BIOGAS REGIONS

Framework Conditions for Biogas Plant in England and Wales

Report produced by Severn Wye Energy Agency as a partner to the Intelligent Energy for Europe project "Biogas Regions".

Introduction

This document is designed to fulfil several functions:-

- It will provide information on the key decisions to be made and the conditions to be met for anyone considering the development of a biogas (anaerobic digestion – AD) plant in England and Wales. It is quite a detailed examination of the issues and would, therefore, not be appropriate to someone in the early stages of decision making in respect of biogas.
- It will provide the core information necessary for the development of a regional strategy for the area of England and Wales covered by the "Biogas Regions" project.
- It will provide England and Wales information as a comparator for similar documents being concurrently prepared in France, Belgium, Spain, Italy, Poland, Slovenia (where biogas has seen little development) and Germany and Austria, where development of biogas projects has been very strong.

It is important to note that legislation and policy surrounding anaerobic digestion in the UK is changing quickly and some of the information in this report will quickly become out-of-date. Users will have to check for up-dated information.

1. Corporate Structure (legal form) of Plant Owners

1.1 Ownership of the plant will vary but there are likely to be three broad categories:-

- Land-owners/farmers who wish to diversify and have feedstock arising on their own land that will form a basic load for the plant. They may or may not take in material or waste products (eg source-segregated food waste) from other farmers or sources.
- Food processors or retailers, (or similar) that have a need to find cost-effective solutions to bio-degradable waste disposal and have decided to use anaerobic digestion. They may, or may not, take in other feedstock either to assist the biological processes or simply to increase income.
- Waste management companies that will establish plant, usually in response to known market opportunities (eg potential or existing contracts with local authorities for domestic waste disposal). Such plant may be co-located at landfill sites and involved in the pre-treatment of bio-degradable waste prior to final disposal to land.

1.2 The above options are not exclusive and others are possible. Joint ventures are not entirely unlikely and there is at least one not-for-profit "community" organisation in the region that is seriously considering the construction of a biogas plant.

1.3 Each organisation would have its particular challenges and opportunities but all would need to attract or develop skills, knowledge and experience in AD technology. It is probably extremely important that any organisation or individual that is considering the development of a biogas scheme understands that it is a biological process that requires intensive management.

2. Availability of Trained Operators or Specialised Training Programmes

2.1 The availability of trained and experienced biogas technicians in the UK is very limited indeed and the opportunities for generic training are currently very restricted. Most AD plant manufacturers do, however, offer training on the running and maintenance of their installations and thus the situation will change as new plant comes

on-stream. There is, therefore a reasonable prospect that the current shortage of skills and training will be overcome relatively quickly. The general shortage of people wishing to work in practical trades is possibly as much of a significant obstacle to progress as is the specific current shortage of those with specific AD skills and experience.

2.2 Although there is limited experience of using anaerobic digestion as a technology to produce energy through energy crops, or for treating food waste within the UK, one of the first digesters anywhere in the world was built in Exeter in the 1890's to treat sewage sludge in order to reduce the odour. AD is now the preferred method of treating sewage sludge within the UK and there are digesters on waste water treatment plants throughout the country. There is therefore expertise and experience in closely related technology and the transfer to the sort of digesters to be encouraged under Biogas Regions is relatively easy.

2.3 The very limited experience in the UK outside of the waste water industry is, not mirrored in the whole of the EU and opportunities do exist to learn from the very considerable knowledge and experience in the likes of Germany and Austria. The Biogas Regions project can assist with this transfer.

2.4 The technical competence of the operator is a vital consideration in the granting of a Environmental Permit for the plant so the availability of trained personnel and strong environmental management systems is more than something that it would be preferable – it is essential. See section 4 – Authorisation Procedures.

3. Site Constraints

3.1 Land-use Planning

3.1.1 The Town and Country Planning (General Permitted Development) Order describes certain categories of development that, under specific conditions and circumstances, do not require specific planning permission. It is just conceivable that a small AD plant that does not require the importation of "waste" material (feedstock) into the site or farm and utilises most of the energy through onsite processes, would not require specific planning permission. This must always be confirmed with the relevant local planning authority (LPA) – usually the unitary or district council.

3.1.2 There is very little experience of anaerobic digestion in the UK and it is rather unlikely that the local planning authority to whom any application is submitted will have any specific policies in its development plan.

