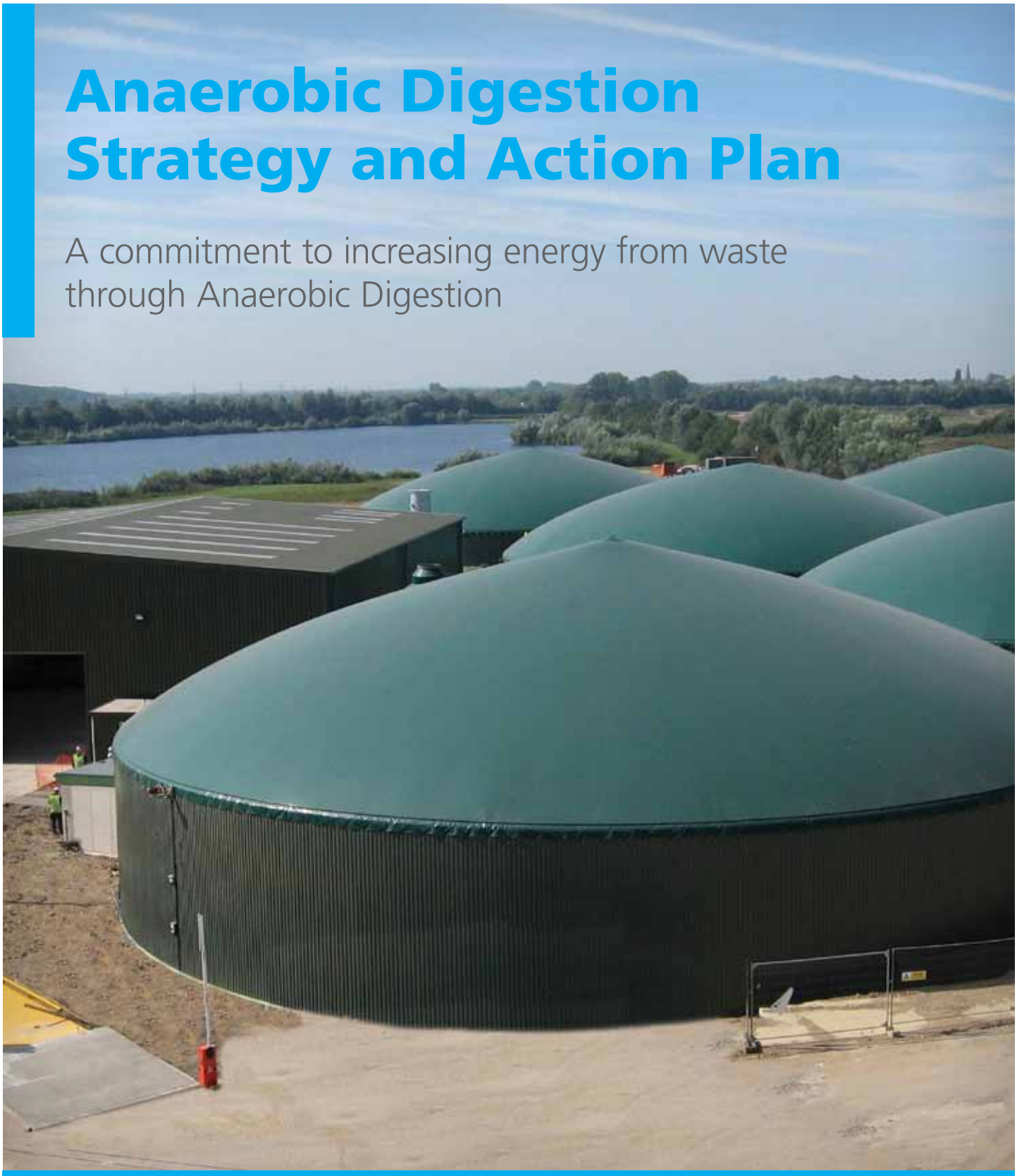
Anaerobic Digestion Strategy and Action Plan

A commitment to increasing energy from waste through Anaerobic Digestion



DEPARTMENT OF ENERGY & CLIMATE CHANGE

defra
Department for Environment Food and Rural Affairs

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Ministerial Foreword

We are delighted to announce the publication of the joint Government and Industry Anaerobic Digestion Strategy and Action Plan for England.

The coalition is committed to being the 'Greenest Government ever' and achieving that will in part mean substantially increasing energy from waste through Anaerobic Digestion (AD). This offers a local, environmentally sound option for waste management which helps us divert waste from landfill, reduce greenhouse gas emissions and produce renewable energy which could be used to power our homes and vehicles. Farmers and gardeners can also benefit from the fertiliser produced, returning valuable nutrients to the land.

Our first priority must be to prevent waste from arising in the first place. However, energy recovery can be a sustainable option for unavoidable waste that would otherwise go to landfill. There are many different technologies available that can process waste and each may have a role to play, given the variety of waste arising and local situations. AD is the technology we are focussing on in this document but we are also looking at how other technologies can also contribute to providing renewable gas.

AD is well established in Europe and we see significant potential for increasing uptake in England too. Based on likely waste feedstock resources, AD could deliver between 3–5 TWh of electricity by 2020.

We do recognise that there are significant barriers that must first be overcome. During the past six months, we have been working closely with industry to identify the key barriers to uptake and to agree an ambitious programme of work to help overcome them. This Strategy and Action Plan are the result of this work. Each action has a named lead organisation and all have committed to drive the work forward. Changes cannot be delivered overnight, and the Action Plan may well need to be modified by experience, but this Plan is the first and key step to enabling a thriving AD industry to grow in England over the next few years, delivering new green jobs as well as new green energy.

In addition to the actions identified in this document, DECC and Defra are working to ensure that the financial incentives available for AD provide the revenue support needed for investment to pull through the AD potential.

We are very pleased with the joint work that has been done so far and the way that industry has risen to the challenge. We look forward to continuing to work closely with industry to implement the Action Plan.

Lord Henley **Gregory Barker**

Executive Summary

1 The Government made a commitment to work towards a 'zero waste' economy in the Coalition Programme for Government of 20 May 2010, and to introduce measures to increase energy from waste through anaerobic digestion (AD).

2 Where waste cannot be prevented, there are several technologies available to treat it, including those providing energy from waste such as AD. Each of these may have a role to play, given the variety of waste arising and the local situation.

3 AD can play an important role as a means of dealing with organic waste and avoiding, by more efficient capture and treatment, the greenhouse gas (GHG) emissions that are associated with its disposal to landfill. AD also offers other benefits, such as recovering energy and producing valuable biofertilisers. The biogas can be used to generate heat and electricity, converted into biofuels or cleaned and injected into the gas grid.

4 The Government's Structural Reform Plans of 16 July 2010 therefore included an action to 'set out steps to promote increased energy from waste through anaerobic digestion'.[1] The Department for Environment, Food and Rural Affairs (Defra) incorporated this into its Business Plan and published on 30 November 2010 a Framework Document which aimed to set out the steps necessary to increase energy from waste through anaerobic digestion.[2]

5 Since then, we have been working closely with industry to identify barriers to the development of AD and the actions that are needed to overcome them. This document is the result of this work. It is a Strategy with an Action Plan. The **Strategy** sets out a vision for AD whilst the **Action Plan** sets out the actions in detail that are needed to bring about an increase in energy from waste through anaerobic digestion.

6 The AD Strategy and Action Plan is not a comprehensive road map to achieving the Government's commitment to the increase of energy from waste through AD. However, we believe this is a first step towards one. It has been worked up in partnership between Government and industry, and reflects the level of evidence and information currently available, and the relative immaturity of the AD industry in England (other than in the waste water industry where the technology is commonly used to treat sewage sludge).

7 The Strategy does not set specific targets or regional strategies for the adoption of AD. The Action Plan should help ensure there are no unnecessary obstacles to the development of AD, by addressing the barriers that have been identified by industry representatives during this process. There may also be some separate adjustments to the incentive regimes. Together, this should increase the growth rate of AD. However, it will ultimately be up to local authorities, communities and industry to decide which technologies are most suitable for their waste and energy needs.

1 http://www.number10.gov.uk/wp-content/uploads/defra-srp.pdf
2 http://www.defra.gov.uk/environment/economy/waste/

8 A significant number of the actions in the Action Plan are aimed at improving the dissemination of information that is already available, and making it widely accessible to landowners, communities, local authorities, planners, AD operators, farmers and financiers. This is particularly relevant for the area of regulation, where the discussions revealed surprisingly few issues of contention except a perceived lack of knowledge by some parties around how to work within the exiting regulatory framework. Where it was felt that there was a lack of clarity or information, the Action Plan includes measures to address the concerns that were raised.

9 Other actions relate to developing best practice, providing an agreed framework for skills and training, and further work to deal with specific barriers such as connection to the gas grid.

10 Actions that will take longer to deliver include building markets for digestate, building a robust evidence base using longer term research and experience, and a detailed analysis to understand the barriers that currently restrict the use of biomethane as a transport fuel.

11 Developing work on the use of purpose-grown crops as a feedstock for AD was highlighted, and the Action Plan contains actions that will enable us to gain a full understanding of this.

12 Each of the actions has a lead action owner who will be responsible for ensuring that the action is completed. If others wish to contribute to the work they will have the opportunity to do so where appropriate.

13 The Action Plan envisages the need to continue to gather information on a number of issues. Delivery and implementation of the Action Plan will be monitored and reported on by Defra, and it will be amended, if needs be, in the light of ongoing research and other developments. The AD Strategy and Action Plan anticipates that discussions between the Government and its partners will continue and that there will be an ongoing process of monitoring and evaluation.

14 Alongside the AD Strategy and Action Plan, the Government is working to ensure that the financial incentives available for AD under the Renewables Obligation (RO), the Feed-in Tariffs (FITs) Scheme, the Renewable Heat Incentive (RHI) and the Renewable Transport Fuel Obligation (RTFO) provide the revenue support that investors need.

15 The Government recognises that many of the advanced technologies required to deliver more complex output products and energy recovery, for example biomethane, are less mature than other forms of energy recovery, with technical challenges to overcome, and the consequential difficulties associated with obtaining funding for early commercial technology. Government will continue to take action to help address these issues.

