Energy Recovery from Municipal Solid Waste | An international collaboration within the IEA Implementing Agreement on Bioenergy. | The Task objectives include the maintenance of a network of participating countries as a forum for information exchange and dissemination.<br>The participating countries in this Task are Australia, Canada, the EC, France, Finland, Japan, Sweden, Norway and the United Kingdom. | Gary Shanahan, DTI |
| IEA Task 37 Energy from biogas and landfill | An international collaboration within the IEA Implementing Agreement on Bioenergy. | The overall objectives of Task 37 are to review and exchange information on biogas production, upgrading and utilisation in research, development, full-scale application and legal frameworks. | Christopher Maltin, Organic Power Ltd |
| IEA Task 38 Greenhouse gas balance of bioenergy and biomass | An international collaboration within the IEA Implementing Agreement on Bioenergy. | Task 38 analyses and integrates information on bioenergy, land use, and greenhouse-gas (GHG) mitigation; thereby covering all components that constitute a biomass or bioenergy system, i.e. from biomass production to bioenergy conversion and end use. The ultimate goal is to aid policy and industry decision makers in selecting mitigation strategies that optimise GHG benefits while being practical and cost effective. | No UK representation |
| IEA Task 39 | An international | Task 39 "Liquid Biofuels from Biomass" is currently composed of 13 | Gary Shanahan, DTI |

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| Liquid biofuels from biomass | collaboration within the IEA Implementing Agreement on Bioenergy. | countries The Task brings together leading researchers and industry pioneers in our bid to successfully introduce biofuels for transportation into the commercial marketplace. Activities include the technical challenges of biofuel production, as well as the policy and regulatory issues that must be addressed in commercialization. The goal is to provide our members with comprehensive information that will assist them with the development and deployment of biofuels for transportation fuel use. | Tony Sidwell, British sugar |
| International Poplar Genome Consortium | An international consortium to develop poplar as the model tree for bioenergy, timber, paper and pulp. | Poplar is the first tree for which the complete DNA sequence is now known. As such it provides biologists with a unique resource, which funded by the USA Department of Energy, is central to the research push to develop second generation biofuels from woody lignocellulosic materials. This network of scientists exists to promote poplar at all levels including developing a science plan. | Gail Taylor, University of Southampton |
| Global Bioenergy Partnership | An international partnership lead by FAO | GBEP brings together public, private and civil society stakeholders in a joint commitment to promote bioenergy for sustainable development.<br><br>The Partnership builds its activities upon three strategic pillars: Energy Security - Food Security - Sustainable Development | Both DTI and DEFRA are partners in this network. |
| LAMNET | Latin American Network on Bioenergy | The project Latin America Thematic Network on Bioenergy (LAMNET) is funded by the European Commission in the framework of the specific research and technological development programme 'Confirming the International Role of Community Research'.<br><br>The main objective of LAMNET is to establish a trans-national forum for the promotion of sustainable use of biomass in Latin America and other emerging countries. | EU membership |

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| BMT-CES: Biofuel Micro-Trigeneration with Cryogenic Energy Storage (EPSRC funded UK-China Energy Awards) | collaborative projects | The Research Councils' Energy Programme wishes to develop collaborative projects in the fields of energy technologies, hydrogen and fuel cells as a key component of its strategy to foster closer scientific, technological and engineering links with China. | Prof Y Ding, N J Hewitt, A P Riskilly<br><br>University of Leeds, Ulster, Newcastle |
| Impact of DMF on Engine Performance and Emissions as a New Generation of Sustainable Biofuel (EPSRC funded UK-China Energy Awards) | collaborative projects | The Research Councils' Energy Programme wishes to develop collaborative projects in the fields of energy technologies, hydrogen and fuel cells as a key component of its strategy to foster closer scientific, technological and engineering links with China. | http://gow.epsrc.ac.uk/ViewGrant.aspx?GrantRef=EP/F061692/1Dr HM Xu, University of Birmingham |