

RENEWABLE ENERGY

ADAS CAPABILITY STATEMENT

OVERVIEW

Renewable energy production, to replace the fossil fuels that contribute such a large proportion of greenhouse gas emissions, is an important political objective in the UK and Europe. In the UK, the Government has set challenging targets:

- 5% of road transport fuels from renewable sources by 2010.
- 20% of electricity generation from non-fossil fuels by 2020 and 40% by 2050.

To achieve these targets will require dramatic changes in land use across the country, as energy production takes its place alongside food production among the priorities for British agriculture; and wind-farms continue to proliferate on higher ground, along coastlines and off-shore.

As well as more wind-farms and dedicated biomass crops, such as willow coppice and Miscanthus, there will also need to be further increases in our usage of 'wastes' such as forestry and arboricultural thinnings, sawmill residues, sewage sludge, livestock slurries and household refuse as the raw materials for heat and electricity production.

The biofuel sector is also developing rapidly, with significant investment from several major players in the oil and chemicals industries. This will provide new non-food markets for conventional arable crops, such as oilseed rape, wheat and sugar beet – which provide the raw materials for alternative fuels such as biodiesel, bioethanol and biobutanol.

ADAS CAPABILITIES

As the UK's leading research and consultancy organisation for rural and land-based industries, ADAS is particularly well placed to assist Government departments, agencies, NGOs, commercial companies and farmers in the development of a sustainable renewable energy industry

ADAS expertise in renewable energy includes consultancy, research and project development; and covers:

- biomass and biofuel crop production
- land suitability assessments
- environmental and economic assessments
- conversion technologies.

ADAS consultants have advised on renewable energy projects that have ranged from heating units for a single building to larger-scale electricity generating stations.



Short rotation willow coppice at ADAS Drayton, Warks

As a result of the company's long association with the agriculture industry, our consultants have particular strengths in the production and utilisation of biomass and biofuel crops, including Miscanthus and other energy grasses, willow short rotation coppice, cereals (for straw or bioethanol) and oilseed rape. We do, however, also have consultants with skills in many other relevant disciplines, including foresters, arboriculturalists, GIS specialists, engineers, business management specialists, environmental and crop yield modellers, crop physiologists, soil and water scientists, market researchers, policy analysts, weed control specialists, pathologists, entomologists, ecologists, landscape architects and climate change experts.

This unique grouping of specialists can provide our clients with research-based solutions to all

aspects of the biomass and biofuel supply chain, as well as other renewable energy sectors – including wind-farms. We offer a comprehensive renewable energy research and consultancy service, which includes:

- GIS-based land suitability and land availability analyses for biomass or biofuel crop production
- Development of data-based models of yield and water use for biomass crops
- Feasibility studies for biomass-fuelled heat boilers, CHP units and power plants
- Feasibility studies for anaerobic digesters and biogas plants
- Engineering solutions for renewable energy plants
- Risk assessments for pollutants in ash
- Planning submissions, and project development and management; sourcing finance and partners
- Environmental impact assessments, including ecological surveys and landscape assessments for biomass schemes and wind farms
- Energy crop advice, including producer group development, grant applications and crop agronomy
- Commercial energy crop planting and harvesting
- Supply of Miscanthus rhizomes, coppice rods/cuttings and seeds of other energy crops
- Weed control research and consultancy
- Nutrient cycling studies, catchment modelling and carbon sequestration research
- Biodiversity monitoring and ecological studies
- Crop agronomy and physiology research
- Genetics research and plant selection for desirable traits
- Arrangement of fuel supply contracts for guaranteed tonnage
- Environmental audits and life-cycle analysis
- Regional or national-scale analyses of the potential impacts of climate change on land suitability/availability for biomass crops
- Socio-economic assessments of renewable energy schemes, including market research (e.g. surveys of farmers or general public)
- Reviews, technology transfer, exhibitions and open days
- Training in all aspects of bio-energy crop production and utilisation

- Impartial advice on fibre, animal bedding and other alternative markets for energy crops
- Project development and management – both national and international.

ADAS is actively addressing the many questions raised by the emergence of a market for liquid biofuels. Current research includes projects that aim to define the quality requirements of crops, optimise crop production and facilitate the breeding of new varieties. For biofuels to make a positive contribution to climate change it is important that greenhouse gas savings are maximised. ADAS are involved in work quantifying greenhouse gas emissions from cropping and developing carbon accreditation schemes for biofuels.