16 It is not possible at this stage to give a definitive growth potential for AD. However, based on current information available, and assuming that the real and perceived barriers are overcome through the actions undertaken, an estimated potential for AD deployment for heat and electricity could reach between 3 and 5 TeraWatt Hour(s) (TWh) by 2020.

17 To help the development of this capacity, Government has agreed that WRAP will set up a new loan fund to help stimulate investment in additional AD infrastructure. A total of £10m over 4 years will be made available to provide debt finance to stimulate investment in additional AD capacity. The focus and criteria of the fund will be developed and a more detailed announcement made in due course.

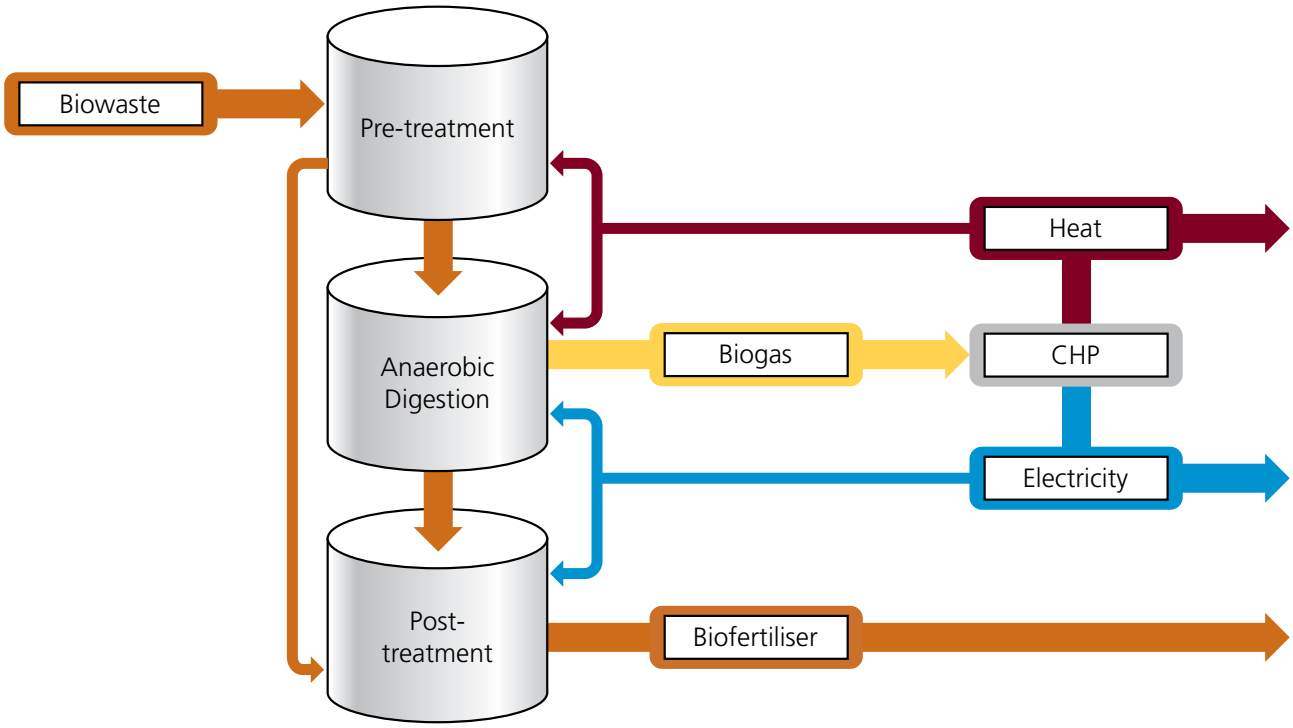
18 The AD Strategy and Action Plan is published in conjunction with the Waste Review and reflects the content of that document. This is an AD Strategy and Action Plan for England. Wales, Northern Ireland and Scotland, while working within the same EU legislative framework, are responsible for their own waste and energy from waste policies and delivery. However, all four parts of the United Kingdom work closely together and the devolved administrations have been consulted in the preparation of this document.

1. Anaerobic Digestion Strategy

1.1 What is Anaerobic Digestion?

19 AD is a natural process in which micro-organisms break down organic matter, in the absence of oxygen, into biogas (a mixture of carbon dioxide (CO_2) and methane) and digestate (a nitrogen-rich fertiliser). The biogas can be used directly in engines for Combined Heat and Power (CHP), burned to produce heat, or can be cleaned and used in the same way as natural gas or as a vehicle fuel. The digestate can be used as a renewable fertiliser or soil conditioner. AD is not a new technology, and has been widely applied in the UK for the treatment of sewage sludge for over 100 years. However, until quite recently it has not been used here for treating other waste or with purpose-grown crops.

Figure 1: Example of an AD plant configured to produce energy and biofertiliser from biowaste feedstock



1.2 Why are we interested in Anaerobic Digestion?

20 The Government is carrying out a Waste Review, looking at all aspects of waste policy and delivery in England. Dealing with waste is closely linked to the protection of the natural environment, and is addressed in the Natural Environment White Paper (NEWP).[3] The AD Strategy and Action Plan sits alongside and reflects the Waste Review and deals specifically with issues that relate to AD. Where waste cannot be prevented, there are several technologies available to treat it, including those providing energy from waste. Each of these may have a role to play, given the variety of waste arising and the local situation.

21 AD can play an important role as a means of dealing with organic waste and avoiding, by more efficient capture and treatment, the GHG emissions that are associated with its disposal to landfill. The technology also offers other benefits, such as recovering energy, producing valuable biofertilisers, and using the nutrients. Article 4 of the revised Waste Framework Directive[4] (rWFD) requires a 5-step waste hierarchy to be applied as a priority order in waste management legislation and policy (prevention; preparing for re-use; recycling; other recovery; and disposal). The rWFD has now been transposed in England and Wales and the requirements associated with the waste hierarchy come into force on 28 September 2011.[5]

22 'Recycling' is defined in Article 3(17) of the rWFD and explicitly excludes 'energy recovery and the reprocessing into materials that are to be used as fuels'. In most cases, the principal purpose of consigning waste to AD is to recover energy from it. This means that in most cases the anaerobic digestion of waste will be classified as 'other recovery' for the purposes of the waste hierarchy.

23 However, Article 4(2) makes provision for specified waste streams to differ from the waste hierarchy, where justified by positive life-cycle assessment analysis. For certain organic waste, such as food waste, the use of AD to treat the waste is considered to be a better overall environmental outcome than recycling such waste, taking into account the local economic and environmental considerations. Under certain circumstances waste from households used in AD can count towards recycling targets set in the rWFD.

24 AD also has a number of advantages over other renewable energy technologies. The energy is generated constantly, unlike wind, tidal and solar power, and can be stored in the grid (in the form of gas). Methane is one of the few renewable fuels suitable for Heavy Goods Vehicles (HGVs), and has the potential to reduce reliance on imported gas. The construction of AD facilities can be comparatively swift, and compared to some other waste management technologies can be relatively inexpensive. The inputs and outputs of the technology are flexible, meaning that the plants can be designed to meet local requirements for feedstock or outputs, while remaining connected to the national electricity and/or gas grid. By providing low carbon fertilisers for agriculture, AD helps deliver a sustainable farming sector, where resources are reused on-farm to reduce GHGs and provide secure and sustainable inputs, particularly phosphate.

3 http://www.defra.gov.uk/environment/natural/whitepaper/

4 Directive 2008/98/EC.

5 Regulation 12 and other provisions of the Waste (England and Wales) Regulations 2011 (S.I. 2011 No. 988).

1.3 Anaerobic Digestion models and technologies

25 AD is a flexible technology, and plants can be built on many different scales, from large facilities treating sewage sludge or municipal waste, to smaller ones handling materials from a particular farm or a small community.

26 AD plants can also be assessed in terms of whether the output is considered a waste. Where a material is a waste within the meaning of the rWFD, its management, by way of treatment such as AD or by spreading on land, is subject to the requirement for a permit, the principal purpose of which is to prevent harm to human health and the environment. The rWFD also allows countries within the European Union (EU) the discretion to provide exemptions from the need for a permit, providing general rules are laid down for each type of activity, covering the types and quantities of waste and the method of treatment used. Those carrying out exempt waste operations must register with the regulator, which in England and Wales is the Environment Agency (EA). The permitting and exemptions are set out in the Environmental Permitting (England and Wales) Regulations 2010. Where a waste is recovered in a manner that meets end-of-waste criteria it may cease to be a waste and subsequently handled outside the rWFD controls.

27 AD plants may also be considered in terms of the type of input that they process:

28 **Sewage sludge only**: Technology requirements are relatively straightforward and the treated sludge biosolids can be spread according to the Sludge (Use in Agriculture) Regulations in conjunction with the requirements of the Safe Sludge Matrix.

29 **Farm products**: Plants using slurry and manure generated on-site and/or crops grown specifically for use as feedstock for AD. Technology will remain simple, with little or no requirement for pre-treatment and pasteurisation. Feedstock will either be free of charge or purposely grown and therefore incur a marginal production cost. Crops grown specifically for AD are not considered waste in terms of the rWFD, and so the resultant digestate will not be subject to environmental permitting or waste exemption (as these apply only to wastes). Where an AD operator includes manures with purpose-grown crops as a feedstock for a digester, the EA has issued a guidance note which sets out their position with respect to the regulation of the resulting digestates. The EA state that they will not consider these materials as wastes and thus farmers that operate AD systems that use manures and purpose-grown crops as a feedstock need not apply for a waste permit when they use the digestate.

30 **Off-farm generated feedstocks**: Plants using waste, for example a farm plant accepting food waste, or an off-farm plant digesting food waste. The materials may be source-segregated or in some cases may be the organic fraction derived from a mixed waste collection. The degree of source segregation will of course affect the quality of the digestate outputs and will dictate how the use of the outputs will be regulated. Waste-derived digestate which meets the end of waste criteria set out in the Quality Protocol for Anaerobic Digestate can be used as a non-waste product. However, waste-derived digestate which does not meet these criteria continues to be classified as waste and can be used only under the terms of an environmental permit or a registered permit exemption where appropriate.

