“Bioenergy in the West Midlands”

A description of the regional bioenergy sector and recommendations for future development.

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Executive Summary.

Energy is rising up the political agenda with dramatic speed. This is due to a number of government concerns including security of supply in the short term and climate change and economic development in the long term. The West Midlands can to some extent demonstrate the use of each currently available technology (CHP, Biodiesel & Biogas) to utilise biomass feedstocks.

The West Midlands Regional Energy Strategy has set targets for the production of heat and power energy against consumption in line with National Policy set out in the Energy White Paper.

Each of the following bioenergy processes is at a very different stage of development and operates with a very different infrastructure. There are existing opportunities for farmers to grow and harvest biomass crops to engage in various stages of the process to diversify/supplement income streams and grow crops for which there is a potential market. However, the market is restricted by the end use potential at present and there is a lot of stakeholder concern that the Government is not doing enough to stimulate activity. A particular example being expressed by rural stakeholders is the lack of grant aid for bioenergy installation capacity to encourage "demand pull" for supply chain development.

- Road Biofuels: currently largely reliant on the waste cooking oil resource in the region, a few major production facilities and the existing fuel distribution and filling station network (B5).
- Biogas: currently operates at either a 'farm-scale' or municipal (landfill and sewage gas) scale, there are also significant research installations in the region.
- Biomass: this sector currently has the most individual installations in the region and these are very diverse. From small-scale and localised (e.g. using a farm/estate/local supply company timber processor's own resources) to larger-scale (biomass/co-fired power stations and public sector installations) that use global biomass feedstock's but are turning attention to the development of a local supply infrastructure (e.g. miscanthus growers, pellet processors, wood chip, etc).

Renewable GWh	**Biomass**	**Biogas**	**Road Biofuels**
Current Capacity	384	220	200
Target	1,500 *(Heat: 250. Electricity: 1,250)*		460
Potential	5,025	894	540

(Source: - MEA, 2005)

There are a number of higher/further education establishments in the region that have developed research departments for Bioenergy related activity. Stakeholder engagement through regional forums suggests that Aston University, University of Central England (UCE), Wolverhampton University, Warwick University, Keele University and Harper Adams University College provide the region with a strong knowledge base to support the development of a regional bioenergy industry.

The potential of wind, solar, ground-source heat and hydro resources and installations are beyond the scope of this report but should also be considered if this is being used to inform on the wider context of renewable energy potential in the region.

The next stage of this report will be to provide a detailed analysis of current activity for each of the above bioenergy processes and to ascertain the main opportunities for the land based sector to engage in Bioenergy economic activity. The aim would be to use this information to produce a 'Non Food Crops Action Plan' for the region and to provide a framework for regional support mechanisms (e.g. "Rural Development Plan for England" (RDPE II) that will be delivered by Advantage West Midlands to facilitate collaborative rural socio-economic projects).

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Contents.

1.0 Introduction.

This study has been commissioned by Warwickshire County Council. This report is intended to provide the European INTERREG IIIC 'Regional Innovation for a Competitive Europe' (RICE) project (project summary at annex 1) partners with a description of the bioenergy activity in the West Midlands region of England This report will describe the levels of current bioenergy activity (Biomass, Biofuels and Biogas) across the region. This report will also be circulated around the Bioenergy West Midlands network in order to disseminate the information to West Midlands stakeholders.

1.1.1 Context.

For the purposes of this report bioenergy can be defined as 'the use of agricultural and forest crops, their residues and biological waste feedstock's for the production of energy'. Evidence from other European countries (e.g. Sweden) suggests that bioenergy has the potential to deliver large scale environmental and economy benefits (www.bioenergydays.com).

It is envisaged that by sharing knowledge between the participating European partners that best practice can be shared and the relevant information will be recognised at a regional policy and implementation level by the relevant regional and national bodies. The relevant outputs of this report are intended to be posted onto an individual (RICE) project website.

1.1.2 West Midlands Policy

In line with Government targets to reduce carbon dioxide emissions by 20% by 2020 and as proposed in the Energy White Paper the West Midlands has set targets for renewable energy generation and liquid biofuels through the Regional Energy Strategy[1] (RES). This is an independent regional strategy and recognises the contribution that 'renewable heat' can make, in recognition of the emerging biomass sector.

The other major Government targets:-

- Requirement for electricity generation to be 10% renewable by 2010 (RES sets 5 % in West Midlands due to low opportunity for wind power).
- 'Renewable Transport Fuel Obligation (RTFO) that will require 5 % of all retail fuel in the UK to come from renewable sources.

The West Midlands Regional Energy Strategy was published in 2004 and was developed by the Regional Assembly, Advantage West Midlands and the Government Office for the West Midlands. The strategy reflects the regions position as a net consumer of energy, and the need to reduce carbon emissions significantly, starting now and continuing through to 2050 and beyond. The strategy has four main objectives:

- Improving energy efficiency
- Increasing the use of renewable energy
- Maximising the uptake of business opportunities
- Ensuring focused and integrated delivery and implementation

The production of biomass fuels have been identified as a key regional strength in a survey that has been conducted by Green & Ciaraldi (2006) from Birmingham University analysing the "Energy Strengths in the West Midlands – A report to the AWM ITC". This reflects both the regions potential for producing the fuels and the technology and research capability within the region.

[1] www.energywm.org.uk

1.1.3 Policy Implementation.

Various Government measures are in place to ensure the delivery of these targets. The 'Renewables Obligation' (RO) has been implemented as the main support mechanism for renewable electricity generation. Under the obligation, electricity suppliers must source a set percentage of their electricity from renewables. This was set at 4.9 % for 2005 and the Government plans to increase this to 15.4 % by 2016. At the time of writing this report there is a consultation exercise underway on the future arrangements for delivery of this system. In the past the RO has largely facilitated the delivery of renewable electricity through larger providers (Co-firing & large renewable plants) due to a number of economic and administrative issues favouring this process. However, financial incentives for large scale generators (co-firing) are now considerably less than twelve months ago when co-firing power stations could claim ROC's and this may well lead to the need for more, probably smaller embedded plant. Therefore, there may be opportunities for smaller, more dispersed installations that can assist in delivering other policy aspirations such as those set out in the Rural White Paper (e.g. rural economy regeneration). The development of micro-generation installations (incl. heat only) has the potential to make a significant contribution towards providing our energy requirements from renewable sources, particularly for heating requirements. However, there are a number of perceived barriers with the development of a network of small scale electricity generators including the complexities of linking to the National Grid. Research by the Carbon Trust found that the potential for carbon saving through heat only is significant and should be encouraged. However, the lack of a Renewable Heat Obligation (excluded from the RO in 2005) does not make such installations as financially attractive in terms of unit price of energy in comparison to electricity generating installations but is a growing market (e.g. biomass) due to the rising costs of conventional fuels (oil, gas, electric).