3.1.3 Powys County Council does have a generalised reference to AD in the Energy chapter of its Unitary Development Plan and declares itself to be supportive of the technology. The relevant policy against which an AD plant is likely to be judged states:-

POLICY E2 – SMALLER SCALE "THERMAL" POWER UNITS
Developments for the generation of energy (heat and/or electricity) from combustion processes, at a relatively small-scale (5MW or below of electrical capacity) will be supported subject to the following criteria being met:

1. The fuel is from a demonstrably local source (usually from within a radius of 15km) and should not have been diverted from a more environmentally valuable use.
2. The proposal would not prejudice highway safety and would have a vehicular access and access route that is of a standard appropriate for the volume and character of traffic to be generated.
3. The proposal would not lead to any significant impact upon the amenities of local residential or other sensitive uses by reason of noise, dust, smell or fumes.
4. The development would not significantly detract from the landscape or townscape within which it is situated.
5. Emissions to the atmosphere and ground (including water) are such as to not lead to unacceptable levels of pollution: and
6. The proposal would not destroy or significantly damage a site of importance in archaeological, historic, ecological or conservation terms.

3.1.4 Whilst this policy only really addresses the energy generation aspect of an AD plant, the same principles are likely to apply to biogas production. If "feedstock" is substituted for "fuel", then the spirit of the first criteria of the policy will be maintained. Developers (in Powys at least) should usually be looking for locally generated feedstocks.

3.1.5 Planning policy advice is available at a national scale through the Planning Policy Statements (PPS) in England and Technical Advice Notes (TAN) in Wales. The relevant

documents are PPS22 and TAN8 – both entitled "Planning for Renewable Energy".

3.1.6 A companion guide has been issued to accompany PPS22 and the technical annex describes renewable energy technologies and gives advice and guidance on relevant land use planning issues. It comes under the heading "Energy from Waste (Biological processes)" and makes no reference to feedstocks other than waste. Although only produced in 2004 it is somewhat dated and by no means comprehensive in its coverage of AD.

3.1.7 Annex C to TAN 8 describes renewable energy technologies, including AD. It does so in nowhere near as much detail as PPS22's Companion Guide. Its conclusion is that "planning implications will vary tremendously between individual proposals, depending upon the scale of the operations and the type and source/s of feedstock."

3.2 Adjoining Landowners and Neighbours

3.2.1 Adjoining landowners and neighbours do have rights and could conceivably challenge the proposal directly through private action but by far the most likely way in which they might influence the proposal is via the representations that they make during the consenting procedure. It is likely that Local Planning Authorities (especially as they have little experience on which to make judgements) will err on the side of caution and look to long separation distances from the nearest houses or other sensitive properties such as schools. This is particularly likely if those neighbours make representations at the planning application stage.

3.2.2 It is clearly of considerable importance that neighbours are kept fully informed as the development concept progresses. If it is practicable, neighbours might be offered site visits to existing, well-operated AD plant of a similar type to that planned. Assurances must be given in respect of the questions that are likely to arise eg smell and safety. Planning Officers and elected Members are likely to be sympathetic to the concerns of neighbours unless they can be satisfied that they are unwarranted.

3.2.3 If the access to the site is other than directly off a public highway it is clearly of considerable importance that the right exists, or can be negotiated to cross all land in the ownership of any third parties. It is also important to check the requirements of the

Highway Authority in respect of any improvements that might be required to public or private highways. If such improvements require the agreement of third party land-owners then such individuals can either effectively block the scheme completely or require to be paid highly inflated prices for the land. It is, for instance, quite likely that visibility improvements might be required at the junction of the site access road onto the public highway. This might involve the setting back of field boundaries for a hundred metres or more. It could well be a condition of a planning permission that such works be carried prior to the commencement of work on the biogas plant and thus the developer must be in a position to carry out those works whether on their own land or that of a neighbour (either with their permission or through purchase).

3.3 The Avoidance of Nuisance (Odour and Noise)

3.3.1 Depending, to some extent, on the precise nature of the plant and the feedstocks involved, it would be wise to recognise that it is almost inevitable that there will be some smell associated with the development, even if only occasionally. Siting the AD plant immediately adjacent to, for instance, a residential area would probably be unwise – even if planning permission could be gained for such a location.

3.3.2 Consideration should also be given to the direction of the prevailing wind in the locality – for the vast majority of cases in the UK, this will be from the south-west. Noise can be reduced through the construction of suitably located and designed earth baffle mounds or acoustic barriers (fences or walls made of dense material such as concrete, hardwood or glass). It would also be good practice to visually screen operations from neighbours as much as possible, preferably through the judicious use of topographical features (natural or man-made) and/or existing or newly planted vegetation. A receptor of (lower levels of) noise or odours may well not perceive them as being so serious an issue if their source cannot be seen.