31 Plants that use waste as feedstock require a standard or bespoke permit, go through an exacting planning process, and would need to comply with waste permitting requirements as well as authorisation under the Animal By-Products Regulations (ABPR) where appropriate. Generally, feedstock pre-treatment technology is required to remove packaging and homogenise the feedstock before it is added to the digester. Because of this, capital and operating costs tend to be higher than those plants where feedstocks require lower levels of treatment, but income can be generated through charging a gate fee for waste coming in.

32 Generally speaking, where AD plants are treating animal by-products, including waste food, they will need an approval from the Animal Health Veterinary Lab Agency (AHVLA) under Animal By-Products legislation. Regulation (EC) 1069/2009 on the handling and use of animal by-products permits the use in AD of low-risk animal by-products which are essentially material passed fit for purpose, but no longer intended for human consumption. High-risk material such as dead/fallen stock cannot be used in AD. Permissible AD plant treatment and hygiene standards are set out in the Implementing Regulation (EC) 142/2011. The EU rules are administered and enforced in England by the Animal By-Products (Enforcement England) Regulations 2011 (SI 2011/881). There are certain limited exceptions where AD plants treating animal by-products, including food waste, will not need to have an approval from AHVLA. These include AD plants treating food waste on the premises of origin, and there is a small list of animal by-products that can be used in AD without needing an AHVLA approval, including manure, milk and milk products and colostrum.

33 Digestate derived from AD plants treating animal by-products and approved by AHVLA is subject to a grazing ban once the digestate is used on land. Livestock must not be allowed access to the land during this time period.

34 **Co-digestion with sludge**: Sludge treatment facilities accepting another feedstock stream such as food waste, slurry or crop material. Technology requirements and regulation becomes more complex when accepting other feedstocks, as does the potential for spreading the treated sludge or digestate. There is a clear action within this Action Plan to address and to clarify the specific regulatory issues surrounding the co-digestion of sludge and other waste materials.

35 **Anaerobic digestion technologies:** Various technologies are available for AD. The digester can be wet or dry, mesophilic or thermophilic, and single or multistage. In England currently the most common type is the mesophilic, wet, single style as explained below.

- Dry AD uses only minimal mechanical sorting, and the digestion process takes place from waste in its solid form. In wet AD the waste is first turned into a pulp prior to being processed. The latter type is therefore better for more liquid feedstocks, such as those generated on farms.
- Systems using bacteria that live optimally between 35–40°C are known as mesophilic; those using bacteria that can survive at 55–60°C are called thermophilic. In thermophilic systems the energy input is higher. The increased temperatures facilitate faster gas yields. Operation at higher temperatures also helps to sterilise the end digestate.
- A single-stage digestion system is one in which all of the biological reactions occur within a single sealed reactor or holding tank, which can reduce construction costs. In a multi-stage digestion system different tanks are used to optimise the reactions.

36 The flexibility of AD means it can meet a wide variety of needs at a local level. Some examples are:

- Providing the heat to be able to grow mushrooms or horticultural crops in the UK on a large scale.
- Treating dairy waste and providing energy for the farm.
- Providing for energy-intensive businesses such as brick factories.
- Using the waste from a prison to provide its heat and energy.
- Operating refuse collection vehicles on methane generated from the waste collected.

37 It is not the intention of the Government, by its support for the AD Strategy and Action Plan, to promote or preclude any particular type of plant, but to give local people the information and opportunities to react to their needs, and in particular to assist them to manage and use resources in a sustainable manner. Therefore the AD Strategy and Action Plan supports the development of an evidence base for various types of plants. For example, smaller developers are likely to find it most difficult to secure initial advice at a reasonable cost, and so the Action Plan proposes the provision of case studies with sample costings that might be suitable for plants processing waste from a single farm or small community.

1.4 Feedstocks for Anaerobic Digestion

38 AD can use a variety of organic material to produce energy, such as food waste from both domestic and industrial sources, farm manures and slurries, sewage sludge and purpose-grown crops for energy.

1.4.1 Food waste

39 Around 16 million tonnes (Mt) of post-farm gate food and drink waste arises annually in the UK. Around half of this is waste is from households, the rest mostly comes from manufacture, retail, hospitality, other businesses and the public sector. Evidence suggests that large quantities of this food waste is actually avoidable (i.e. could have been eaten at some point). The production, distribution and disposal of this avoidable food and drink waste generates significant CO_2-equivalent emissions,[6] as 20 Mt CO_2-equivalent emissions are associated with annual avoidable household food waste. To put this in context, 20 Mt CO_2 is equivalent to around 3% of the total UK annual GHG emissions. Alongside the energy use there is also significant water use in the production of food and drink which is then wasted. For example, the water footprint of avoidable UK household food waste is 6% of the UK's overall water footprint. This causes significant economic costs, to both householders and business.

40 Preventing this avoidable food and drink waste from arising in the first place offers the most substantial environmental and economic gains; much more than any form of treatment currently available. Compared to land filling, each tonne of food waste prevented means 4.2t of CO_2-equivalent emissions are avoided while only around 500kg is avoided for each tonne processed through AD, the best currently available treatment option, and less for other options such as composting and other energy recovery. However, we still need to ensure that food waste that is unavoidable and any avoidable food waste that we are unable to prevent arising is kept out of landfill and treated as sustainably as possible, to minimise adverse GHG and other environmental impacts. An important element of this is efficient food waste collection and renewable energy production.

41 Figures from the Waste and Resources Action Programme (WRAP) for March 2011 indicate that separate weekly collections of food waste are provided to approximately 3 million households (out of 22.5 million in England) in 71 local authority areas. Mixed food and garden waste (for processing through large-scale enclosed composting plants known as In-Vessel Composting (IVC))[7] is collected from a further 3.15 million households in 65 local authority areas across England.

6 While the majority of these emissions occur in the UK, some do arise overseas.

7 Food waste treated through composting must be in facilities that are ABPR compliant – typically 'in-vessel'. Garden waste not mixed with food waste can be composted in open sites.

42 The most environmentally preferable treatment options for food waste are usually AD or composting. AD is generally preferable because it produces both renewable energy and a biofertiliser, which together do more to offset GHG emissions than producing compost. Both, however, should result in GHG savings. There are some organic waste streams for which composting will remain the best option, such as co-collected food and garden waste, or woody garden waste that is collected on its own. In these cases there is little advantage in adding materials to a digester that will not break down and thus not contribute to the energy generation capacity of the plant. To be treated by 'wet' AD systems, food waste needs to be collected separately at source; to be treated by composting, or 'dry' AD systems, it can either be separately collected at source or mixed with green waste.

43 The key to a viable and sustainable AD project is a secure supply of quality feedstock. Where food waste is separately collected, it becomes far more economic to treat it by AD, or IVC, where it can be turned into useable, saleable products, rather than sending it to landfill and paying landfill tax.

44 The co-digestion of food waste in large sludge treatment plants has the potential to be an efficient way of producing energy from waste, particularly as many of the plants are conveniently located by urban centres. This is one of the topics addressed in this Action Plan.

1.4.2 Farm manures and slurries

45 In the UK an estimated 90 million tonnes of manures and slurries are generated each year. These are generally used on the farms where they arise, recycling the nutrients that they contain. However, if these materials are not used appropriately within a farm there is the potential for over-application of nitrogen and other minerals, and also for potential impact upon water resources. The Nitrate Vulnerable Zone Regulations mean that many organic manures cannot be spread in certain periods of the year and must be stored for an extended period before being landspread as fertilisers. However, if storage tanks are not covered, storage can result in emissions of methane to the atmosphere. There is potential for AD to be used in this situation to capture methane from stored slurries and manures, and also to stabilize and treat these materials. The digestate produced has a lower biological oxygen demand and can be used as a more uniform, easily calibrated fertiliser than the original untreated manure. There are also benefits in the reduction of GHGs from spreading by pipeline from farm to field, which reduces transport use, enables the use of less disruptive 'minimum tillage' farming techniques which use less energy and fuel, and have benefits for soil quality, further minimising farm energy use. Methane emissions from manure management are reduced, and the fossil fuels used in the manufacture of artificial fertiliser are displaced, saving 5 tonnes of CO_2 for every one tonne of nitrogen.

46 Manures and slurries are not 'waste' if they are used directly as fertiliser. The EA has issued guidance to the effect that manures and slurries used as feedstock for AD will also not be treated as 'waste' if used as fertiliser.[8] This will apply to both solid and liquid digestates. Other nutrient management regulations and the requirements of the Codes of Good Agricultural Practice for the protection of soil, water and air are still applicable.

8 http://www.environment-agency.gov.uk/business/sectors/32601.aspx

47 The farming industry has highlighted AD's role in reducing GHG emissions in the agricultural sector. The Industry Climate Change Taskforce (comprising the National Farmers Union (NFU), the Country Land and Business Association (CLA) and the Association of Agricultural Industries) has developed a Greenhouse Gas Action Plan, emphasising the importance of a significant increase in the utilisation of manures in on-farm AD.

1.4.3 Sewage sludge

48 AD is one of the most important methods for treating sewage sludge and roughly two thirds of the country's sludge is already treated in this way. The water industry has a well established infrastructure of AD plants and extensive knowledge of the technology and its operation. In 2008, of 1.6 Mt of sewage sludge produced annually by the industry, 66% was treated by AD and 60% of the biogas produced by this process was used to generate renewable heat and power using a CHP engine. Current water industry installed capacity in this area is estimated at 115 megawatts (up to 1 TWh). This contributes approximately 90% of the energy produced from AD in the UK.

49 Around 75% of the 1.1 Mt of sewage sludge produced in England and Wales is used on agricultural land. Indeed, 5 water companies are over 90% dependent on this recovery route for treated sewage sludge. The use of sewage sludge on agricultural land is regulated through the European Commission's (EC) Sewage Sludge Directive (86/278/EEC) ('the 86 Directive'). This is transposed through the Sludge (Use in Agriculture) Regulations 1989 (amended 1990) ('89 Regulations').