There is a plethora of grants (annex 2) that are available for capital equipment. Principally, the DTI "Low Carbon Buidlings Programme" has been implemented to cover the domestic sector and SME scale enterprises. However, there is generally a high level of confusion amongst stakeholders regarding grant availability and eligibility that is perceived to be restricting the development of the market (Talbott (pers comm., 2006). For instance, the Government has accepted proposals to introduce a national biomass grant through the recommendations made in the Biomass Task Force (DTI, 2006). However, implementation of these proposals has been slow in forthcoming and stakeholders feel that investment in Biomass has been delayed on the expectation that a grant scheme will be implemented in the near future. The England Woodfuel Strategy is currently being written with one of the key objectives to assist the "development of a substantial and sustainable market for woodfuel" (Forestry Commission, 2006).

Policy implementation for the development of the supply chains has been delivered on an 'ad-hoc' basis where Defra has delivered one round of a national 'Bioenergy Infrastructure Scheme' in 2005 that funded two supply companies in the West Midlands. However, details have not yet been released regarding another round of this scheme. The region also has two public sector "Energy Champion" bodies, Energy West Midlands and Bioenergy West Midlands (see table 1). The latter is a network that was formed to provide a knowledge transfer function to rural stakeholders in conjunction with Rural Hubs, CLA and NFU organisations to convey the non-food crop opportunities to the land based sector. It is recognised by stakeholders that this was a very useful tool (Rural Partnerships, 2006) but that the more resources needs to be put into this in order to optimise the potential market benefits. The successor Rural Development Plan of England (RDPE II) is currently under development where the responsibility for delivery of rural socio-economic schemes for the land based sector is to be transferred from Defra to the Regional Development Agencies. In the West Midlands, Advantage West Midlands has identified Bioenergy and the development of collaborative supply chains as a potential key investment sector and this is will be captured in the development of the funding package. However, it is unlikely that funding will be allocated to AWM before the end of 2007. AWM are also examining the evidence base for developing a "Renewable Energy Capital Grant Scheme" in the Rural Regeneration Zone.

Another national policy tool used is the tax relief available on such capital investment (approved biomass boilers) through the Enhanced Capital Allowances scheme. However, there are difficulties with enhanced capital allowances because they do not favour new start up companies. For instance the development of a small scale electricity generator through energy crops is unlikely to receive any benefits as it is probably unlikely to make taxable profits in its first year unless the business is adopted by a profitable company.

1.1.4 Local Authorities

Public Sector organisations have traditionally been first to embrace the new technologies due to their large ownership of capital and pre-existing green agendas. Some Local Authorities may have such objectives through formal commitments to a Corporate Climate Change Strategy (most in the region have adopted some form of strategy), an EMAS/ISO2001 system and to contribute towards 'Best Value' Indicators. Their ability to demonstrate the technology to a wide audience (i.e. the community) makes them useful advocates and can set the ball rolling for the development of new supply infrastructures for example. Many Local Authorities within the region are now considering bioenergy as a means to satisfying both internal and national targets. Many of the Local Authorities have an identifiable 'champion' for this cause who assists in steering projects through technical issues within these authorities. Local Strategic Partnerships also enable councils to disseminate sustainable practice through their partnerships with other public services through policy vehicles such as the Local Area Agreements (LAA's).

1.1.5 Associated Further Education / Research institutions in the Region

The University of Birmingham have recently collated data in order to inform the establishment of stakeholder group for Energy on behalf of the West Midlands Innovation and Technology Council (ITC). The survey report (Green, 2006) implies that there is a "strong involvement in areas of energy-related research and activity that mirrors other regional organisations to suggest that there is a good alignment between the potential science base and industry". The regions land-based research organisations (Horticultural Research Institute (Warwick) and Harper Adams University College) provide the region with a strong rural land based research expertise and a valuable link to industry to communicate the opportunities for land based energy feedstock's.

1.1.6 Bioenergy legislation considerations

There is a raft of legislation to consider before getting involved in bioenergy activity. Legislation can be difficult to interpret and can be influenced by a range of influential parameters including scale, location for example and the standard regulations covering planning, waste, etc.
The interpretation of legislation and regulation is a major subject area and cannot be covered in any detail in the report due to resource constraints.

For transport biofuels the principal consideration lie around the requirements for Integrated Pollution Prevention Control (IPPC) if a supplier intends to sell to the public. There are also complexities around the interpretation of tax relief on fuels under HM Revenue and Customs guidelines (Smiths Gore, 2006). Please see the "West Midlands Biodiesel Economic Evaluation Calculator" that goes into more detail on regulation and was written in conjunction with this report.

The biomass fuel supply chain is regulated in terms of feedstock properties and a decision tree for fuel production has been produced by Midlands Wood Fuel and can be seen at www.mwen.org.uk/regulation.htm
A biomass consideration checklist can also be seen in section 5.2 of this report.

Anaerobic digestion offers a simple model if used on farm for managing animal manures/slurries on the presumption that you comply with Nitrate Vulnerable Zone (NVZ) legislation when spreading digestate produced back to land. However the complexities arise when movements of animal manures/slurries between farms occur or where the Biogas system was to take food / green waste. These obstacles are being overcome but the feeling in the industry is that this newly emerging technology is suffering due to lack of knowledge and inflexibility in the Government licensing Agencies (Needham, A – pers comm, 2006). See section 4.1 for benefits of utilising anaerobic digestion systems.