3.3.3 The Environmental Protection Act 1990 does give powers to Local Authorities to take action against an operation that gives rise to a "statutory nuisance" – eg odour or noise. That action would usually involve the serving of notices that require "Best Practical Means" to be employed to reduce the pollution (eg noise, odour) to a minimum. Whilst the cost of the measures required would be a consideration, it would certainly not be the primary concern of either the Environmental Health Officer or Court. There are no prescriptive noise levels laid down in legislation as this will vary significantly from

location to location – much will depend upon the existing background noise levels. Defining "odour" in a readily measurable way is notoriously difficult.

3.3.4 A court is unlikely to back the actions of a local authority in taking action under the Environmental Protection Act in circumstances where the plant is operating in line with the terms and conditions of a planning permission and the "nuisance" issue is as could, or should, have been predicted at the time of the consideration of the planning application.

4. The Authorisation Procedures

4.1 Town and Country Planning Legislation

4.1.1 In the vast majority of circumstances, the land use planning authorisation would come via town and country planning legislation. It is only under circumstances that the installed electrical capacity would be over 50 MW that the provisions of the Electricity Act would over-ride those of the Town and Country Planning Act. Such circumstances are so unlikely that they are ignored for the purposes of this report.

4.1.2 It is possible under particular circumstances (see para.3.1.1) that specific planning permission is not required but, again, this is rather an unlikely scenario.

4.1.3 It will be of key importance to determine at a very early stage whether or not a formal Environmental Statement will need to be submitted with the planning application. Such a statement is required where it is determined that Environmental Impact Assessment will be necessary in compliance with the Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999.

4.1.4 Any development falling within Schedule 1 of those regulations will automatically require Environmental Impact Assessment (EIA). The relevant category for a biogas plant is "thermal power station and other combustion installations" and the threshold is 300 MW of heat output. It is extremely unlikely, therefore, that any biogas plant will fall under schedule 1.

4.1.5 Schedule 2 of the regulations describes developments which may require EIA and it is rather more likely that a biogas plant proposal will fall for consideration under this

section. "Schedule 2" developments include:-

- Industrial installations for the production of electricity, steam and hot water occupying more than 0.5 hectare
- Surface storage of natural gas or underground storage of combustible gases in a building or structure exceeding 500 sq m or lying within 100m of any controlled waters
- Gas pipeline occupying more than 1 hectare or operating at a pressure that exceeds 7 bar gauge
- Waste water treatment plants of over 1,000 sq m

4.1.6 Developments falling within one or more of the Schedule 2 categories must seek a screening opinion from the Local Planning Authority (LPA) as to whether EIA is required. If the view of the Planning Authority is that EIA is necessary then the developer must supply an Environmental Statement with the planning application. There is a right to appeal against the decision of the LPA.

4.1.7 The LPA is guided in its decision making by Schedule 3 of the regulations whilst schedule 4 provides guidance on the content of an Environmental Statement:-

SCHEDULE 3

Regulation 4(5)

SELECTION CRITERIA FOR SCREENING SCHEDULE 2 DEVELOPMENT

1. Characteristics of development

The characteristics of development must be considered having regard, in particular, to –

(a) the size of the development;
(b) the cumulation with other development;
(c) the use of natural resources;
(d) the production of waste;
(e) pollution and nuisances;
(f) the risk of accidents, having regard in particular to substances or technologies used.

2. Location of development

The environmental sensitivity of geographical areas likely to be affected by development must be considered, having regard, in particular, to - (a) the existing land use;

(b) the relative abundance, quality and regenerative capacity of natural resources in the area;

(c) the absorption capacity of the natural environment, paying particular attention to the following areas - (i)wetlands;

(ii)coastal zones;

(iii) mountain and forest areas;

(iv) nature reserves and parks;

(v) areas classified or protected under Member States' legislation; areas designated by Member States pursuant to Council Directive 79/409/EEC on the conservation of wild birds[41] and Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora[42];

(vi) areas in which the environmental quality standards laid down in Community legislation have already been exceeded;

(vii) densely populated areas;

(viii) landscapes of historical, cultural or archaeological significance.

3. Characteristics of the potential impact

The potential significant effects of development must be considered in relation to criteria set out under paragraphs 1 and 2 above, and having regard in particular to - (a) the extent of the impact (geographical area and size of the affected population);

(b) the transfrontier nature of the impact;

(c) the magnitude and complexity of the impact;

(d) the probability of the impact;

(e) the duration, frequency and reversibility of the impact.

SCHEDULE 4 Regulation 2(1) - INFORMATION FOR INCLUSION IN ENVIRONMENTAL STATEMENTS

PART I

1. Description of the development, including in particular –

(a) a description of the physical characteristics of the whole development and the land-use requirements during the construction and operational phases;
(b) a description of the main characteristics of the production processes, for instance, nature and quantity of the materials used;
(c) an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed development.