50 Other organic waste can be 'co-digested' with sewage sludge, but different regulatory regimes apply. In September 2010 Defra received the EC's working document 'Sludge and Biowaste', which included proposals to revise the 86 Directive to allow for biowaste to be applied to agricultural land. The proposals are still at an early stage and Defra will inform the proposals as they develop. Whilst the proposal considers increasing the scope of the Directive to include biowaste, it does not mention how mixtures of sewage sludge and biowaste should be treated.

51 The Office of Fair Trading (OFT) has also launched a market study into the market for the treatment of organic waste. The study will consider organic waste arising from sewerage businesses (sewage sludge) and from municipal, commercial and industrial sources (including agricultural sources). Their report is due to be finalised in July 2011.

1.4.4 Purpose-grown crops for energy

52 Purpose-grown crops or biomass such as maize, grass silage or whole-crop cereals have been widely used on the continent as a feedstock for anaerobic digesters. In AD plants processing farm and/or food waste, some crop material may be required in combination with the slurries to increase the dry matter content in order to make the chemical process more efficient and therefore increase the biogas yield. Such crops can be grown as part of, and indeed can support, a normal agricultural cropping rotation. Encouragement of rotation can also result in enhanced yields from wheat and subsequent crops by replenishing nutrients, conditioning the soil, reducing the occurrence of soil-borne diseases and improving soil and water quality. Likewise, land which is not suitable for the production of food crops may be suitable to supply biomass to AD plants. However, it is important to be mindful of potential unintended consequences should there be significant areas of crops grown for AD feedstock. Any intensive production of a single crop could cause environmental concern, whether grown for food, as an AD-specific crop biomass or for transport biofuels; these concerns are generally managed by applying agricultural best practice. German experience suggests that this can be an issue. Where purpose-grown crops for energy do supplant food crops on a large scale, this might impact the price of food and the security of supply. This should not be the case with AD using sustainable biomass: designers, operators and planners will need to ensure AD projects do not have a detrimental environmental impact. To inform itself on the potential impacts, the Government is developing a Bioenergy Strategy, which will gather evidence on the availability and impact of a wide range of feedstocks for bioenergy. This is due to be published later in 2011.

53 This question is not just about a change from producing food crops for food uses to non-food uses. It is also related to sustainable land use and the overall capacity to produce food whilst capturing the environmental and sustainable aims and constructive use of waste. It is about using available land in a way that best combines all these aims sympathetically, whilst recognising the multifunctionality and market-led demand of land use in England – delivering food, fuel, fibre and eco-systems services.

54 The recent Foresight Food and Farming report has indicated that the production of energy through second-generation transport biofuels and the integration of biomass production has potential; it also recognises that AD can help mitigate GHG emissions from farming.[9]

9 The Foresight Report 'The Future of Food and Farming' by the Government Office for Science, supported by Defra and DFID, was published on 24 January 2011.

55 Taking into account all of these considerations, it is not the Government's policy to encourage solely purpose-grown crop-based AD systems, particularly when these are grown to the exclusion of food-producing crops, or where growth of these crops might adversely affect biodiversity or deter optimal use of waste materials. It is recognised that where sustainable biomass AD plants are in operation or planned, these can contribute to our clean energy goals. Consideration needs to be given to areas planted to provide feedstock to facilitate the utilisation of slurries in AD plants, thus realising the multiple benefits available. Research is currently underway to look at these issues. But again, it is for local authorities, communities and industry to decide which models are suitable in their circumstances (subject to legal requirements).

1.5 Products of Anaerobic Digestion

56 AD produces biogas and digestate.

1.5.1 Biogas

57 Biogas is the output of an anaerobic digester that provides energy. It is approximately 60% methane and 40% CO_2. At present it is mainly used to generate electricity for local use and for feeding into the national electricity grid. Where electricity is generated in a CHP engine, heat is also produced. This is partly used to provide heating for the digester, but may also be used for heating buildings or water for co-located processes.

58 If CO_2 and other unwanted compounds are removed from the biogas, the methane remaining can be injected directly into the national gas grid. This will lead to a displacement of natural gas and a consequent reduction in GHG emissions. At the time of publication of this report, only two digestion plants have adopted this option (one for demonstration and one on a commercial scale), though the Gas Distribution Networks have reported many enquiries. The recently announced Renewable Heat Incentive (RHI), which pays a tariff for the injection of biomethane, is expected to lead to greater uptake. In some other European countries, this use of biomethane is already well established. Around 60 plants are connected to the grid in Germany and increasing numbers are seen in Switzerland, Holland and Sweden.

59 Methane can also be compressed and used directly as a transport fuel in vehicles designed to run on gas. It can also be liquified, but this is not currently an economic option in the UK. When produced from municipal organic waste, it is estimated to deliver 80% lifecycle GHG savings relative to fossil diesel. It could be particularly useful in transport sectors where there are limited options for reducing GHG emissions, as is the case with HGVs.

60 13 million vehicles worldwide run on natural gas, with an annual growth rate of more than 25%. Germany now has 900 compressed natural gas (CNG) filling stations and around 100,000 vehicles. Biomethane use for transport is much less common, but experience is growing in a number of countries including Sweden and France. In these countries the first step has been the introduction of a viable CNG fuel network to encourage the use of gas cars, followed by the direct substitution of CNG with biomethane or the continued decarbonisation of the gas network through biomethane injection. In the UK, however, although there is already a national gas grid, there are thought to be under 200 vehicles running on natural gas, and there is only one supplier of biomethane for transport applications. As yet, there is no compressed biomethane or liquid biomethane produced in the UK from AD plants.

61 The AD Strategy and Action Plan makes clear that the Government and its partners are committed to facilitating biomethane injection into the national gas grid, and the use of biomethane as a transport fuel. If achieved, this would help add value to the

products of AD, making the facilities more viable. The development of these uses of biogas is currently lagging behind, due to difficulties with the regulatory framework (designed principally for the large scale injection of natural gas), and the lack of vehicles and a refuelling infrastructure for the use of methane by the transport industry. These issues are addressed in the Action Plan.

62 Government has provided grant funding for AD and advanced gasification projects and is currently considering options for possible future bioenergy/energy from waste demonstration programmes based on technology needs assessments. Collaborative R&D and demonstration work has also been carried out by other organisations such as the Carbon Trust and Energy Technologies Institute. AD, gasification and pyrolysis are eligible for financial support under the Renewable Heat Incentive and Renewables Obligation, and the Department for Transport has recently consulted on proposals to implement the transport elements of the Renewable Energy Directive which include introducing double certification for biofuels produced from waste to reflect their relative benefits. The proposed change will give twice the financial support to these biofuels compared to crop-based biofuels.

63 There is clearly a gap between the potential of energy recovery from waste and the delivery, resulting in valuable resources going to landfill. There are a number of reasons why more residual waste is not currently diverted from landfill and value recovered from it. The role of Government is to help overcome these barriers by facilitating change through the delivery of information and support. The forthcoming Bioenergy Strategy forms the best opportunity to explore various bioenergy uses in more detail, and draw conclusions about Government's role in promoting these.

1.5.2 Digestate

64 In addition to generating energy, AD produces digestate. This is a valuable biofertiliser that can be used as a renewable source of critical resources such as nitrogen and phosphorus. The nutrient composition of the digestate depends on the feedstock, but generally speaking, the digestate that is produced will contain the nitrogen, phosphorus and trace elements that are fed into the system in the feedstock. However, this also applies to heavy metals and persistent organic compounds which may also be present in the feedstock materials in varying amounts depending on the nature of the feedstock and therefore have to be taken into consideration.

65 The effect of Article 6(3) of the rWFD is to enable national end-of-waste criteria to be adopted for specified waste streams where none has been adopted at EU-level under Articles 6(1) and (2). Any such national criteria must take into account the applicable case law on the rWFD's definition of waste. National end-of-waste criteria for digestate have been adopted in '*End of waste criteria for the production and use of quality outputs from anaerobic digestion of source-segregated biodegradable waste*' – which specifies a requirement to comply with PAS110.[10] Digestate which meets these national end-of-waste criteria is considered to have been 'fully recovered' for the purposes of the rWFD and can be used as a non-waste product without being subject to waste management controls.

10 REAL (Renewable Energy Association Ltd) currently run the Biofertiliser Certification Scheme for the BSI PAS110 (the British Standards Institute Publicly Available Specification for digestate).

66 Maximising the re-use of nutrients by returning digestates to agricultural land offers significant benefits, but there are potential barriers to such use if the use of these materials is not well understood or poorly managed. Although the UK has long-term experience with digested sewage, digestates derived from purpose-grown crops, food wastes and other inputs are often regarded as novel by the market, which is wary of accepting them until evidence of their quality and benefits can be provided. Such information is becoming more widely available, but there is still uncertainty in specific market sectors.

67 The AD sector is already extremely diverse, although digestates themselves can be grouped by their classification under the rWFD into non-wastes and wastes:

68 Non-waste digestates:

- Digestates that are derived from the anaerobic digestion of non-wastes. For example, digestates derived solely from purpose-grown crops.
- Digestates that are derived from the anaerobic digestion of wastes (or a mixture of wastes and non-wastes), but have been treated to a standard that meets the end-of-waste criteria. These digestates will be non-wastes.

The non-waste digestates can be spread directly to land.

69 Waste digestates:

- Digestates that are derived from the anaerobic digestion of waste (or a mixture of waste and non-waste) and have not been treated to the appropriate standard, so remain a waste.

The waste digestates can only be spread directly to land if they have a permit or an exemption from a permit. They can be divided as follows:

- Digestates derived solely from sewage sludge. These can be spread to land under the Sludge (Use in Agriculture) Regulations (generally) in combination with the Safe Sludge Matrix.
- Amended sewage sludge digestates (commonly referred to as co-digestates). These are derived from feedstocks which include sewage sludge. The regulatory environment governing the production and use of such digestates is complex and subject to discussion between the regulators and producers.

70 Waste or non-waste digestates may also be further processed to generate Solid Recovered Fuel (SRF), which can be used for a variety of end uses such as fuel for cement kilns or for energy generation.