ADAS staff also have good 'hands-on' experience of biomass crop production, managing significant areas of short rotation willow coppice and Miscanthus on the ADAS farms. For example, ADAS grows over 90 ha of willow at Drayton and is a major producer of planting material for new Miscanthus crops.

PROJECT EXPERIENCE

Our renewable energy, environmental, land-use and crop production specialists have carried out a wide range of projects – some of which are listed below – that give us both the breadth and depth of knowledge needed to deliver this project.

Biomass Crops – biology and agronomy

Arable Energy Coppice: a review of published R&D and discussion of the potential for widespread production on surplus agricultural land in the UK

MAFF. 1994-1995.

A comprehensive review of the agronomy of short rotation willow and poplar coppice, and the potential environmental and agricultural impacts of the crop. Aspects covered included the biological principles of coppicing, potential markets, species and clones, site selection, ground preparation, planting, weed control, pests and diseases, nutrition, hydrology, crop physiology, harvesting and storage.

Best Practice Guidelines for Growing Short Rotation Coppice (Defra PB No. 7135)

Defra. 2002.

Production of an advisory booklet for farmers.

Best Practice Guidelines for Planting and Growing Miscanthus (Defra PB No. 5424)

Defra. 2001.

Production of an advisory booklet for farmers.

Effect of planting density and harvesting frequency on plant growth and yields in two varieties of SRC willow

MAFF. 1996-2000.

Field experiments at two contrasting sites to compare the effects of five planting densities (10,000 to 111,000 plants ha⁻¹) and two harvesting frequencies (two or three-yearly) on plant morphology, light interception, survival, growth and yields of two willow varieties (*Salix x dasyclados* and *S. viminalis* cv. Jorunn).

Yield modelling of Miscanthus

Defra. 2003.

Development and validation of a yield model for Miscanthus growing at seven sites in England and Wales, based on daily observations of weather and local soil characteristics. Development and application of a computer code was used to apply the model to spatial data on soils and weather for England and Wales at a 1km² resolution.

Poplars: a multiple-use crop for European arable farmers (PAMUCEAF)

EC/ Defra. 1999-2004.

A large, multi-disciplinary research project that examined all of the main aspects of poplar production on agricultural land (arable or improved grassland). The project included tasks on environmental impacts (soils, water, biodiversity and landscapes), GIS, economic modelling, products and markets, and farmer and public attitudes. The research was co-ordinated by ADAS, and involved seven partners in Belgium, Ireland, Poland, Sweden and the UK.

Review of weed control in short rotation coppice crops

DTI. 1999-2000.

A review of published literature and current guidance for farmers on weed control in short rotation willow and poplar coppice crops.

Biomass Crops – land suitability, resource availability and supply chains

The potential of Miscanthus and wood fuelled heating systems in Pembrokeshire

PLANED LEADER+ (EC/Defra). 2004.

This study presented a technical and financial analysis of the potential for a wood heat and

Miscanthus industry in Pembrokeshire. The technical and fuel production costs of both Miscanthus and wood were evaluated. Clusters and individual installations were analysed and several ESCo models discussed, and a route map developed for the way forward.

ARBRE Wood fuelled power station fuel supply chain monitoring

Defra. 1999-2004.

ADAS were awarded the contract for monitoring the entire fuel supply chain inputs and operation at First Renewables' wood fuelled power plant in North Yorkshire. The work included significant environmental monitoring of the UK's first commercial SRC plantations, including crop agronomy and yield, machinery performance, vehicle exhaust CO₂ and NO_x emissions, dust and spore emissions from the wood fuel and assessing crop water use and drainage characteristics.

Strategic study of wood fuel heating and CHP in the South West

Regen SW. 2004.

This comprehensive study evaluated the economics and technical feasibility of wood heating and CHP for the whole of the SW region of England, identifying areas where it was most likely to be viable (such as off gas grid) and determining barriers to its uptake.

Biomass resource study

CRE/ Slough Heat and Power Ltd. 2001.

Evaluation of biomass resources, primarily forest residues. As a result of this ADAS study, using Forestry Commission survey data and lists of sawmills, Slough Heat and Power were able to source the required wood residues from a minimum number of large local suppliers.

Biomass Feedstock Study for proposed 28 MW power plant.

Peninsula Power. 2004

As lead fuel supply consultant to this project, ADAS evaluated potential fuel availability, handling options, fluctuations in price and long-term availability of a range of fuels from energy crops, forestry and waste streams.