2. An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects.

3. A description of the aspects of the environment likely to be significantly affected by the development, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.

4. A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development, resulting from:(a) the existence of the development;
(b) the use of natural resources;
(c) the emission of pollutants, the creation of nuisances and the elimination of waste,

and the description by the applicant of the forecasting methods used to assess the effects on the environment.

5. A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.
6. A non-technical summary of the information provided under paragraphs 1 to 5 of this Part.
7. An indication of any difficulties (technical deficiences or lack of know-how) encountered by the applicant in compiling the required information.

PART II

1. A description of the development comprising information on the site, design and size of the development.
2. A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.
3. The data required to identify and assess the main effects which the development is likely to have on the environment.
4. An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects.
5. A non-technical summary of the information provided under paragraphs 1 to 4 of this Part.

4.1.8 Whether EIA is a formal requirement or not, the type of information required under the Regulations, is likely to be requested by the LPA and developers should ensure that they submit it with the application or have adequate answers prepared should the questions arise. It is better to submit a fully justified and comprehensive application in the first instance.

4.1.9 The information that is more specific to a biogas operation and likely to be required to satisfactorily negotiate a planning permission is:-

- A detailed site plan clearly showing the development site (usually edged red), all other land in the applicant's control (usually edged blue) and all neighbouring dwellings or other sensitive building/uses.

- Plans, elevations and sections of the development that clearly set out the proposed appearance
- A full description of the processes to be employed – eg waste reception, processing, digestion, energy generation
- Description of the feedstock to be utilised, its origins, transport routes, delivery vehicles to be employed etc
- Description of the solid and liquid digestate and the strategy for utilisation/disposal.
- Estimated energy outputs and its utilisation.
- Environmental advantages of AD – carbon emissions offset
- Economic advantages to the area
- Details of the safety regime and the strategy to avoid explosion
- Details of all emissions even under worst-case conditions
- Measures to avoid the release of odours
- Noise minimisation technology and measures
- Measures to avoid pollution to the air, ground and watercourses even under worst-case conditions
- Details of any off-site equipment that would be required as a result of the development (eg electricity lines or substation)
- Details of any proposed mitigation measures – eg tree or shrub planting.

4.2 Other authorisations

4.2.1 Environmental Permitting. Many plants will require an Environmental Permit under the Environmental Permitting Regulations which came into force on the 6th April 2008. These regulations replaced the Waste Management Licensing and Pollution Prevent and Control regimes that preceded them and have the stated intention to:-

- Protect the environment
- Deliver permitting and compliance effectively and efficiently in a way that provides increased clarity and minimises the administrative burden on both the regulator and the operators of facilities
- Encourage regulators to promote best practice in the operation of regulated facilities, and
- Continue to fully implement European legislation

Most AD plants are encompassed by the regulations because the current definitions of "waste" are wide-ranging and include most agricultural wastes – especially where they

leave the holding upon which they arose. Whilst the regulator responsibility for the Regulations is split between the Environment Agency and the local authority, the Environment Agency will always be the relevant regulator for an AD plant. Unlike planning permission, where the permission goes with the land or building, the Environmental Permit goes with the Operator.

4.2.2 Operators should normally make an application when they have drawn up full designs but before construction work commences. A planning permission will be a pre-requisite for an Environmental Permit to be granted but the submissions can, to a large extent, run parallel to each other. The key to the granting of an Environmental Permit is the satisfaction of the regulator that risks to the environment are minimised. Much of this is down to plant design, procedures and practices but operator competence is also a key consideration. In order to comply with the requirements an applicant must demonstrate that they fit with the following requirements:-

- **Technical Competence**. Managers must have obtained the relevant Certificate of Technical Competence – this would usually involve training delivered by the Waste Management Training Board (WAMITAB)
- **Absence of Relevant Offences**. The company and persons acting for the company should not have any summary convictions relating to provisions of regulations affecting the industry. A license can be revoked if a license holder receives subsequent convictions.
- **Financial Provision/Security**. The applicant would need to demonstrate that it has sufficient finances to cover all eventualities that might arise as a result of failures of the plant etc. It is not sufficient to demonstrate that finance is available only for the ordinary course of business.

4.2.3 It is possible in very large and complex cases that a permit would previously have been required under the Pollution Prevention and Control Regulations. Where such a permit has already been issued by the Environment Agency it has already been automatically become an Environmental Permit.