71 There are technologies that are currently at or approaching market which could deliver a much wider range of options for post-digestion processing to provide an extremely diverse range of products ('secondary' digestate products). These technologies include nutrient-stripping, struvite precipitation, supercritical wet oxidation, biofuel generation (e.g. digestate used as feedstock for cellulosic ethanol production), and use of separated fibre fractions in construction materials.

72 Digestate contains nitrogen in a form that is readily available for crop uptake, and can help reduce reliance on other (industrially produced) sources of nitrogen. Inorganic phosphate fertilisers are derived from non renewable sources and will become more expensive as increasing pressures are placed on limited current supplies. The phosphate content of digestates will thus become increasingly attractive in the near to medium term. Use of digestate as renewable fertilisers offers a potential saving in GHG emissions from mining, and the transport and production activities associated with the manufacture of inorganic fertilisers. There are also benefits for food security, by reducing reliance on fertiliser imports from potentially unstable areas.

73 The Government and its partners wish to encourage the recognition of digestate as a quality product with valuable uses. This should add value to the AD process and increase the economic viability of the plants.

1.6 Industry capacity

74 Although AD is widely used in the treatment of sewage sludge, a wider AD industry treating manures, purpose-grown crops or wastes has been slow to establish in the UK. There are currently (April 2011) 54 operational AD facilities in the UK (32 on-farm and 22 off-farm), excluding sludge treatment facilities. Biogas is being used in various ways, most commonly for CHP generation or in a gas boiler for heat generation; however there are also two facilities that will inject biomethane into the gas grid.

75 There are currently around 50 additional plants which have obtained planning consent, with a total additional capacity of around 70 MWe. There are a further tranche of plants that are in the process of obtaining planning permission, environmental permitting and approval under the ABPR. However, it is difficult to use the planned capacity data to accurately predict the actual level of capacity that will become available as there are usually many hurdles to be overcome between the point at which a developer applies for planning permission and a plant actually being built. It can take from a few months to over a year to obtain planning permission, which can be subject to numerous public consultations. All this means that whilst it is possible to estimate how much AD capacity is being planned, it is unrealistic to translate this into an actual capacity being in place by a given date.

76 Beyond the UK, AD is widely adopted throughout the world, from large-scale municipal plants in France and Italy, thousands of farm-based plants in Germany, farm-based food waste plants incorporating crop feedstocks in Denmark and Sweden, through to many hundreds of thousands of micro-digesters in South East Asia.

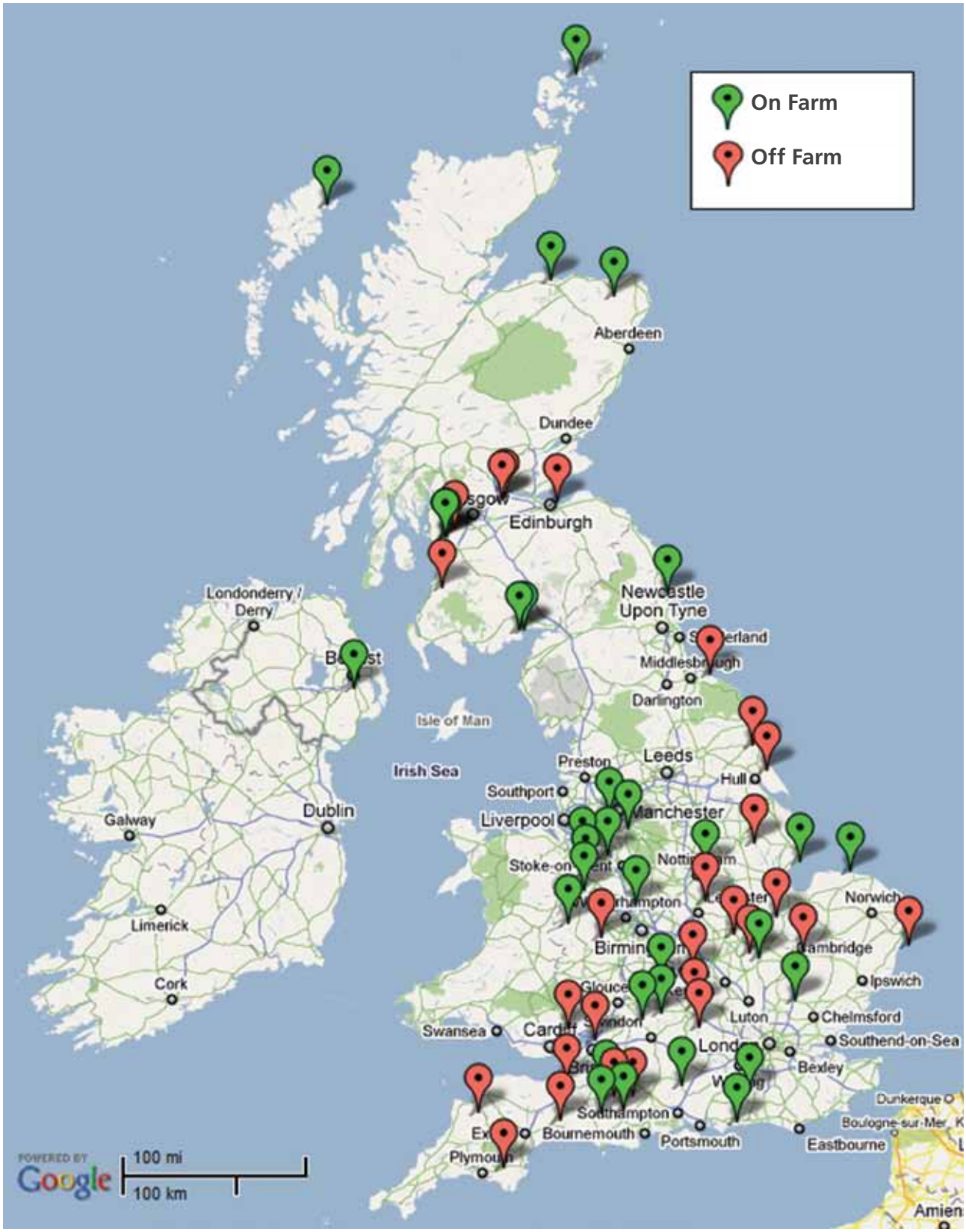
1.7 Future potential

77 The Government has set out its commitment to an expansion of energy from waste through AD. At the heart of this commitment is the recognition that AD unites a number of the Coalition Government's priorities. For this reason, the Government is keen to see a substantial increase in the deployment of AD.

Table 1: Anaerobic Digestion Industry Capacity in the UK

Treatment capacity of existing 54 AD plants (not including sewage sludge treatment facilities)	534,200 tonnes of commercial waste 382,000 tonnes from food and drink manufacture 136,156 tonnes in farm-based plants
Output capacity of existing 54 plants	35 megawatts electrical (MWe)
Treatment capacity of existing 146 sewage sludge treatment AD plants producing energy	1,100,000 dry tonnes of sewage sludge
Output capacity of existing sewage sludge treatment plants	110 MWe
Output capacity of 50 planned AD plants	70 MWe

Figure 2: Anaerobic Digestion facilities in the UK (excluding sewage sludge plants and plants treating farm waste only) in January 2011. For regular updates, please visit http://www.biogas-info.co.uk/index.php/ad-map.html



78 In order to realise the potential of AD, there are a number of barriers that must first be overcome. The AD Strategy and Action Plan has been developed in partnership with the many different organisations with a stake in the future of AD. It sets out a shared programme of work to be delivered jointly by industry, Government, its delivery agencies, and others.

79 Alongside the AD Strategy and Action Plan, Defra and the Department of Energy and Climate Change (DECC) are working to ensure that the Government's policy framework, which drives the development of UK renewable energy – specifically, the financial incentives available for AD under the Renewables Obligation, the Feed-in Tariffs Scheme and the Renewable Heat Incentive – provide the revenue support that investors need to invest in the future of AD. Together, all the actions set out in this document aim to provide a confident business environment that will enable faster deployment of AD and build a strong and sustainable industry.

80 There is currently around 145 MWe or approximately 1.08 TWh of installed AD capacity in the UK. Given this low level and the quantities of feedstock likely to be available, there is no doubt that the industry has the capacity to grow substantially.

81 The evidence base and data available at the moment needs further development, and work is being carried out to establish baseline data on the quantities and location of available feedstocks and then to map these with current and potential AD projects. The potential growth of AD over the coming 10–20 years is difficult to quantify at this point in time. There are a number of studies which estimate feedstocks arising, mainly foodwaste and agricultural animal waste. However it is not possible to predict with certainty the effect of a number of current policy levers.

82 A number of sources suggest that per annum approximately 7 Mt[11] of food waste is sent to landfill. It is also estimated that UK agriculture produces roughly 90 Mt[12] of slurry and manures per year.

83 Potentially by 2020 with a medium expansion curve of AD plants and allowing for Government policy on reducing the amount of food – waste in general, a reasonable expectation for England could be in the range of 5 Mt of food – waste realistically available for AD and somewhere in the region of 20–60 Mt of animal waste.

84 If this 5 Mt of food waste was digested this would replace 47,500 tonnes of nitrogen (N), 14,720 tonnes of diphosphorus pentoxide (P_2O_5) and 20,400 tonnes of potassium oxide (K_2O), saving a total of 386,000 tonnes of CO_2-equivalent in GHG emissions. Combined with 40 Mt of manures this gives the potential to generate approximately 3.5 TWh of electricity, enough to supply 913,000 households and saving 1.8 Mt of CO_2-equivalent GHG[13] from grid-based electricity production.

85 As outlined above, it is not possible at this stage to give a definitive growth potential for AD up to 2020. However, based on current information available, and assuming that the real and perceived barriers are overcome through the actions undertaken in the Action Plan, the forecast potential for AD deployment for electricity could reach between 3–5 TWh by 2020.

86 To help the development of this capacity, Government has agreed that WRAP will set up a new loan fund to help stimulate investment in additional AD infrastructure. A total of £10m over 4 years will be made available to provide debt finance to stimulate investment in additional AD capacity. The focus and criteria of the fund will be developed and a more detailed announcement made in due course.