Use of waste and recycled wood for biomass energy generation in the North East of England

Environmental Industries Federation. 2004.

An overview of the volume and sources of waste wood being produced within the UK, plus an estimate of the volume of waste wood produced specifically in NE England, in order to

provide an indication of the quantities available for use as a biomass fuel within that region.

Trees in Towns II

ODPM. 2003-06.

ADAS-led project, also involving Myerscough College (Preston), which studied urban trees and their management. The project included a field survey of approximately 160,000 trees in 147 towns and cities across England, aerial photograph survey, a postal survey of all relevant English local authorities (examining urban tree management policies and practices) and 12 detailed case studies on various aspects of tree management. Although the project was not directly aimed at renewable energy production, ADAS inputs included one case study on "Green waste utilisation" – which looked in detail at the ways in which the London Borough of Croydon use waste wood from their urban trees for wood fuel and other purposes.

Dataset of Agricultural Land Use in England and Wales

MAFF. 1998-2001.

A spatial dataset of agricultural land use (crop areas and livestock numbers) was developed for England and Wales with a resolution of 1 km². The dataset used a combination of agricultural census statistics, satellite-derived land cover mapping and thematic mapping from the Ordnance Survey.

Biomass fuels in Greater London

Private client. 2005.

ADAS produced a report outlining the contractual considerations for reliable biofuel supply contracts, and giving a succinct overview of the potential biomass supplies suitable for combustion in local heating units in London. Bioenergy supplies close to major conurbations have lower transport costs, an important consideration where local heating projects are planned.

Wood Fuel Handbook

Forestry Commission, Wales. 2004.

Production of a handbook and series of leaflets, to launch the Forestry Commission Wales 'Wood Energy Business Scheme'.

Resource study for the production of Bioethanol

East of England Development Agency. 2003.

This study employed input-output analysis and Keynesian Multiplier analysis to identify the direct and indirect benefits that an indigenous biofuel capacity would bring to local and national sectors. The magnitude and manner of support (capital grants, excise duty cuts or other grant aid) necessary to overcome competitive issues with

fossil petroleum were analysed and a carbon emission analysis included.

East Midlands fuel supply chain study.

Defra. 2002.

A study of supply chain options for fuel for biomass production in the East Midlands. Harvesting and transport options and costs for central storage and embedded plant were included.

Feasibility study on the biomass energy options for the East Midlands

Defra. 2001.

The objective of this study was to inform strategic planning, to target developers and attract appropriate inward investment to the region. Other similar studies have been undertaken in different regions.

Crops for Set-Aside Land: an economic and environmental appraisal

MAFF. 1997-1998.

Desk study to assess the potential environmental and economic impacts of producing various non-food crops (for fibre, starch or biofuels) on set-aside land in the UK.

EU Bioenergy chains

ADAS were contracted to analyse the fuel supply chain costs and logistics of a range of crops - Cardoon, Miscanthus, Arundo and switch grass - in several physical forms (pellets, cane, bales, billets and chips).

Biomass Crops – utilisation

Feasibility study for a proposed biomass fuelled heating system for Sparsholt College and the associated fuel supply chain and fuel production methods

Bridgets Research Trust. 2006.

This report considers the siting of a biomass boiler at Sparsholt College and reviews the locations for providing the best return through fuel savings and operational convenience. Fuel supply land requirements were reviewed on the basis of the various bioenergy requirement options.

A guide to biomass boilers in Wales

WDA. 2004.

ADAS produced a guide listing all biomass boilers in Wales. Interviews with the operators and owners were undertaken to evaluate the effectiveness of each system.

Technical and economic feasibility of installing a wood heat boiler, Brecon

WDA. 2004.

An evaluation of the technical and economic feasibility of the proposed installation of a wood-fuelled boiler at Penpont Mansion in Brecon. The project involved sizing the boiler, evaluation of fuel supply options, comparison of the economics of pellets and wood chips, and making recommendations regarding suitable boiler equipment (from a range of suppliers).

Technical and economic feasibility of installing a wood heat boiler, Pwllpeiran farm

WDA. 2004.

An evaluation of the technical and economic feasibility of the proposed installation of a wood-fuelled boiler at ADAS Pwllpeiran, Ceredigion. The project involved sizing the boiler, evaluation of fuel supply options, comparison of the economics of pellets and wood chips, and making recommendations regarding suitable boiler equipment (from a range of suppliers).

Private Financing Initiative for integrated waste management.