4.2.4 Built into the Environmental Permitting Regulations is the ability of the Secretary of State, the Welsh Assembly Government and the Environment Agency to make "standard rules". If developed in respect of biogas plants such rules would simplify procedures and reduce costs to the plant operator. Such rules are under active consideration at present with the Renewable Energy Association representing the

interests of the UK biogas industry.
4.2.5 It is strongly recommended that early contact is made with the Environment Agency but there are also a series of guidance documents that readily available.

4.2.3 Animal By-Product Regulations. These regulations apply when a plant operator accepts food waste. They are concerned with the prevention of spread of animal diseases such as "Foot and Mouth" and require that waste foods be sterilised. The absence of meat products from cooked food does not render it immune from the need for sterilisation. The Animal Health Agency (AHA) (formerly known as the State Veterinary Service) administers the regulations. It is a key part of the considerations of the AHA that the plant is totally isolated from livestock farming operations – the AD operation must be fenced in order to ensure that no livestock enter the compound or the vehicular access route.

4.2.4 Building Regulations Consent. It is recommended that contact be made with the relevant local authority Building Control Officer in order to establish the extent to which the development will be impacted by the "Building Regulations".

5. Components of the Plant

5.1 There are a number of components to any AD operation and each will require to comply with relevant standards and regulations. Of critical importance, however, is the full integration of the component parts in order that the system works efficiently, safely and as a reasonable "neighbour".

5.2 The feedstock reception and processing facilities will depend very much upon the nature of the operation and the type of materials under consideration. Most biogas feedstocks have the potential to cause odour nuisances and it is critical that feedstock deliveries are handled correctly, probably happen within an enclosed space and often under "negative pressure". The sooner the feedstock is contained within an airtight receptacle such as a mixing or fermenting tank, the less the chance that nuisance will be created.

5.3 The digester (usually a twin-walled steel tank in the UK) is clearly the defining component of a biogas installation. It is also one of the physically largest components. It is critical that the digester is set-up properly, maintained well and fed according to its

design parameters and feedstock currently in use. Feedstock will often vary from one time of year to another and it is important that the processes within the digester are monitored and managed as necessary.

5.4 The biogas is drawn off from the digester and, again, it is vital that this process is well-managed. There is a theoretical potential for explosion because of an undue build of gas/pressure as well as the ignition of the flammable gases but safety systems are put in place to ensure that this doesn't happen. Gas collection, control, storage and utilisation systems are designed in accordance with good engineering practice and, where appropriate, the technical and safety standards issued by the Institution of Gas Engineers and Managers (IGEM). Good plant manufacturer's designs are reviewed by a Chartered Gas Engineer.

5.5 Where a significant quantity of Hydrogen Sulphide is anticipated to be produced within the digestion process, it is normal for the biogas to be cleaned prior to its combustion in a boiler, engine or turbine. This process is designed to remove corrosive compounds of sulphur. It is clearly critical that this plant/process is notified as part of the authorisations for the operations and is noted as part of the pollution prevention measures.

5.6 Once the biogas reaches this stage in the process it is regulated and controlled very much like any gas combusting equipment. It is possible the gas is, indeed, piped to a remote location for utilisation elsewhere.

5.7 Should the gas be used to generate electricity then there are clearly important safety issues that need to be addressed with the generator itself and with the connections to the supply network (which could be "private wire" or the public network). Connections to the public network have to be undertaken by and through negotiation with the relevant District Network Operator.

6. Feedstock to be Utilised

6.1 Source-Segregated Food Waste.

6.1.1 Local authorities in England and Wales are charged with the collection and disposal of municipal waste. In the Welsh part of the region the local authorities are unitary and

therefore undertake both functions but in the English counties, the district councils collect the waste but the county councils are responsible for disposal. The English arrangements would appear to make integrated solutions more difficult.

6.1.2 The EU Landfill Directive is driving the disposal authorities towards solutions that divert waste, but bio-degradable waste in particular, from landfill. The Animal By-products regulations require food waste to be sterilised and thus it usually has to be diverted from open windrow style composting solutions. In-vessel composting can be undertaken so as to comply with the sterilisation requirements but the process is not efficient from a carbon emissions standpoint and the end product is of limited economic value. Anaerobic digestion, whilst a little more capital intensive, offers a much better solution in terms of the carbon balance and the potential usefulness of the outputs.

6.1.3 Current indications are, however, that only Powys is seriously considering AD solutions at present with Monmouthshire, Gloucestershire and Wiltshire apparently looking to combustion based energy-from-waste plants, and/or in-vessel composting to solve their municipal food waste problems. Powys County Council is already facilitating segregated food waste collections from households in the Upper Severn Valley area and this is to be extended to a wider area in the near future. The collected waste is sent to the Greenfinch digester at Ludlow – just outside the project region. The Welsh Assembly Government has very recently indicated to all Welsh local authorities that they must collect source-segregated food waste.