11 Household food and drink waste in the UK, WRAP 2009; Food waste in schools, WRAP; Waste arising in the supply of food and drink to households in the UK, WRAP 2010; C&I waste survey, EA 2003; Defra Municipal waste management UK 2006.

12 'Accelerating the uptake of Anaerobic Digestion in England': An Implementation plan, Defra 2010.

13 'Farm Digestion' Towards Economic and Environmental sustainability, Professor Charles Banks, Southampton University.

1.8 Key legislation

87 As described above, there are a number of key benefits in the use of AD to create energy from waste, many of which will deliver the objectives of several key elements of legislation.

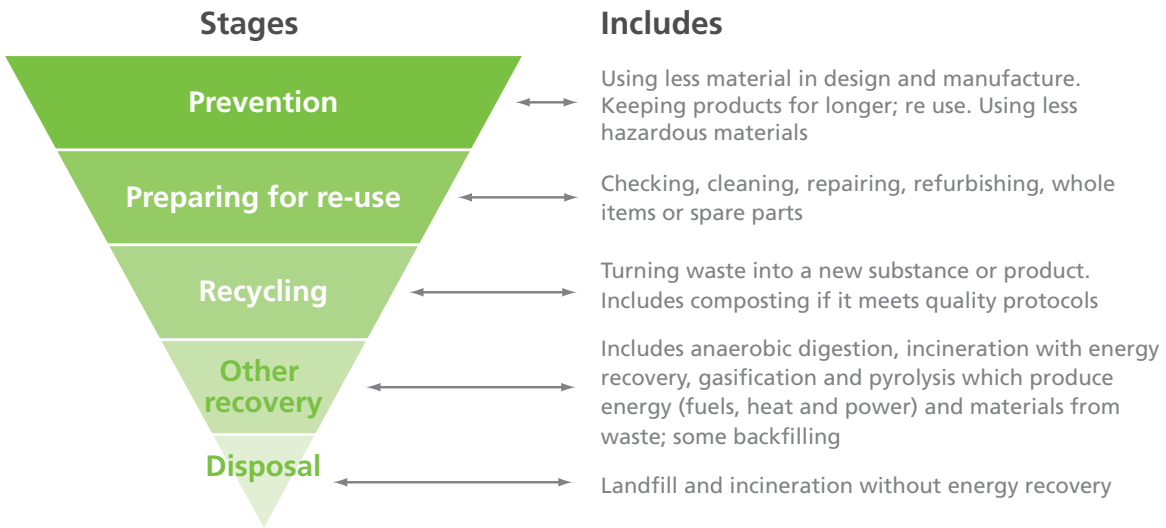
88 The Government is keen to move towards a 'zero waste economy'. This does not mean somewhere where no waste exists. Instead, this means a society where resources are fully valued, financially and environmentally; one person's waste is another's resource; nothing is actually 'wasted'; where, over time, we get as close as we can to zero landfill of most types of waste, and where there is a new public consciousness about waste. As mentioned, with respect to the waste streams for which AD is a viable option (food, certain soft garden waste), it is a recovery method generally preferred to composting (due to the cumulative benefits of biogas and digestate), combustion with energy recovery (because it preserves all of the nutrients and produces valuable biofertilisers), or landfill.

89 In particular, Article 4 of the rWFD requires a 5-step waste hierarchy to be applied as a priority order in waste management legislation and policy. Defra is publishing guidance in June 2011 on the practical application of the waste hierarchy and the circumstances in which departures from the hierarchy are justified for specified waste streams.[14] Public bodies and businesses will be required to have regard to this guidance when fulfilling their duties in relation to the waste hierarchy.[15]

90 Additionally, AD has a role to play in helping the UK meet the following commitments:

- The targets to reduce GHG emissions. The Climate Change Act 2008 requires the reduction of carbon emissions by 80% by 2050 compared to 1990 levels. It established a system of 5-year caps on emissions, 'Carbon Budgets', to set the path to achieving this. The use of AD can reduce the emission of methane, a GHG, from slurries and agricultural residues, and from the landfilling of food and garden waste. AD also produces biofertilisers, which can displace mineral

Figure 3: The 'waste hierarchy' ranks waste management options according to what is best for the environment



14 http://www.defra.gov.uk/environment/economy/waste/eu-framework-directive/

15 Regulation 15 of the Waste (England and Wales) Regulations 2011 (S.I. 2011 No. 988).

fertilisers (made from fossil gas and which are responsible for 1.1% of the UK's total GHG emissions).

- The targets for renewable energy set in the EU Renewable Energy Directive. This requires the UK to source 15% of its energy from renewable sources by 2020. AD produces biogas that can be used for heat, and electricity, and upgraded to methane for transport and injection to grid. Biogas is made from renewable waste streams and can displace the energy provided by fossil fuels. Methane derived from waste through AD is considered to be a sustainable renewable transport fuel. The Directive also requires the UK to source 10% of energy used in transport from renewable sources by 2020, and the use of methane as a fuel for transport can contribute to this.
- The targets set in the EU Landfill Directive. This requires the UK by 2020 to cut the volume of biodegradable municipal waste sent to landfill to 35% of that produced in 1995. AD can have a significant role in treating food waste which would otherwise go to landfill.
- The target set by Article 11(2)(a) of the rWFD[16] to recycle 50% of waste from households by 2020. As to what counts towards this target, the two main factors are the definition of 'recycling' in Article 3(17) of the rWFD and the target compliance rules to be adopted under Article 11(3) of the rWFD. The target compliance rules have not yet been adopted. However, the indications are that the input to AD of biodegradable waste from households may be counted as recycled for the purposes of demonstrating compliance with the target where the treatment results in digestate which meets end-of-waste status. Pending the adoption of EU-level end-of-waste criteria for digestate under Articles 6(1) and (2) of the rWFD, this would mean compliance with the national end-of-waste criteria set out 'End-of-waste criteria for the production and use of quality outputs from AD of source-segregated biodegradable waste'.

1.9 Other legislative issues

91 The Government is already addressing various legislative and regulatory issues to facilitate AD. For example, new exemptions from the need for an environmental permit for AD at both agricultural and non-agricultural premises were introduced in April 2010.

92 The EA has completed the development of revised standard rule permits for AD. This should make the granting of a permit easier and quicker for those applicants who can meet the standard rules.

93 DECC is currently exploring the possibility of a gas licence exemption for onshore gas production. This should make it easier to inject biomethane from an AD plant into the gas grid.

94 The Government is reforming the planning system to ensure that the sustainable development needed to support economic growth is able to proceed as easily as possible. This embraces a range of measures which should make it easier to obtain planning permission for appropriately sited AD plants.

1.10 Economic growth

95 The move towards a low carbon and resource-efficient economy presents opportunities for the growth of new industries and services. AD offers employment opportunities in the UK in terms of both the operation of plants and also the manufacture, construction and delivery of AD equipment. It is estimated by

16 http://www.defra.gov.uk/environment/economy/waste/eu-framework-directive

the industry that 35,000 new jobs may be generated from the use of AD technologies. If a successful industry can be established in the UK, it may also be possible to export products and services. Already, one UK exporter is currently supporting Thailand's PTT (the state oil and gas company) on their first biomethane for vehicles project. In the North West, the RESCO project is working with manufacturers to convert their existing skills to make products for AD plants, which has the potential to contribute to the green economy and exports.

1.11 Incentives

96 Various financial incentives are available for the support of AD.

1.11.1 Renewables Obligation (RO)

97 The RO provides financial support to generators of renewable electricity. AD is in the top banding at 2 ROCs/MWh (Renewables Obligation Certificates per megawatt hour).

98 The Government carries out regular reviews of the banding levels under the RO. The timetable for the 2013 Banding Review is being brought forward to give investors and developers greater certainty and confidence to plan ahead. The Government will consult on new banding proposals in summer 2011 and will confirm the new bands by autumn 2011, a full year ahead of schedule. The new bands will come into effect as planned on 1 April 2013 (except for offshore wind) but industry will now get an earlier indication of the support available for future projects.

1.11.2 Feed-In Tariffs (FITs)

99 The FITs scheme went live on 1 April 2010. It aims to encourage deployment of additional low carbon electricity generation, particularly by organisations, businesses, communities and individuals who are not traditionally engaged in the electricity market. This 'clean energy cashback' will allow many people to invest in small scale low carbon electricity, in return for a guaranteed payment both for the electricity they generate and export.

100 AD plants are currently eligible for a tariff of 12.1 pence per kilowatt hour for installed capacity of 500kW or less, and 9.4 pence per kilowatt hour for installed capacity of greater than 500kW. An additional 3.1 pence per kilowatt hour is paid for electricity exported to the national grid.

101 Following concerns from industry that the tariffs were not high enough to make small-scale AD worthwhile, the Government issued a fast-track consultation in March 2011 on proposals to increase the rates. On 9 June 2011, the Government announced the intention to implement the changes proposed in the consultation. This will increase the tariffs levels to 14p/kWh for AD installations with a total installed capacity of up to 250 kW, and to 13p/kWh for AD installations with a total installed capacity of between 250 kW and 500 kW. Subject to Parliamentary approval and State Aid clearance from the European Commission, the new rates will come into effect from 1 August 2011.

102 An additional wider comprehensive review is looking at all aspects of the scheme, including tariff levels, administration and eligibility of technologies. A consultation on this will start in summer 2011, with draft legislation in the autumn. Any changes in tariffs as a result of the comprehensive review would not come in until April 2012, unless the review showed the need for action to be taken sooner.

1.11.3 Renewable Heat Incentive (RHI)

103 Details of the forthcoming RHI were announced on 10 March 2011. The scheme will for the first time provide long-term guaranteed financial support for renewable

heat installations. AD will be eligible to receive a tariff of 6.5 p/kWh over a 20 year period for biogas combustion in installations below 200 kWh and biomethane injection into the gas grid at all scales. The aim is to obtain Parliamentary approval of the scheme's underpinning legislation in summer 2011, with the scheme to be launched shortly afterwards.