Leicester City Council. 2003.

Technical consultancy for procurement of a system including a 40,000 tonne/annum anaerobic digester. Significant avoided emissions of carbon dioxide arising from digester gas to renewable energy conversion were also calculated.

Renewable Energy from Agriculture

Defra. 2002.

A technical overview of renewable energy projects in agriculture, identifying barriers to firing wood chip on existing solid fuel energy conversion plant.

Biofuel Crops

GREEN Grain: Genetic Reduction of Energy use and Emissions of Nitrogen through cereal production

Defra/ HGCA. 2004-2009.

'GREEN Grain' is a large LINK project, funded by Defra, SEERAD and HGCA - in collaboration with Syngenta, Scottish Crop Research Institute, Scotch Whisky Research Institute, Wessex Grain, Grampian Country Foods Group and FOSS UK Ltd. The project has the combined aims of genetically reducing the nitrogen emissions and growing costs of wheat production, whilst enhancing the value of wheat grain for the bioethanol and grain distilling industries, for pigs and poultry and for other markets. The project seeks to achieve these goals by identifying wheat genotypes with minimal

nitrogen storage in the stems, and reduced gliadin protein in the grain. ADAS has also recently started an equivalent project looking at oilseed rape production for biodiesel.

Wheat as a feedstock for alcohol production

HGCA. 2006.

This study aims to inform growers and processors of the specifications required for wheat for bioethanol. In collaboration with the Scotch Whisky Research Institute, ADAS will define the grain characteristics required to maximise alcohol production and avoid processing problems. The work will identify appropriate varieties and crop management strategies to meet these specifications.

Facilitating carbon accreditation schemes for biofuels: feedstock production

HGCA. 2006-2007.

Being able to quantify savings in greenhouse gas emissions from the production of biofuels, through the development of carbon accreditation schemes, is important for the RTFO and for the credentials of a UK biofuels industry. In collaboration with Imperial College London and North Energy Associates, this project is developing methodologies for quantifying greenhouse gas emissions from crop production for biofuels.

Biomass for Hydrogen

Hyvolution

EC (Framework 6). 2006-2010.

Hyvolution is a large pan-European research project, which aims to develop a sustainable and economically viable process for the production of hydrogen from fermentation of biomass. Within the project, ADAS is working on the potential socio-economic and environmental impacts of such a process.

Environmental issues

Potential Impacts of Future Renewable Energy Policy on UK Biodiversity

Defra. 2004-2005.

Review of the potential impacts of renewable energy production, including bioenergy and wind-power, on UK biodiversity. The method used a series of impact matrices, summarising the effects by broad habitat type across the different technologies.

Bioenergy Crops and Bioremediation – a review
Defra. 2000-2002.

Literature review/desk study, which examined the potential use of bioenergy crops for the utilisation of organic and other waste materials, and their use to stabilise or 'clean' contaminated land. The project covered aspects such as environmental impacts (nitrogen and phosphorus losses to water, gaseous losses, heavy metals, impacts on biodiversity), phytoremediation of contaminated land, potential use of GMOs and relevant legislation.

UK Environmental Change Network

MAFF/Defra. 1992-present.

Long-term, integrated, UK monitoring network examining the impacts of environmental change. Management and data collection at the Drayton ECN site, a mixed lowland farm (with a significant area of willow SRC). Routine monitoring includes soil, soil water and precipitation chemistry; atmospheric chemistry (NO₂, NH₃, SO₂); vegetation, birds, bats, ground beetles, butterflies, moths, spittle bugs and craneflies.

Methodologies for Ecological Monitoring of Bio-energy Crops: a review and recommendations

Defra. 2002-03.

Literature review and expert analysis, including a review of available information on the ecology of short rotation coppice and *Miscanthus* crops. Part of the EC/Defra-funded PAMUCEAF project (Poplars: a multiple-use crop for European arable farmers).

Wind-farms in Wales: Environmental impact assessments (EIAs)

Dulas Ltd.

Environmental impact assessments for proposed wind-farm sites in Wales. Landscape assessments including cumulative impact assessment, zone of visual influence interpretation, ecological surveying and assessment of effects.

Energy balances

Carbon and energy balance of small-scale heat from wood and Miscanthus biomass boilers.

International Energy Agency. 2004.

This study quantified the carbon dioxide emissions and energy input from the planting, machinery and boiler manufacture and operation of biomass boilers versus fossil fuel boilers.