1.1.7 Research / knowledge transfer funded to develop Bioenergy sector in the West Midlands

Table 1. Research / Knowledge Transfer project currently operation within the West Midlands Region

University / organisation	Project	Support bodies	Website	Contact
University of Central England	EBOP	AWM	www.tic.ac.uk/enviroinnovate/	David Terry
Harper Adams University College	Sustainable Technologies Network /	Higher Education (HEIFCE),	www.harper-adams.ac.uk	Andrea Humphries
Aston University	Supergen	ESPRC	www.supergen-bioenergy.net/	Rob Fenton
Marches Energy Agency	Bioenergy WM	AWM	www.mea.org.uk	Tristan Haynes
Bioenergy WM	Bioenergy WM	AWM, Harper Adams, Forestry Commission	www.bioenergywm.co.uk	Andrea Humphries
Energy WM	Energy WM	AWM, WMRA, GOWM, DTI	www.energywm.org.uk	Andy Stephenson

On a national scale there is the National Non-Food Crops Centre (NNFCC) and the Renewable Energy Agency (REA). The NNFCC's purpose is to provide a single, independent and authoritative source of information on the use and implementation of non-food crop products and technologies in the United Kingdom. The Centre will disseminate scientific and technical information on these 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.

The REA's main objective is to secure the best legislative and regulatory framework for expanding renewable energy production in the UK. We undertake policy development and provide input to government departments, agencies, regulators, NGOs and others.

1.2 Current Regional Capacity and Resource.

Bioenergy in the region is still in a very early stage of development however the region is able to demonstrate most technologies at some scale and is home to several key manufacturers, local authorities and organisations able to progress this development. A previous Bioenergy Audit for the region that was commissioned in 2005 (MEA) found that there was between 100-250 activities going on in the bioenergy sector, some 50-200 were actual installations generating renewable energy from biomass. An extract from the Bioenergy Database completed by Marches Energy Agency, showing relevant information for installations is provided in Annex 3 & 4.

The West Midlands region currently has some 160MW (RESTATS, 2005) of installed Renewable Energy Capacity generating nearly 600GWh per annum (www.restats.org.uk). The majority of this is from landfill gas with co-firing of biomass at Ironbridge and Rugeley power-stations making up much of the remainder.

1.3 Barriers to uptake of Bioenergy technologies.

The value of undertaking such activity is well supported. In a Europe-wide survey of energy advisory agencies[2] it was found that the greatest barriers to uptake of biomass technologies in particular, apart from perceived high initial capital cost, was a lack of information on suppliers, costs etc. In order of importance these barriers were:

[2] Rakos, C. (2005) The Role of Local Energy Agencies in RES Heat Market Development.

- Lack of information on suppliers and costs.
- Lack of skilled planners & engineers.
- Availability of fuels.
- Lack of general information for potential users.
- Lack of skilled and motivated installers.
- Availability of stoves/boilers.
- Lack of planning guidelines.
- Lack of standardised tender documents.

Cost of fuels was a lot less significant an issue than any of the above. Given that many of these barriers are 'knowledge-based' utilising existing knowledge, skills and resources in the region could go a long way towards promoting development of this sector.

2.0 Scope of the Study by Sectors / Processes

The key bioenergy technologies and subdivisions as defined by resource type that this report focuses on are:

- Biomass:
  - Biomass Crops: Miscanthus
  - Short Rotation Coppice: Willow
  - Timber: Poor quality roundwoods
  - Timber processing off cuts:
- Biogas
  - On-farm Anaerobic Digestion (AD): Slurry etc.
  - Centralised AD: Sewage, Landfill, Municipal Waste etc.
- Road/Liquid Biofuels
  - Biodiesel
    - Waste Cooking Oil Methyl Ester
    - Rapeseed Methyl Ester
  - Bioethanol
    - Sugar beet.
    - Apples and other waste fruit.
    - Wheat.

3.0 Liquid Biofuels Infrastructure.

Liquid Biofuels can be defined as liquid fuels derived from biomass that can be used for the production of fuel (predominately used for road transport in the UK). There are three main products available, straight vegetable oil (SVO) (usually from spent vegetable oil from the catering sector or produced from virgin sources), biodiesel (from esterification of used cooking oil or crushed oil seed) and bioethanol (primary opportunities from distillation of wheat or sugar beet in the UK). To date only SVO and Biodiesel are produced and processed in this region.

There is research into the development of an energy production facility at Bulmer's (Herefordshire) to produce biofuel for energy from Herefordshire's apple resource. However, at this time the project plans are not yet in the public domain.

British Sugar is due to invest in producing bio-butanol at the Norfolk plant (East of England region) to progress domestic bioethanol production. The Allscott British Sugar production facility in Shropshire has recently announced that will be closing down its conventional production. Plans are in progress to develop a project to look at the non-food cropping alternatives for growers in the region to find alternative non-food crop markets and it is anticipated that the regional development agency, Advantage West Midlands will be facilitating a non-food crops market development project in conjunction with a number of regional partners.

As previously stated vegetable oils can be used straight in diesel engines (as SVO) although in the long-term the vehicle will require conversion to run on these optimally. This process has been restricted due to the confusion around the tax rebate whereby it is unclear whether SVO is eligible for the 20 p/pl rebate. There are several companies involved in refining waste oils and converting vehicles to run on these present in the region

and these may one day develop a sufficient market to encourage the crushing of rapeseed to supply the region's SVO users.

For more information on the small scale opportunities for rural businesses in the region please see the "Opportunities for Liquid Biofuels in the Marches" report and the "West Midlands Biodiesel Economic Evaluation Calculator" report[3] (Smiths Gore, 2006) that have been commissioned in conjunction with this report.

The Regional Energy Strategy proposes a target of 460 GWh of renewable energy to be generated by road biofuels by 2010. The region currently has capacity for around 200 GWh, although very little of this is used within the region (MEA, 2005).