1.11.4 Renewable Transport Fuel Obligation (RTFO)

104 The RTFO obliges fossil fuel suppliers to produce evidence that a specified percentage of their fuels for road transport in the UK comes from renewable sources, including biomethane. This can include the use of biomethane as a road transport fuel. Biofuel suppliers are awarded Renewable Transport Fuel Certificates (RTFCs) for the volume of renewable fuels they supply. These can in turn be sold on to any fossil fuel suppliers who have not supplied enough biofuel to meet their obligation for the year. In 2009/10, the second year of operation, the RTFO met its objective of driving a market for biofuels in the UK. 3.33% of the UK's total road transport fuel supply was biofuel, which was slightly higher than the Government's target of 3.25%.

105 The EU Renewable Energy Directive (RED) requires the UK to source 10% of energy used in transport from renewable energy by 2020. The Department for Transport has recently consulted on proposals to amend the RTFO to implement the transport elements of the RED.

106 The RED encourages biofuels from wastes, residues and lignocellulosic material (plant biomass that is composed of cellulose, hemicellulose and lignin) by double counting the contribution that they make towards national targets. The DfT implementation proposals involve introducing double certification for biofuels produced from wastes, residues and lignocellulosic materials including biomethane. The proposed change will give twice the financial support to these biofuels compared to conventional biofuels and no support to biofuels that do not meet the required sustainability standards.

Anaerobic Digestion case studies

Lower Reule Farm

Lower Reule Farm is a family business focused on soft fruit production such as strawberries. Their AD plant takes in food wastes from local authority collections and commercial food production outfits. The AD plant generates biogas for the farm as well as digestate.

The plant was awarded funding of £750,000 from WRAP's capital grant scheme, which aims to support projects which would not have been able to proceed without assistance. Lower Reule managed to secure the remainder of funding from their bank, partly as a result of being awarded the grant. The planners were supportive of the facility once the decision was taken to move the reception facility to the industrial estate.

The plant has enabled Local Authorities to implement planned weekly food waste collections, which is very challenging without having nearby processing capacity.

Case study and picture courtesy of WRAP and Lower Reule Farm

Westwood – BiogenGreenfinch

The Westwood food waste digester in Northamptonshire was designed and built by BiogenGreenfinch using home-grown UK technology. The plant was commissioned in 2009 and is owned and operated by BiogenGreenfinch. The operational throughput is 45,000 tonnes per year, and the outputs are 2.1 MWe of electricity and 40,000 tonnes per year of pasteurised digestate which is irrigated on contiguous land owned by Bedfordia Farms. The food waste is both from local authorities through kerbside collection of household kitchen waste, and from commercial sources.

During the planning and construction phase of the plant BiogenGreenfinch invited the local community to attend a public exhibition where they could obtain information, gain an understanding of the process and raise any concerns about the AD plant. The exhibition was well attended, helped to allay any perceived fears and allowed the company to explain the benefits of AD to the community.

Case study and picture courtesy of BiogenGreenfinch

Hill Farm – Trevor Lea

Hill Farm is an 80 ha organic dairy farm. Feedstock for the 22-year-old digester is slurry from 80 cows housed indoors from October to April. Biogas is used for digester and farmhouse heating, cooking and dairy/farmhouse hot water. The purchase of the digester was made possible through a MAFF 50% pollution abatement grant.

Trevor runs an organic farm, which means that whilst the digester runs very well, he cannot supplement gas production by bringing in organic substrates from outside the farm.

Trevor notes, 'We use the gas to keep us warm and the digestate to nourish the land' and lauds the benefit of AD as an excellent slurry and nutrient management system. Both the liquid and fibre fractions of the digestate are applied on the farm as both can be easily spread and incorporated into routine pasture management.

Case study and picture courtesy of The Royal Agricultural Society of England and Hill Farm

Sustainable Youlgrave

Sustainable Youlgrave is a voluntary, community group covering 3 villages and 3 hamlets in the Peak District, Bradford Valley.

The group has been attempting to establish an AD project within the community for some time. The project will involve more than 40 farmers. Numerous problems and issues have been overcome to date, principally by liaising, talking and meeting with all the stakeholders involved in the project to remove obstacles to development such as issues with National Park planning policies and local authority support for the project.

Sustainable Youlgrave are currently supporting one farmer with development of his single, on-farm AD, and proceeding with the early stages of an on-farm, shared AD with 5 local farmers.

Case study and picture courtesy of Brian Mallalieu

Cockle Park Farm

Cockle Park Farm have just installed an on-farm AD plant. Feedstock at present includes dairy and pig slurry with straw based pig manure and vegetable residues. Energy crops are proposed for future input. Outputs include heat via a biogas boiler. Electricity will be used on site with the surplus being exported to the National Grid.

Cockle Farm are experiencing some issues with EA permits. Cockle Park Farm are currently operating under an Exemption. A standard on-farm permit 2010 SR016 was applied for but it was rejected on the basis of proximity to on-site farm cottages. They then applied for a Bespoke permit in December 2010 but withdrew it due to the EA consultation on the Standard Rules on-farm permit. They are now working with the EA with respect to the classification of feedstocks and whether this will allow operation via an Exemption.

Case study and picture courtesy of Cockle Park Farm

Avonmouth Works

Bristol sewage treatment works in Avonmouth is Wessex Water's largest digestion facility, treating sewage sludge from a population equivalent of 1 million and imported municipal sludges.

In 2007 a program was instigated to increase renewable power generation from 2MW to 4MW by diverting sewage sludge from carbon intensive lime treatment to renewable energy generation via AD. Installing a Monsal Enzymic Hydrolysis process prior to AD to increased biogas production to 33,000m^3/day (425m^3/tds), generating an additional 1MW. A further 4 primary digesters, increased treatment further raising generating output to 4MW. The project, funded internally on a ëspend to saveí premise, was dependent upon support of 1 X ROC tariff to be economically viable. Future planned development, by Wessex Water's waste to energy business GENeco, includes digesting food waste to further utilise the sites 5.75 MW installed generating capacity.

Case study and picture courtesy of Monsal and Wessex Water

2. Anaerobic Digestion Action Plan

107 Government has been working closely with industry to firstly identify the hurdles to development and then assess the actions needed to overcome them. These actions when completed would speed up the deployment and development of a sustainable industry and thus facilitate the uptake of energy from waste through AD.

108 The Government and its partners would like to thank those members of industry, public bodies and community groups who have assisted in this process, in particular the chairs and rapporteurs of the workgroups:

109 Chairs: John Baldwin (CNG Services Ltd); Steve Lee (CIWM); Government representative (DECC).

110 Rapporteurs: Greg Archer (LCVP); Lucy Hopwood (NNFCC); Howard Leberman (EA); Tim Lunel (NEF); Denise McGlynn (EU Skills); Bruce Nelson (ADBA); Jonathan Scurlock (NFU); David Tompkins (WRAP).

111 A list of organisations involved is included in Appendix B and Appendix C.

112 In the course of this process of discussion and consultation, industry has confirmed its support for the Government's commitment to an increase in energy from waste through AD. Partners have also agreed on the importance of a sustainable and long-term growth in the use of AD, a technology with the potential to contribute to climate change mitigation and broader environmental goals.

113 A clear framework that is owned and delivered by industry with Government is likely to be much more successful than one produced by Government alone. Actions have been identified that will need some input from Government, but other actions have been taken on by industry partners.

114 The actions fall broadly into three headline themes:

1. Improving our knowledge and understanding
2. Smarter working models
3. Regulation and finance

115 The work that has been undertaken by the working groups has highlighted that the following issues are key and that they need to be addressed by actions in this Action Plan if a sustainable industry is to emerge:

- Feedstock security.
- Use of digestate as a valuable resource.
- Biogas use.
- Access to finance to build plants and certainty around the financial incentives that are in place to encourage renewable energy generation.

2.1 Theme 1: Knowledge and Understanding

2.1.1 Key issues

116 As described in the preceding sections, there are numerous potential benefits to the use of AD technology. However, there is a need to ensure that knowledge and understanding of the benefits is captured, analysed and made widely available for the industry, Government and civil society to use. Knowledge and understanding must be made available in forms which can be understood by everyone, so that the benefits of adopting AD can be identified, and publicly accepted.

117 It is vital to assess all the available research and have a better grasp of the lifecycle economics of planning and running an AD plant. We are seeking to identify best practice and want to learn from shared experience in the UK and from other countries.

118 It is important that we establish an accurate baseline of AD activity that can be used to monitor the progress and development of the industry and also the delivery of the actions within this Action Plan. This is vital for all those involved in the development of AD – investors, operators, planners, Government, energy utilities, food waste generators and those who use digestate.

119 The pace of growth within the AD industry has the potential to be rapid, with a growing demand for training. However, the need for training is difficult to quantify due to the uncertainty of the development of projects. Some training provision may be needed to underpin technical competence assessment. Other training will be dependent on individual needs or requirements.

120 The use of AD to generate renewable energy is well understood. However, all plants also generate digestate, and whilst there is a good understanding of the technologies and routes for the utilisation of the biogas from AD, a similar breadth of information and knowledge relating to the beneficial use of digestate is not as well understood.

2.1.2 Key challenges addressed by the working groups

- What does the AD landscape look like?
- How much feedstock do we have and where is it?
- What are the available AD models and where are they most appropriate?
- Lack of industry-specific training for operators.
- Promotion of a competitive domestic manufacturing base.
- Understanding digestate, the outlets and how its use should it be promoted.
- Raising the profile of AD generally so that the benefits of the technology are recognised in the context of both waste management and energy generation.

2.1.3 Agreed actions for industry and government

121 Please refer to the summary of agreed actions in section 2.4 below. Actions 1–29 address the issues identified for this thematic work stream.