Carbon and energy balances for energy grasses.

Department for Trade and Industry (DTI). 2000.

Full life cycle analysis techniques were employed, accounting for emissions from machinery manufacture and production, seed sources etc.

KEY STAFF

John Spink BSc

Head of the ADAS BioRenewables group. An experienced research manager and specialist in arable crop agronomy and physiology, John utilises these skills and his thorough knowledge of the agricultural industry to guide the group's strategic consultancy and research on biofuels. He also has good practical knowledge and research experience of biomass crops such as *Miscanthus* and willow SRC. John has very close links with the agricultural industry, built up over many years, and is widely respected for his technical expertise. An author of many published papers, reports and press articles, John has excellent technology transfer skills and the ability to write for a range of different audiences.

Peter Nixon HND

Peter is a Senior Consultant with specialist expertise in the agronomy and physiology of biomass (willow, *Miscanthus* and other energy grasses) and biofuel crops. One of the UK's leading experts in *Miscanthus*, with more than 12 years experience of research and consultancy on the crop. He was responsible for the UK's first precision planter for *Miscanthus*, has worked with scientists at Kew Gardens on a germplasm collection project (from Asia) and currently manages a commercial *Miscanthus* propagation programme. Peter has also conducted feasibility studies and resource availability assessments for several new biomass power plants. Publications include 'Best Practice Guidelines' for both *Miscanthus* and SRC.

Catherine Heywood BSc (Hons)

Cathy is a research consultant with considerable experience of biomass and arable crops. She has a practical background, working for several years on field trials at ADAS Rosemaund, with additional expertise in literature reviews and technology transfer (including organisation of demonstrations and open days, and production of practical advisory booklets for farmers). Cathy's recent projects have included the production of a growers' guide for *Miscanthus* and a booklet on 'Energy Generation and Energy Efficiency on Farm – a

guide'. She is also currently developing a new biomass website for farmers in Wales.

John Garstang BSc (Hons)

John is a very experienced agronomist, with an extensive knowledge of UK and European agriculture. He has particular expertise in strategic consultancy, agricultural policy and project management. In recent years John has focused strongly on the renewable energy sector, utilising his strengths in arable agronomy and agricultural policy to deliver research and consultancy related to biomass and biofuel production. Recent projects have included studies of biomass crop supply chains and woodchip storage research.

Phil Metcalfe BSc (Hons), MSc, CEnv, CEng

Phil is a Chartered Engineer and Chartered Environmentalist with over 30 years experience in environmental management, consultancy and research – providing engineering solutions and strategic planning for energy and waste management schemes. Recent projects have included feasibility studies for anaerobic digesters, and strategic and resource studies for renewable energy schemes using biomass, biofuels and municipal wastes.

Bob Watson BSc (Hons), MSc

Bob is a very experienced senior consultant, with a background in soil science and mechanisation. He now specialises in farm energy audits, renewable energy feasibility studies, design of renewable energy plants, soil conservation planning, farm pollution risk audits, and farm waste management planning and system design. To date, Bob has completed more than 300 detailed energy audits on farms and horticultural units. He has also undertaken consultancy for Miscanthus and wood-fuel biomass heating projects in Devon and Cornwall.

Peter Berry BSc, MSc, PhD

Peter is a senior research consultant specialising in biofuel crops. He is currently using his expertise in cereal and oilseed rape physiology, biotechnology, and the genetics of arable crops in research that aims to improve crop performance and reduce pollution from cropping systems for food and fuel production. Peter currently manages a major Defra LINK research project – 'Breeding oilseed rape varieties with a low requirement for nitrogen fertiliser'.

Daniel Kindred BSc, PhD

Daniel is a research scientist with a background in crop physiology. His current work centres around growing crops for liquid biofuels. He is project manager for the 'GREEN grain' project, which aims to breed wheat varieties suitable for bioethanol and associated with reduced diffuse pollution. Other projects include defining the specification of wheat as a bioethanol feedstock and calculating greenhouse gas emissions associated with growing crops for biofuels. He is also involved in an EU project (Hyvolution) looking at the socio-economic impacts and life cycle analysis of producing hydrogen from biomass.

Richard Safford MIBiol, CBiol, PhD

Richard is a senior consultant with expertise in plant biochemistry and plant biotechnology, including 20 years experience developing nutritionally-enhanced GM crops. He is currently on secondment to the National Non-Food Crops Centre (NNFCC) where his role is to promote regional uptake of non-food crop products and technologies, including developing opportunities in the biofuel and biomass sectors.