6.1.4 The theoretically available segregated food waste from the domestic waste stream is little more than academic interest at present – once decisions are made and long-term contracts signed, in respect of energy-from-waste plants, waste from that authority is effectively unavailable to AD. Food waste from restaurants, canteens, schools, hospitals, care homes etc is, however still potentially available and often collected outside of the municipal arrangements. It will be the English counties, in the major centres of population such as Gloucester and Swindon where the major opportunities are likely to exist.

6.2 Residual Municipal Waste

6.2.1 Waste disposal authorities must satisfactorily treat waste before it enters a landfill site. The driver behind this requirement is the need to prevent the bio-degradable

element from decomposing within the site and releasing methane into the atmosphere. If this process can be accelerated and undertaken within the controlled conditions of an AD plant then this requirement is met.

6.2.2 The nature of "residual waste" however does not general lend itself to easy processing and digestion. The term "residual" is used for that fraction of the initial municipal waste stream that cannot practically be recovered via recycling or source segregated composting/AD.

6.2.3 There is only limited experience of such residual waste AD plants in the UK at present but the "dry" AD systems recently developed in Germany appear to be of considerable potential. As with segregated food waste from the municipal stream it would currently appear that only Powys is seriously examining this possibility at present.

6.3 Waste from Food Processing (including Abattoirs)

6.3.1 Most of the waste from abattoirs cannot be processed via an AD plant and must be sent for high temperature processing but some of the material is available. The number of animal-slaughtering facilities has reduced very significantly over recent years and the trend appears to be continuing as hygiene standards/costs and the economies of scale force out of business all but the biggest operations. Whilst there are currently abattoirs within and adjoining the project region that could be a source of suitable feedstock, the apparent uncertainty in the meat processing industry would be a cause for concern for any biogas developer.

6.3.2 There are a number of other food processing operations that have the potential to provide significant feedstock for AD plants and, indeed, some of them are known to be seriously investigating the development of projects of their own. There are a number of food processing operations that have enough potential feedstock to justify the construction of an AD plant but there are many more than could either cooperate with others or provide material to a third party facility. In the latter case, the AD plant operator would expect to receive income from gate fees ie the waste producer would have to pay disposal charges.

6.4 Animal Slurries

6.4.1 The density of livestock across the project region varies quite significantly. For much of the upland region of Wales (most of Powys) the predominant form of agriculture is sheep rearing and this mostly involves extensive operations with little opportunity or need to collect slurry. Even within Monmouthshire where cattle-rearing is more common, the animals are largely reared extensively and for their meat. The collection of slurries from housed animals is relatively restricted. The real opportunities for larger quantities of slurries arise in areas where dairy farming is common or where there are intensive pig or poultry units. Whilst these are largely concentrated in the English part of the region, there are also opportunities in Wales.

6.4.2 AD plants utilising only animal slurries are perhaps less likely than those accepting mixed waste but there still might be operations that revolve around the waste arising from within a single agricultural unit. Cooperation or contracts with a number of slurry and/or waste and/or crop feedstocks is likely to produce a better overall biogas project.

6.5 Especially Grown Crops and Crop Residues

6.5.1 Whilst the growing of crops especially for digestion is reasonably commonplace in Germany at present, it would appear to be a rather unlikely scenario in the UK for the foreseeable future. The future of the current market support for renewable energy (Renewable Obligation Certificates) is too uncertain for most prudent investors or lenders. Even if the UK government were to introduce German style feed-in tariffs, the current high price of grain on the world market would militate against the use of such crops for biogas production. Grass, silage, maize residue silage and such crops are perhaps more likely and indeed, grass from roadside verges has been trialled at a small AD plant in Powys.

6.5.2 Unless circumstances change significantly in the UK it seems unlikely that there will be any biogas developments planning the exclusive digestion of especially grown crops or even crop residues. It is, perhaps, far more likely that such crops, especially residues, could form part of a mixed feedstock.

7. Gas Utilisation

7.1 Electricity production

7.1.1 The usual and, in many ways, the easiest means of productively utilising biogas (or

more typically in the UK at present, landfill gas) is the generation of electricity via a gas engine or turbine. So long as there is capacity in the electricity distribution network in the vicinity of the gas plant then this route for utilisation is relatively straightforward.

7.1.2 Electricity produced from biogas is soon to be eligible for "double ROCs" and a producer is thereby receiving an income very significantly higher than the value of the power sold. ROCs (Renewable Obligation Certificates) represent the current UK government renewable energy market support mechanism and their value depends upon the requirement of the electricity supply industry to include a minimum percentage of renewable energy in its sales, or effectively pay a fine for under-performance. It is the level of this under-performance "fine" pot that determines the value of ROCs.