3.1 Producers.

The vast majority of the biodiesel currently produced in the Region is from processed Waste Vegetable Oil and there are two notable individual processors (BIP and Greenbiodiesel) that operate on a relatively large scale of around 7-15 million litres per annum. Previous communication with Chris Butler (Pers Comm, 2006) indicated that the processors were very interested in procuring virgin rapeseed oil. However, the recent decreases in mineral diesel price (99 p/pl to 90 p/pl) and the comparatively high cost of virgin rape oil makes the margins of virgin rape oil production unfeasible although it is acknowledged that this would be a better fuel product. Other studies have been undertaken to suggest that Biodiesel production from pure rape oil grown in the UK if the whole crop can be utilised. From a 'whole crop' perspective lots of feasibility work has been undertaken into the utilisation of the on the use of 'whole-crop' in order to increase the viability of biofuel production. Some authors imply that the use of straw, glycerol and "cake" for biomass renewable energy production makes the economics viable (Guy, 2006).

In order for the industry to significantly expand there will eventually need to be crops grown specifically for biofuels, but in a global market these could be from abroad but preferably within the region to minimise 'fuel' miles and to develop UK supply chains.

In 2005 Oilseed Rape (OSR) was widely grown by arable farmers (Table 2). Warwickshire currently has the greatest resource growing 34% of the region's crop. Herefordshire, Worcestershire, Shropshire and Staffordshire have between 15 – 20 % each. (Defra Census data, 2006).

Table 2. OSR (2004/05 data)

County	No of Holdings	Hectares
Herefordshire	283	5730
Worcestershire	213	5296
Shropshire	262	7484
Warwickshire	312	11,046
Staffordshire	196	5,674
Totals	**1266**	**37,230**

(Source :- Defra Census data, 2006).

Greenergy, a London-based fuels company, already offer specific contracts for biodiesel, through existing agricultural merchants, and there were 61 farmers in the Region were growing under these in 2003/4, the majority of which were in Shropshire. 10% of the Oilseed Rape grown in the UK is now grown under this contract (2005/6 Cropping Year). Under the new Single Farm Payments regime there is a €45 per hectare premium for growing energy crops, including oilseed rape, on non-set aside land.

Small-scale crushing and processing (> 450 t / yr) may present opportunities for individual farmers or groups as the equipment required is basic and requires relatively low investment to add value to this basic commodity product. However, the economics of this are reliant upon global values for rapeseed and fuel prices. At present there are no grants to encourage small scale processing in the UK. For

[3] http://www.bioenergywm.co.uk/library.aspx

more information on small scale biodiesel production please see the "Economic evaluation of small scale Biodiesel Production" that has been produced in conjunction with this report (Smiths Gore, 2006).

There is currently no bioethanol infrastructure although this may eventually become an important market for sugar beet, wheat and fruit growers in the Region and a feasibility study to produce bioethanol from orchards in Herefordshire has undertaken by Herefordshire Sustain.

3.2 Users.

The UK market for biofuels is still very much at an early stage of development and despite there appearing to be little activity in the West Midlands the presence of two large processors (BIP and Greenbiofuels) means it is regionally strong in terms of production. The use of this biodiesel in the region abates some 70,000 tonnes of carbon dioxide per year (MEA, 2005). The majority of sales, however, go out of the region.

There are a number of filling stations selling biodiesel at a 5% blend (B5[4]) throughout the Region as this can be used in every diesel vehicle without infringing warranty. A regional initiative to provide a consistent branding and help filling station owners promote the fuel and inform potential users as to how they can use the fuel is being developed to help grow the number of filling stations stocking the fuel. Such a scheme is currently being trialled in Shropshire.

Larger volume fuel users may be in a position to purchase the fuel at various different blends through a fuel wholesaler where the minimum order is usually 1,000 litres. Biodiesel processors may also sell pure biodiesel directly in 1,000 litre Intermediate Bulk Containers (IBC's) or larger volumes by tanker.

100% biodiesel has very limited practical application due to the issue that transport vehicle warranties only extending to 5% blends by vehicle manufacturers, although some fleet managers have successfully negotiated warranty terms with manufacturers to run blends of 20-30%. Biodiesel is not currently an economically viable option for fuelling agricultural machinery, due to the comparatively low cost of red diesel, despite being an ideal fuel for use in agricultural machinery.

Due to a 20ppl duty derogation on biodiesel it may cost slightly less than fossil fuel to those that can purchase in viable quantities, although the 'saving' afforded on duty is largely outweighed by higher production costs. The cost of blended fuel has tended to be higher due to a more lengthy supply chain and additional process involved in blending the fuel with biodiesel. At present users of this should expect to pay a 1.5-3ppl premium over fossil diesel.

4.0 Biogas Infrastructure

Biogas is produced by bacteria digesting organic matter (primarily animal, food and green wastes) and can be harnessed when this process is undertaken in simple airtight tanks (anaerobic digestion). This gas can be used on-site or centrally as a heating/cooking fuel or to power gas-fired turbines for electricity generation. The surplus heat from this can be recovered through the use of Combined Heat & Power units. The by-products of this renewable energy technology may, in practice, be worth more than the gas as a nutrient-rich digestate liquid and fibrous matter (a useful soil conditioner) is also produced.

There is currently around 220GWh of electrical energy being produced through biogas installations, almost entirely through the 17 landfill gas sites in the region with the exception of a small number of small scale installations (see 4.1 – 4.2 below).

4.1 Producers.

The Region is fortunate to play host to a pioneering research and development organisation, Greenfinch, who offer a superb case study / resource in the West Midlands region. There are also several individual on-farm installations in the Region. Because the value of gas is not greatly significant

[4] http://www.mea.org.uk/b5shropshire

on its own, given the capital and operating costs of all scales of equipment, installations have been developed for reasons other than generating renewable energy.

Some of these reasons for the use of biogas technology are outlined below:

- Technological Research & Development: research programmes in the region have looked into subjects as diverse as the destruction of pathogens and optimising harvesting schedules for Ryegrass as a 'feedstock' for biogas production.
- Demonstration: Walford Agricultural College in Shropshire and the Greenfinch South Shropshire Bio waste Plant offers practical research / educational resources.
- Recycling of 'municipal' and 'other' wastes: a 'gate fee' is received as landfill tax can be avoided and this can make centralised biogas installations economically viable. Gas is harvested as a by-product from landfill and sewage installations for generation of electricity for use on-site or to generate an income. A new project to process household waste for biogas is present within the region.