Prof. Roger Sylvester-Bradley BSc, PhD

Roger is a Principal Research Scientist and a special professor with the University of Nottingham, specialising in temperate crop physiology. His research in 'predictive agronomy' has delivered canopy management and fertiliser recommendations, and growth stage keys, all used internationally by cropping industries. He has reviewed research on nitrate and genetic improvement for Government, and has published over 150 scientific papers on the resource capture by crops, disease impacts, crop stature and yield determination. He leads the GREEN grain project (see above).

Elizabeth Sagoo BSc (Hons), PhD

Lizzie is a research scientist, with specialist expertise in soil science, nitrogen and phosphorus leaching, and gaseous emissions of ammonia. She has experience of managing research projects and technology transfer. Her current research focuses on manure management and minimisation of nitrogen losses. Since joining ADAS in 2003, Lizzie has successfully completed a PhD at the University of Leeds, on 'Nutrient dynamics and growth at a coppice biofuel site'.

Andrew Urquhart BSc (Hons)

Andrew is a senior consultant and business development manager specialising in waste management, composting and the development of new products for waste materials. He is an experienced project manager and has good marketing and technology transfer skills. Andrew's previous experience has included projects studying uses for timber waste, including heat and power production.

William Little MRICS, CES

William is a chartered environmental surveyor with considerable experience of environmental assessments and planning consultancy for a wide variety of clients, including developers, electricity companies and national and local government. His recent work has included numerous strategic and environmental assessments, as well as draft designs, for proposed wind-farms in Devon, Northumberland, Wales and Scotland. William has also carried out environmental assessments for other renewable energy schemes, waste recycling facilities and composting plants. He has a good knowledge of environmental legislation and planning regulations, and has experience of expert witness work.

Chris Procter BSc (Hons), MSc

Chris is a Senior GIS Developer and consultant specialising in geographical information systems and spatial data sets for environmental assessment, analysis and reporting. He has extensive experience in the use and integration of data for environmental assessments and modelling exercises, and experience of delivering these systems through both intranet and web-enabled facilities. Chris has managed GIS-based projects for a number of high profile clients, including commercial companies, local and regional Government. Chris also has extensive GIS skills in terms of data manipulation and analysis, and is experienced in the use of ArcInfo, ArcView and ArcGIS software. In addition Chris has programming skills including Avenue and Visual Basic.

Greg Hughes BSc (Hons), MSc, PhD

Greg Hughes is a Senior Research Consultant within the ADAS Environment Systems modelling group. He has over a decade of experience in the modelling and management of natural resources within both research and consulting environments. In addition to undertaking project management, he specialises in spatially explicit ecological, environmental and hydrological simulation modelling, Geographic Information Systems (GIS),

spatial data analysis and scientific application development.

Chris Forster-Brown BA (Hons), MSc

Chris is an experienced Senior Ecological Consultant, with expertise in plant, bird and mammal surveys. Responsible for numerous ecological surveys in a range of habitats. Surveys, environmental impact assessments and mitigation strategies completed for a large number of proposed wind-farms across the West Midlands and Wales.

John King BSc (Hons), PhD, MIBiol, CBiol, MISoilSci

John is an experienced research scientist with specialist expertise in carbon and nutrient flux in crop/soil ecosystems, soil mineralisation/immobilisation turnover processes, root/soil interactions, trace gas emissions from soils and crops, carbon sequestration by energy crop systems and remote sensing of soils. He has authored numerous research papers and contributed to various reviews, including 'Bioenergy Crops and Bioremediation'.

In addition to the above staff, ADAS has a broad range of experts in other subjects that may be relevant for certain types of renewable energy project. For example, some of our business management consultants have previously been involved in feasibility studies for on-farm biomass heating projects; and our GIS specialists have completed studies on land suitability for biomass crops and environmental constraints affecting regional planting strategies.

PUBLICATIONS

From 20 years of experience in the renewable energy sector, ADAS staff have accumulated an impressive list of publications. Those listed below have been selected from more than 60 relevant scientific papers, reviews, reports and articles.

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Thomas T H, Tabbush P, **Britt C P** & Bulfin M (1999). Poplar as an alternative use of agricultural land in the UK and Ireland. In: *Farm Woodlands for the Future* (Eds P J Burgess, E D R Brierley, J Morris & J Evans). Bios Scientific Publishers, Oxford. 139-150.

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