7.1.3 ROCs are a market based mechanism with no guarantees as to their value over time. Unlike the German feed-in tariff for instance ROCs therefore are only of limited value in the securing of a bank loan.

7.1.4 The primary consideration at the stage of planning of a biogas project is the capacity of the local network to accept the anticipated production and the cost of connection. The only really secure way of calculating this cost is via direct contact with the District Network Operator for the area concerned. For northern Powys this is SPManweb and for southern Powys and Monmouthshire, Gloucestershire and Wiltshire, it is Western Power Distribution.

7.2 Heat Production

7.2.1 There is some requirement for heat in the digestion process itself and this is best supplied by utilising some of the biogas.

7.2.2 The remainder of the gas could be utilised to produce heat for buildings, processes, water heating etc and could be utilised for absorption chilling (ie for the production of coolth). Given the difficulties and expense involved in storing large quantities of gas, it is best to have a heat and/or cooling load that is near constant and well-matched to the gas output.

7.2.3 Whilst it would clearly be better if the demand for the heat energy was sited close to the biogas facility it is certainly possible to transfer gas by private pipeline at a

reasonable cost. This cost would be very much less than the cost of a heat main (insulated pipes carrying hot water).

7.2.4 Should the private gas pipeline or heat main options be considered then it would clearly be necessary to come to an early agreement with the owners of any "third party" land to be crossed. The cost of excavation and construction of such networks will depend, in quite large part, on the nature of the land to be crossed. Laying pipes in an existing road or hard-surfaced area, for instance, is very expensive. By contrast, laying additional pipework into a road network at the time of construction of a new project is relatively inexpensive.

7.2.5 There is currently no premium or ROC equivalent for heat produced from renewable sources and this option is not as financially attractive as, perhaps, it should be.

7.3 Combined Heat and Power

7.3.1 Combined heat and power (CHP) is an attractive option in that it combines the production of renewable electricity, and thereby income from ROCs, with the productive use of the heat that is an inevitable by-product of the power generation process. The key, however, is the identification of an appropriate heating/cooling load and therefore the ability to attract additional income from energy sales. A good, efficient CHP system is designed to meet the heat load with electricity generation following. A "good" heat load will be 24 hours a day and all year round. A combination of users, for example residential, office, leisure may provide just such a load with the summer requirement for cooling providing the year round demand.

7.3.2 As with the heat only option, consideration needs to be given to reducing to an optimum the length of required heat main and thus consideration should be given to piping biogas from the AD plant to the CHP unit.

7.3.3 There is currently no additional revenue advantages in terms of electricity generation (ie additional ROCs payments) it seems likely that such incentives will be introduced in the future. It is, however, reasonably likely that capital grant could be successfully sourced to assist with construction costs.

7.4 Feeding (Bio) Methane into the Gas Grid

7.4.1 It is possible to strip out the gases other than methane (ie mostly carbon dioxide) in order to match mains gas. This bio-methane can then be injected into the gas grid and sold anywhere that is grid connected. This option has not yet been adopted in the UK but it is being seriously considered and there is no technical or institutional reason to prevent it.

7.4.2 The cost of the equipment required for the gas processing operation is still high as are the standards laid down for the quality/purity of the gas, and there is currently no premium price payment for renewable gas.

7.4.3 It is clearly necessary to be within reasonable distance of the gas main and early discussions with the gas network operator are recommended. In the case of the region directly under consideration, the relevant operator is Wales and West Utilities.

7.5 Utilisation as Transport Fuel

7.5.1 Methane is already in use as a transport fuel in the form of CNG (compressed natural gas) and rather more usually LNG (liquefied natural gas). Utilising a cleaning process similar to that required for injection into the gas main, biogas can be converted to a transport fuel. There is a mechanism for supporting the utilisation of bio-methane as a transport fuel through the Renewable Transport Fuel Obligation (RTFO). This operates very similarly to the ROCs system with the relevant target for fuel suppliers being 5% by 2010.

7.5.2 By far the most likely scenario for this utilisation would be where there is a captive fleet of vehicles in the control of the AD plant operator or a partner – a landfill site with waste freighters for instance, or possibly a public bus fleet. All of these would be converted to run on the gas and thus it would be important that the projected output of the AD plant matched reasonably well with the demand for fuel.

7.5.3 Storage of the bio-methane is very expensive but it is equally important that there is always sufficient fuel available to the captive fleet. This would be a difficult balance to achieve unless the transport fuel option is run in parallel to a mains gas operation. Spare gas could be injected into the mains and any under-provision could be purchased

from the mains. An alternative might be to deliberately under-size the AD output with the remainder of the gas purchased from alternative sources.