- Controlling pollution: digestate material is a much more concentrated material with properties that enable more efficient handling and management (application). If applied correctly this material is less likely to pollute (through run-off and nitrate leaching) than raw slurries/sludge spread on land, it may also be better utilised by pasture and crops in this form. Where this is a priority in Nitrate Vulnerable Zone's (NVZ's) there may be economic value in avoided fines and clean-up costs and existing farming systems can be continued without mitigation. This may initially attract the support of public money as there is an environmental benefit. Several Dairy farms in the region are utilising this technology.

  The benefits of digesting raw slurry into AD fertiliser are reported to be[5]:

  - pH of 7.0 - 8.2
  - Separated liquid and fibre can be spread with slurry tankers and muck spreaders as accurately as fertiliser through a fertiliser spinner, making better use of farm manures.
  - Savings in fertiliser costs.
  - The spreading season is broader as fertiliser from AD is absorbed quickly and does not contaminate the new silage or grazing growth.
  - Grass responds rapidly to AD fertiliser and produces a thick dense sward and animals seem happier to graze more quickly after spreading.
  - Weed seeds are killed by AD and there is also a reduction in pathogens (total elimination of pathogens is achieved through heating the feedstock to 70^{o}C for one hour).
  - The liquid fertiliser can be applied up to 1 month before cutting for silage whereas slurry application must be carried out at least 10 weeks before silage cutting thus AD liquid has the advantage of greater flexibility and offers a greater number of applications per year.
  - Biological Oxygen Demand (BOD) is reduced by around 90% during digestion so the liquid is far less likely to harm fish and aquatic life in water courses should it get there.
  - Silage produced using AD fertiliser is more palatable and has much less rejection by animals, than silage produced using undigested slurry, etc.

As many of these aspects are only just moving up in priority (from a policy point of view) there are not many installations in the Region but it does seem likely that more will come on stream as priorities shift and technology develops to make biogas more economically viable. The value of Renewable Obligation Certificates from electricity generation from biogas also improves the value of this income stream. Due to the nature of biogas it is likely to be used on-site or exported as electricity through use of gas-fired turbines as it is not suitable for integration into the existing mains gas supply network, has a greater value as electricity and can only be produced at a relatively small-scale.

[5] http://www.greenheat.org.uk/conference/bankfarm.shtml

4.2 Users.

Anaerobic digestion (AD) presents opportunities for waste management remediation in intensive livestock areas (e.g. indoor pig / poultry production), particularly in NVZ designated areas. It is estimated that there is a potential for up to 287GWh of energy per year to be derived from such feedstocks. 'Wet' energy crops and their residues could also play a major role in providing biogas as they can also be digested and regional capacity is estimated to be an additional 607GWh of heat and power. In theory this would abate nearly 300,000 tonnes of carbon per year.

However, there are several barriers to investment including the high capital cost of investment, bio-security and economic issues around using central sites to import wastes and the fact that that there are other feedstock's that are actually better fuels for AD. Greenfinch have now developed the "South Shropshire Biowaste" project[6] at Ludlow which is processing South Shropshire resident's food waste and producing electricity.

5.0 Biomass Infrastructure

For the purpose of this study Biomass has been defined as the term for any 'woody' material that can be burnt, primarily to produce heat in order to separate the three separate bioenergy processes covered in this report (Biofuel, biogas & biomass). The principal reference used to define Biomass is the "biodegradable fraction of products, wastes and residues from agriculture, forestry and related activities as well as the biodegradable fractions of industrial and municipal waste. This does not include mineral oils". (HM Customs, 2006) The West Midlands demonstrates a wide variety of 'feedstock's' being used for this purpose including short rotation coppice (SRC), wood waste from forestry, arboricultural and timber processing operations, miscanthus, straw bales and other agricultural crops (e.g. Cereals). Recent work by Marches Energy Agency (2005) suggests that the regional available resource is estimated to be 5,025 GWh (some 1.5 million tonnes of biomass). Recent work on estimating the annually available resource from forestry for this purpose has produced a figure of 1,575 GWh (Annex 5).

Small-scale biomass installations have become relatively frequent throughout the Region. There are many examples of those with a biomass resource, usually country estates and farmers, utilising this resource to heat their own businesses or homes, including over 200 big bale burners being used on-farm for farmhouse heating and grain drying (Teisan, P – Pers Comm, 2006). There are also several medium-scale examples of public sector buildings embracing this technology, including the regional Natural England's offices and Worcestershire County Council. A number of case studies exist on the Bioenergy WM website. There is a fast growing supply network and several notable biomass fuel supply/ technology companies within the region that offer supply and technology installation services (annex 5).

There are currently two CHP units that have been installed in the region. These BG 100 units have been manufactured in the region by Talbotts[7] and the prototype was installed at Harper Adams University College as a prototype earlier this year and is utilised by Bioenergy West Midlands as a regional demonstration unit. The Eccleshall power station in Staffordshire is currently in the 'build phase' but when completed this will provide a medium scale (2.7 MW) demonstration of Combined Heat & Power from biomass in the Region.

Existing biomass energy generation capacity is estimated to be some 384 GWh per annum, the majority of this is electricity being generated through co-firing at the region's major power stations, Ironbridge and Rugeley.

5.1 Producers.

Biomass is one of the oldest fuels with many domestic properties utilising wood for space heating requirements and for cooking. Today the technology is advancing quickly with the development of proven automated units that can use a variety of feedstock's (logs, pellets, wood chips, etc). The development of a strong supply chain is paramount to the development of the industry and the land

[6] http://www.greenfinch.co.uk/ssbd.html
[7] http://www.talbotts.co.uk/bgen.htm

based sector is in a strong position to diversify into biomass fuel supply chains. The main fuel supply network working with small scale heat (heat only) in the region is Midlands Wood Fuel (MWF)[8]. This company has received infrastructure grants through Defra's Bio-energy Infrastructure Scheme and has depots across the region where agricultural facilities are used as satellite stations. With the growing market development there are opportunities for the land based sector to establish fuel supply chains to serve the growing demand for a wide range of biomass crops.

On-farm chipping can be achieved through simple PTO-driven equipment although industrial scale chipping will require investment to purchase equipment that should be mobilised as it probably won't be economic for farmers, foresters to haul small biomass loads to a single processing depot. Significant storage space is also required and dependant on the crop and harvesting system it may be advantageous to use drying facilities.

CASE STUDY MIDLANDS WOOD FUEL LIMITED

Was set up in 2004 in response to the need to establish a wood fuel supply infrastructure throughout the West Midlands; it also supplies and installs wood fuelled boilers. MWF currently operates from three depots. A depot is a redundant or surplus barn on an existing working farm that is used for the outside storage of timber to allow for drying. The timber is then chipped into the barns at regular intervals. Farmers are paid to host the depots thus increasing their incomes. As market demand grows, it is hoped that more farmers will come on board. Two further depots are to be established in 2006. In 2005/06, MWF supplied around 1,500 tonnes of wood chip fuel to various additional wood boiler schemes around the region. At present, it installs one new boiler system about every five weeks, but aims to reach a target of one boiler in every three weeks by the end of 2006. MWF has been awarded a capital grant under the Bio-Energy Infrastructure Scheme to help finance the installation of an industrial wood chipper in May 2006, and to purchase a wood chip tanker. This seed corn funding has enabled the business to become established as a commercial entity.

Small-scale pelletising is technically possible and is the market is thriving in other European countries including Sweden who are one of the leaders for the development of the European biomass market. Increased availability of such a fuel could significantly expand the market for domestic-scale biomass, although this is very much a 'chicken and egg' scenario. The market is restricted due to the fact that many potential investors in biomass technology are deterred due to the shortage of pellet fuel supply chains in the region. This is perceived by many as a particular growth market for investors both in the West Midlands and Nationally.

'Energy Crop' rootstock for both Miscanthus and short rotation coppice (SRC) crops can be supplied within the region and specialist equipment for planting and harvesting has been uniquely developed here. There are several specialist fuel / rootstock supply companies notably BICAL, John Amos & Co and Warwickshire Renewable Fuels Ltd. Under the first England Rural Development programme (ERDP I) 'Energy Crops' were supported through establishment grants. However, these grants closed at the end of ERDP I. The EU have confirmed support for energy crops across the EU and it is anticipated that support grants for Energy Crops will be announced in the near future. The current regional planting statistics for ERDP funded 'Energy Crops' can be seen in table 3.

[8] http://wood-fuel.co.uk/index.htm

Table 3. 'Energy Crop statistics for crops supported through ERDP I.

Year planted / scheduled	Area of Miscanthus (ha's)	Miscanthus ERDP support payments (£)	Area of SRC (ha's)	SRC ERDP support payments (£)
02/03	3.46	3,182.2		
03/04	101.3	93,239.2		
04/05	193.58	178,093		
05/06	466.6	428,755	3.12	3120
06/07	855.69	799,364	17.46	17,460
07/08	16.05	14,766		
Totals	**1636.68 (ha's)**	**£1,517,399.4**	**20.58 (ha's)**	**£ 20,580**

(Source :- Natural England, 2006)

It is assumed that the vastly higher proportion of Miscanthus planting is due to the development of the Eccleshall Power Plant as mentioned previously in this report. This power station has designed to run on Miscathus and BICAL (Bi-Ecc) contracted to develop the fuel supply chain. Also, it is to be assumed that the lower figures of planting for 07/08 are due to the fact that the grant scheme closed in June of this year and the small proportion scheduled for future planting submitted forward committing applications before the deadline.

The region also has a significant proportion of woodland and this could present an opportunity to woodland owners as a new market. Much of the existing woodland within the region is under-managed and the development of wood fuel markets could provide a low end market for poor quality timber.

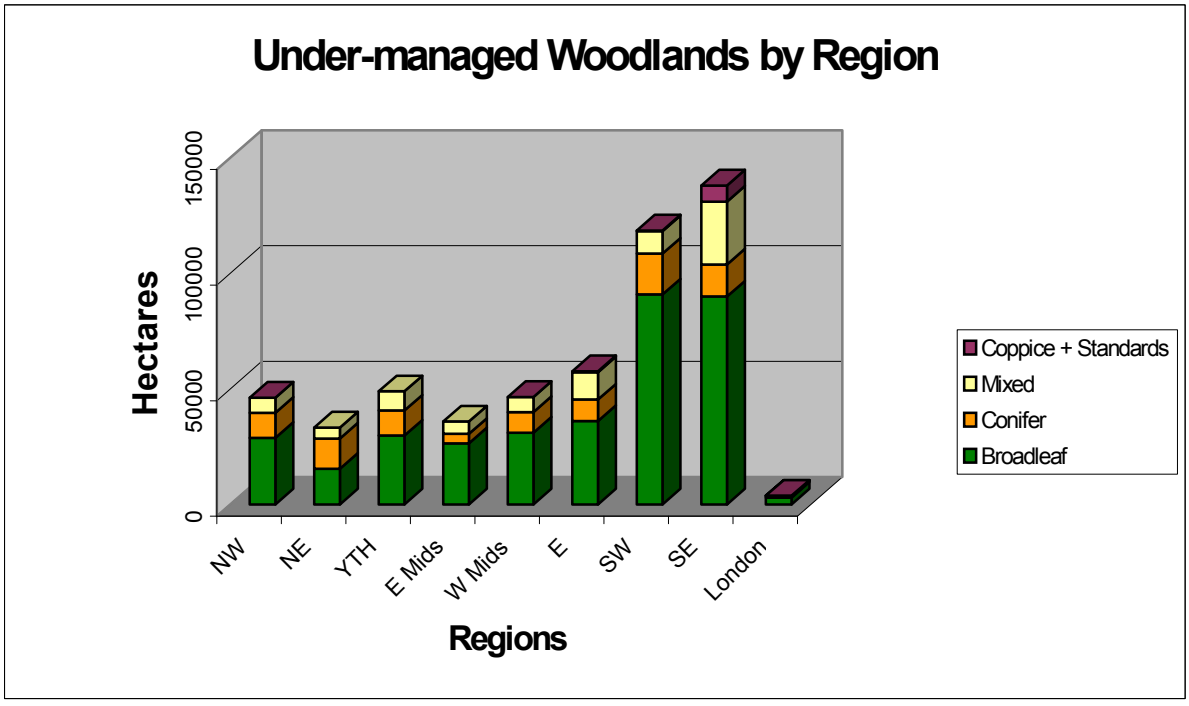

Fig 1. Graph illustrating regional proportion of under-managed woodland.