7.5.4 There is no bio-methane in use in the UK at present but experimental operations are in use in other EU member states (eg France and Sweden).

8. Utilisation of the Digestate

8.1 The Liquid Digestate (bio-fertiliser)

8.1.1 It is the liquid digestate that is potential valuable as a bio-fertiliser, displacing the use of mineral fertilisers. For every tonne of mineral nitrogen displaced there is a potential reduction in carbon dioxide emissions of 2.3 tonnes with the equivalent figure for phosphate fertilisers being 1.1 tonnes. The carbon reduction arguments are supplemented with cost savings to the agriculturalist – the cost of mineral fertiliser is souring.

8.1.2 The current legal status of biogas digestate is that it is classified as a "waste" and thereby requires compliance with the need for "duty of care" when transporting it, a waste license for its storage and an exemption certificate under waste licensing regulations when spreading. A protocol is currently in preparation within the UK that would clarify when waste controls would be no longer required, ensure environmental protection and provide users with certainty that the product conforms with a standard. The development of the protocol is a collaborative venture between the Waste and Resources Action Programme (WRAP), the Environment Agency, Renewable Energy Association, the Composting Association and the Environmental Service Association. It is hoped that the protocol will be published in the autumn of 2008.

8.1.3 It is proposed that, in order to hit the quality necessary for compliance with the protocol, the digestate will have to comply with the proposed PAS110. This sets out how to produce quality digestate and the keys to success in meeting the quality protocol. It will seek to ensure that the inputs (feedstocks) are correct, that material is properly digested, that contamination is minimised or prevented and that the process is fully controlled.

8.1.4 Whether under the terms of a future protocol or under the current "waste" regimes,

great care will need to be taken in the timing, methodology, practice and spreading rates when applying the fertiliser/digestate. There is always likely to be the requirement for storage capacity for at least 6 months production of digestate given the restricted conditions of weather/soil condition under which spreading is appropriate.

8.1.5 Digestate must not be agitated (eg by spraying) during application and thus it is best applied by either direct injection into the soil or by trickling it onto the surface. To do otherwise, would see the release of compounds of nitrogen, such as ammonia, into the atmosphere, seeing a loss of nutrient value to the soil, odour nuisance and atmospheric pollution. Within Nitrate Vulnerable Zones the limits for the spreading of organic manure (which would include digestate) are 250kg of nitrogen per hectare per year for grassland and 170kg of nitrogen per hectare for arable land. A high proportion of the English part of the region is classified as NVZ with a smaller proportion of the Welsh region so designated.

8.1.6 Digestate from AD plant that is treating residual or contaminated wastes will not be allowed to be disposed of to agricultural land. Under some circumstances it may be possible to use it as a fertiliser to non-food crops.

8.2 Solid Digestate

8.2.1 The solid digestate from AD installations will normally provide a soil conditioner type product. Where the feedstocks can be demonstrated to be free of contaminants this product can be utilised in circumstances where food-crops are involved. Lightly contaminated feedstocks will give rise to a solid digestate that would be suitable for use in the cultivation of non-food crops. Some feedstocks will only provide a digestate suitable for daily cover on a landfill site or combustion. In some circumstances it may well be necessary to provide a further period of aerobic composting in order to comply with “Landfill Directive” requirements for the treatment of bio-degradable waste.

9. Avoidance of Hazards

9.1 Construction Design & Management Regulations The contractor constructing the plant will have to comply with these regulations which fall under the Health and Safety at Work Act and administered by the Health and Safety Executive. The purpose of the

regulations is to ensure the safety of those involved in constructing the plant.

9.2 Dangerous Substances and Explosive Atmosphere Regulations. These regulations (DSEAR) require a formal risk assessment be carried out and a suitable strategy implemented to minimise the risk of explosion. They implement in UK law the ATEX (Atmospheres Explosive) Directive of the EU. They are clearly relevant to biogas plant and require extensive planning and strategy implementation particularly in respect of potential sources of ignition in key areas. Equipment in the areas identified as being at risk of explosion must be ATEX compliant.

10. Conclusion

10.1 There are a number of barriers to the development of biogas plants in the UK with one of the greatest, seemingly, the difficulty of gaining town and country planning consent. On the other hand it does appear that the market conditions are changing and that good quality AD developments based on the processing of waste products (ie attracting a gate fee) are now economically attractive.

Useful Documents / Web Pages

www.netregs.gov.uk – advice on agricultural and environmental regulations
www.defra.gov.uk/environment/epp/ - Environmental Permitting updates
www.defra.gov.uk/environment/epp/guidance -Environmental Permitting Guidance index