(Source :- Forestry Commission Newsletter (2) June/July, 2006)

5.2 Users.

Users of biomass systems may very often also be producers of biomass. Potential biomass users will need to consider the heat load of their building(s) and the availability of staff to manage the system (if required). All biomass heating installations require 'lead' time to some extent before they provide heat and all have a 'minimum' heating capacity and so they may not be appropriate for very small heat loads. At its simplest biomass can provide direct space heating through a wood burning stove fuelled by logs or wood pellets. Heat is most often utilised to fire a boiler and central heating system and at its most complex can be utilised in combined heat and power systems. Automatic feed wood pellet boilers are now available and particularly suitable for small-scale installations as they require little storage space and can be easily controlled and managed.

Table 4. Comparisons across energy utilities for conventional and renewable applications

Domestic Scale Technology	**Fuel**	**Typical Peak Energy Rating range (kWt).**	**Application**	**Approx. Capital Cost per kW installed (pre-grant).**
Oil Boiler	*Oil*	*2.5-30*	*Central Heating/Hot Water.*	*£150*
Gas Boiler	*Gas*	*2.5-30*	*Central Heating/Hot Water.*	*£75*
Ground Source Heat Pump	*Electricity*	*4-30*	*Space Heating only.*	*£180*
Wood Burning Stove (Space Heat only)	Logs/pellets	5-30kWth	Domestic and small business (eg Café)	£100-£250 (automated).
Pellet-fired boiler.	Pellets	10-30kWth	Domestic and small premises (Central Heating and Hot Water).	£250.

(Source :- MEA, 2005)

Considerations Checklist:

- Availability of (local) fuel supply: recommended within 25 mile radius.
- Transport of fuel to the site: frequency of delivery, size of delivery.
- Delivery type: bags, Ro-Ro trailer, hopper etc.
- Access to the site and storage area.
- Storage of the fuel: woodchip is a lot less dense a fuel than pellets and will require significantly more space.
- Back-up system: In some cases it is recommended to use an oil or gas-fired back-up system.
- Specification of the system: sizing is crucial to economic viability and can be minimised through maximising energy efficiency. How is it to be used? For example is it to provide part-load or to pre-load a heating system once a day etc.
- Feeding of fuel to boiler: automated systems are readily available.

- Operation and maintenance of the boiler: removal of ash, flue cleaning etc.

At a larger scale woodchip boilers require large storage space (e.g.: hook-lift trailers) and significant works for automatic woodchip feeding and ash removal. Potential users will also need to consider frequency of delivery of fuel when calculating the amount of storage space required, this will be important to planners considering such applications. Good access will be required for delivery vehicles. Such installations tend to be most suitable for sites with a high and consistent demand for heat, such as swimming pools or other large public sector buildings. There are several such installations in the region. Other large institutions such as prisons and hospitals may be particularly suitable sites for potential biomass installations, particularly where they are located off the gas-grid. Those considering replacing oil and gas fuelled central heating systems should consider whether biomass is more appropriate for them. Running costs are becoming increasingly lower in comparison to fossil fuel costs as these continue their inevitable rise and for businesses biomass heating is exempt from Climate Change Levy.

Table 5. Comparative Fuel Costs (MEA, 2005).

Heating Fuel.	**Input Cost per kWh of heat.**
Wood (chip)	1.5
Natural Gas	2.5
Wood (pellet)	2
Heating Oil	3.3
Solid Fuel (coal)	2.5
Electricity (day)	7
Electricity (off-peak)	3.5
Liquid Petroleum Gas	4.7

Many sites utilising larger-scale biomass heating have used “ESCo’s” (Energy Services Contracts) as the mechanism for financing these installations. Under these the installation company will provide and maintain the capital equipment and fuel supply in return for an all inclusive annual charge for the heat supplied. The Wyre Wood Fuel project is currently being facilitated by a number of the regions key agencies and the outputs from this work will give the business figures for the development of biomass energy supply companies in the region based a on a working economic model.

Many timber processors in the region have taken up biomass installations to provide their own energy requirements and there are many more major timber processors within the region with the potential to do likewise.

6.0 Summary and Recommendations for Action.

There is much interest from the agricultural community in developing this sector. As farmers are under increasing pressure to both cut the costs of their core business operations and to diversify they should consider the utilisation of on-farm resources, particularly where these are ‘waste’ resources. Farmers may have the opportunity to become fuel producers or food and fuel producers. The process of raising finance, either through raising private finance, establishing, co-operatives, applying for grants or tax relief, needs to be clarified for those considering this option and impartial advice as to how to go about this needs to be made clearly available. This is at least as important as the availability of actual technical information required to specify the installations. Support mechanisms should be developed to encourage strategic activity where bioenergy opportunities exist for the land based sector (e.g. biomass fuel supply (woodchip / pellet)).

The contribution that these installations can make to the rural economy in terms of jobs and demand for resources is more important than the contribution that they can individually make to renewable and carbon targets. However, this contribution may become cumulatively significant and it is important to monitor this.

Each of the technologies discussed have very different requirements and will be of extremely varied application. Biodiesel clearly requires the provision of a large infrastructure to be of widespread use whilst biogas can be utilised at different scales including farm level and district level although economics and

legislative barriers currently exist. Biomass is a widely applicable technology for heat production at the smaller scale and for combined heat and power (CHP) at both the small and medium scale with demonstration projects available within the region. With increasing fossil fuel costs and access to information and advice the number of installations of such technology should continue to increase rapidly within the next few years. The fuel processing and supply infrastructure has and will continue to adapt to demand.

Further steps are required in the West Midlands to stimulate activity in the non-food crop sector and the drivers are both economic and sustainability, with pressure to reach targets set by a plethora of strategic / legislative drivers. The possibilities for non-food crop supply products including potential added value products such manufacturing fluids, skincare, etc are still relatively unclear. There is currently only one known business in the region that processes farm crops into added value product despite national and international research in this area that identifies various market opportunities for non-food crops uses.

However, there is a clear need for resources to support research, effective knowledge transfer networks and regional policy development to deliver a regional integrated public sector approach to the sector. As previously mentioned in this report there are plans currently being developed by Advantage West Midlands to develop a project to pull together all the land based stakeholders through the 'Bioenergy West Midlands' model and to develop a regional non-food crops 'action plan'. However, there is also a regional effort required to ensure that renewable energy development (including added value non-food applications) is progressed between sectors (manufacturing, industrial, construction, rural development, etc) in order to maximise the sustainable development opportunities in light of Climate Change and to develop the economic opportunities that are evident through other European countries such as Sweden that have embraced a 'holistic view' of sustainable development across a number of sectors.

Considerable knowledge and work has been undertaken on the opportunities for bioenergy within the region, nationally and globally. However the opportunity to interface with other European partner regions through RICE who are more advanced in the development of bioenergy markets presents the region with an opportunity to learn from previous market development experience in Sweden and Germany. Bioenergy West Midlands partners revealed that they would like to know more about the following topics:-

- The role of Bioenergy crops and processes for bioremediation of waste, in particular SRC
- The development of bioenergy related business collaborations (e.g. heat supply companies) and examples of working models
- Government Policy Development and how this encourages rural diversification to energy production / added value non–food crop applications
- Biomass pellet markets and the supply infrastructure in Europe
- The business case and project support for the Energy Farm Project (led by Agrovast)

Local Authorities have often been first to take up new technologies that also have a 'public good', such as reducing climate change impacts and these are most likely to begin to run fleets on biodiesel for example. As farmers are the 'owners' of feedstock and have their own demand for energy they are best placed to employ on-farm AD and small-scale biomass heating, for example, selling any excesses to the National Grid and as fuel respectively. As identified in the Biomass Task Force, Local Authorities have the potential to lead the way through the sustainable procurement of energy and to stimulate economic development in this sector. This also has a hidden benefit to the rural sector to diversify into fuel supply chain development.

As a specific example of suitable sites for installation of medium-scale biomass heating or CHP, the prisons of the region could be targeted for take up of woodchip-fired boilers such as that at WCC as they will have suitably consistent demands for heat and are likely to have the available space and surplus labour to operate the installations. There are sixteen in the region and a list is provided in Annex 6.

Local Authorities and other large public sector institutions should be aware of all the technologies available and consider them in their 'rolling' replacement of boilers, particularly those that are off the gas grid, rather than simply opting for the 'business as usual' option as is appropriate to the individual situation of the building.

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Annex 1. RICE (Regional Innovation for a Competitive Europe) PROJECT SUMMARY

The aim of the project is to facilitate the transition of the land based industries (largely comprising SMEs) in each of the DISTRICT partner regions from dependence on current traditional activities (i.e. food production) to activities centred on the utilisation and exploitation of technical and scientific knowledge to develop new non-food markets for plant based materials and products. The project partners have a shared vision for the development of new market opportunities to strengthen their regional economies through supporting innovative SMEs in both the industrial and land based sectors. Areas of interest (with sub themes) which will be addressed in the project are; health and wellbeing (nutraceuticals, plant derived pharmaceuticals and textiles used in a bio-medical context), bio-energy (biomass, bio-ethanol, bio-diesel) and novel materials (including textiles and bio-ceramics). Our approach will be to examine the whole supply chain for each area; feeding back from end user requirements to the production of plant based raw materials, to identify opportunities and the issues (e.g. regulatory/ policy issues, knowledge gaps) which are currently constraining development of each market area in each partner region. In addition we will identify and describe successes and failures in the partner regions with particular reference to the reasons why they failed or succeeded. We will report our findings and address the issues identified in these analyses through actions aimed at knowledge transfer and exchange of good practice both between partner regions and the different stakeholders throughout each supply chain. Our holistic 'supply chain' approach will establish and strengthen links between cutting edge research being undertaken by Higher Education Institutions (HEIs) and Research & Technological Development (RTD) organisations in the participating DISTRICT regions and their exploitation and application by regional businesses, SMEs and spinout companies. The project partners bring complementary expertise to the project which will enable us to carry out the whole supply chain analyses for each area of interest within each region. All project partners will contribute to all of the analyses but each topic area will have a lead partner. The review of bio-energy will be led by the Västra Götaland partner, the two Sachsen partners will jointly lead on novel materials and the University of Warwick (West Midlands) will lead on health and wellbeing. West Midlands partners will provide the overarching coordination for the project and publish a consolidated report covering all three areas which partners will translate into their language to facilitate valorisation by local SMEs. Each partner region will host a study visit and joint workshop. These will enable partners to assess the market and research situation within each region, will allow partner regions to bench mark their activities against each other and to identify best practice, and will facilitate knowledge transfer between project partners which will thus improve regional and EU competitiveness. There will also be a major dissemination event organised by West Midlands partners during the Royal Show in July 2007. Each region will establish a steering group of stakeholders. These are intended to continue after the project ends. These will include representatives of relevant SME stakeholder groups. In addition a web-based directory tool for renewable resource businesses in each of the participating regions listing research expertise relevant to plant based energy, health and wellbeing and novel materials with key economic development support contacts and market intelligence will be developed.

The project objectives are:

- To identify opportunities, successes and failures within the partner regions in the areas of bio-energy, health and wellbeing, and novel (sustainable) materials;
- To identify constraints on the development of these markets and recommend possible solutions to address them;
- To improve the level of awareness among both land-based and industrial SMEs in the DISTRICT regions to the opportunities and constraints in these markets;
- To publish good practice guidelines for linking SMEs to R&D providers;
- To nurture closer links between land-based SMEs, HEIs and RTD organisations and industrial SMEs to develop new markets;
- To bench mark activities within each partner region against one another and disseminate best practice between the partner regions.