2.1.4 Outcome

122 We believe that through development of the actions, we will make progress towards or achieve the following outcomes:

- A thorough and shared understanding of the potential for AD to fully develop into a significant component of our renewable energy, agriculture and waste treatment industries.
- Training provision is mainly delivered on a commercial basis and therefore is demand led; however it is possible to anticipate the demand, ensuring some appropriate training/qualifications are available in the early stages. All available training will be identified, published and publicised; any new training courses will be developed and accredited.
- A clear and agreed understanding of the existing markets for digestate. When used effectively and appropriately, these materials are valuable fertilisers which can directly replace inorganic fertilisers. Confidence in the use of digestate is established and its use is recognised by all stakeholders to encourage uptake in the market place.

2.2 Theme 2: Smarter Working Models

2.2.1 Key issues

123 There is general awareness of AD technology throughout the UK. However, the profile of the 54 AD plants outside the water sector that are currently operating in the UK is not high. More importantly, the benefits that can be derived for a community, neighbourhood or Local Authority project have not been drawn together and publicised. It needs to be recognised that AD installations that provide benefits at a local level can be of a wide variety of sizes, from micro-scale to very large.

124 Increasing the awareness of the role that can be played by AD in waste management and renewable energy generation should help increase the uptake of various models for AD. Guidance is particularly valuable for smaller developers or communities, to which the cost of initial professional advice may be prohibitive. It is also important that information is available in forms which can be understood by everyone.

125 The use of biomethane via direct injection into the national gas grid represents another important outlet for biogas, however this does not currently happen regularly in England. Using biomethane produced from AD as a transport fuel also has a high carbon savings potential, but again this rarely happens at the current time.

126 To date, relatively few projects have been commissioned in rural areas. Encouraging the uptake of AD in rural areas poses special challenges.

2.2.2 Key challenges that were addressed by the working group

- Improve our understanding of the economic, environmental and social aspects of all models of AD.
- Continuous technological and best fit solutions should be examined for all types of AD projects.
- There is currently limited use of biomethane in either the gas grid or as a transport fuel.
- There are gaps in our knowledge and understanding of the operation of AD on farms and thus a need to overcome these to facilitate development of AD at this scale.

- There is a need to fully comprehend the competing priorities of land use, environment and biodiversity and the interconnection with feedstocks for on-farm AD plants.

2.2.3 Agreed actions for industry and government

127 Please refer to the summary of agreed actions in section 2.4 below. Actions 30–41 address the issues identified for this thematic work stream.

2.2.4 Outcome

128 We believe that through development of the actions, we will make progress towards or achieve the following outcomes:

- Information and guidance is provided in the right format to enable the AD industry, financiers, planners and in particular planning committee members to understand and develop AD plants. Collated and published case studies are available of various models (community, on-farm, micro, commercial etc) of AD plants to demonstrate the varieties of types and the likely costs and returns. These will be publicly available. A 'toolkit' will be produced to help and support all those involved in the planning, procurement, building and operating of AD plants. This will include template documentation.
- Develop and publish a set of steps to gather evidence on the barriers to and opportunities for biomethane as a transport fuel in the road haulage sector and to develop an understanding of the economics of supplying biomethane to transport and running HGVs on biomethane.
- There is clarity on the sustainability and use of crops grown as feedstocks for AD and any further work needed on the issue is identified.
- Evidence on the costs and complexity of injecting biomethane into the gas grid and connecting to the national gas grid for small scale electricity generators is published.

2.3 Theme 3: Regulation and Finance

2.3.1 Key issues

129 The existing regulatory framework for AD needs to ensure that the balance between encouraging growth of the industry and the requirement to protect human health and the environment (including animal health) is well understood. However, there is a perception that the existing regulatory framework that controls the use of AD in England and Wales poses a number of regulatory challenges for AD operators of all scales.

130 The finance sector is cautious when assessing AD projects, particularly small-scale ones. This may be due to a lack of understanding about the risks and possible returns on investment, the high cost of due diligence for small to medium plants and a lack of knowledge in general regarding AD technology and models. Developers are often unaware of the variety of funding sources available.

2.3.2 Key challenges addressed by the working groups

- Where possible, identify regulatory issues that could pose obstacles to the establishment and operation of AD facilities.
- Improve the understanding of the existing regulatory process for obtaining permits for AD.
- Simplify the protocols governing injection into the gas grid and connection to the electricity grid for small capacity plants.

- Build investor confidence by reducing the risks and costs associated with providing finance.
- Provide guidance to developers to help in obtaining the finance necessary to bring forward projects of all types and scales.

2.3.3 Agreed actions for industry and government

131 Please refer to the summary of agreed actions in section 2.4 below. Actions 42–56 address the issues identified for this thematic work stream.

2.3.4 Outcome

132 We believe that through development of the actions, we will make progress towards or achieve the following outcomes:

- 'Best practice' guidance notes are published on industry and Government websites, setting out what the EA and the industry consider good practice.
- Transparent guidance is available on the EA website on the process of engagement required by the EA for highlighting regulatory concerns with the existing regulatory framework.
- General awareness of AD in the finance and venture capital sector is increased and includes knowledge of best practice in the industry. Tools and guidance to improve access to funding are developed and available to AD operators of all scales.
- Government has agreed that WRAP set up a new loan fund to help stimulate investment in additional AD infrastructure.
- The benefits of operating standards for non-waste AD processes to the same level as waste processes (for both Environmental Impact and Health and Safety) are well understood.

2.4 Summary of agreed actions

133 The table below summarises all the actions for all three thematic work streams discussed above. A more detailed description of the actions can be found in supporting document 1.

Table 2: Summary of agreed actions

No.	Ref.	Action Description	Primary Action owner	Due date
1	KUL 1.1	Agree and publish on the existing AD portal a robust baseline that accurately describes the status of the AD industry.	NNFCC and WRAP	September 2011
2	KUL 1.2	Continue to update the AD landscape information that is accessed via the AD portal, including monitoring planned developments. In the long term develop an industry led mechanism to provide this data.	NNFCC and WRAP	Ongoing
3	KUL 1.3	Add to information available on the AD portal though collating robust data on the associated benefits of AD, e.g. number of jobs, renewable energy generated, GHG reduction etc.	WRAP	April 2012
4	KUL 1.4	Agree and publish via the AD portal the collated matrix of ongoing research and development work on AD in the UK.	Defra	September 2011

No.	Ref.	Action Description	Primary Action owner	Due date
5	KUL 2	Collate and make available data and information sources on feedstocks for AD via AD portal.	WRAP	April 2012
6	KUL 3	Build on existing work by WRAP and others on commercial food waste collection to ensure commercial collection becomes more widespread e.g. tool on costs involved in commercial collection schemes, demonstration projects etc.	WRAP	December 2011
7	KUL 4	Undertake an economic study to evaluate the different possible business models for AD and a full review of the supply chain options for AD.	WRAP	April 2012
8	KUS 1.1	Agree and finalise the training provision matrix created by the working group members, maintain it as a live document and publish it via the AD portal.	CIWM	September 2011
9	KUS 1.2	Develop National Occupational Standards to cover the AD process in more detail.	EU Skills	March 2012
10	KUS 1.3	Collate data from other work streams to assess potential demand for skilled personnel and use this data to understand where the training and standards gaps are and the size of the potential market for training. Disseminate this data and develop bespoke training packages if required.	EU Skills	December 2011
11	KUS 1.4	Investigate if there is a need, and if so develop qualifications for the operation of the AD process using the National Occupational Standards.	Awarding Orgs e.g. WAMITAB	2011/2012
12	KUS 1.5	Trade associations to work with their members to identify training needs and then to work with training providers to develop training courses.	ADBA	Ongoing/ subject to demand
13	KUS 1.6	Identify if there are any specific training/skills requirements regarding utilisation of gas/power.	EU Skills	2011/2012
14	KUS 2.1	Publish factsheets explaining Operator Competence requirement for permitted facilities, contextualised specific to AD. Use AD Portal.	NNFCC	September 2011
15	KUS 2.2	Produce information sheet outlining key H&S regulations relevant to AD and specific training required and make this available.	ADBA	September 2011
16	KUS 2.3	Identify and promote tangible benefits of a trained and competent workforce and then communicate via AD industry and AD Portal.	EU Skills	December 2011
17	KUS 2.4	Scope potential for a framework where demonstration/accreditation of training and competence is key to acquiring financial investment.	ADBA	In progress

No.	Ref.	Action Description	Primary Action owner	Due date
18	KUS 3	Promote and replicate existing projects (e.g. the RESCO project where manufacturers are being encouraged to convert their existing skills to make products for AD plants).	ADBA	September 2011
19	KUD 1.1	Collate and publish experience of digestate enhancement and the development of novel digestate products.	WRAP	March 2012
20	KUD 1.2	Obtain and publish empirical evidence from the UK for the benefits of different kinds of digestate products in different markets such as in landscape and regeneration applications or for horticulture.	WRAP	Ongoing – complete March 2014
21	KUD2.1	Define different market expectations and requirements for product quality.	WRAP	Ongoing – complete March 2012
22	KUD 2.2	Collate and publicise existing data on digestate characteristics (including benefits and safety) and use.	WRAP	March 2012
23	KUD 2.3	Obtain field evidence for benefits and safety of digestates in different markets.	WRAP	Ongoing – complete March 2013
24	KUD 2.4	Where lacking, collate or procure research to provide data on processing impacts on hazards of known concern to specific market sectors.	WRAP	Ongoing – complete March 2014
25	KUD 2.5	Work with retail and farm assurance sectors to ensure that required tools are in place to allow these sectors to endorse the use of digestates in food production systems and to communicate the benefits of digestates to consumers.	WRAP	March 2013
26	KUD 2.6	Provide robust data that can be included in farm nutrient planning tools such as PLANET and RB209 when these tools are periodically revised.	WRAP	March 2013
27	KUD 2.7	Work with organic bodies and the EC to clarify the acceptability of digestates derived from non-household food sources on organic land.	WRAP	March 2013
28	KUD 2.8	Agree and publish on AD portal a dictionary of terms for the AD industry to remove confusion.	ADBA	March 2012
29	KUD 2.9	Collate and publicise existing data on the benefits of different digestate distribution models (e.g. service or product solution).	WRAP	December 2011

No.	Ref.	Action Description	Primary Action owner	Due date
30	WMA 1	Collate and publish a library of case studies from all types of AD operation, specifically exploit and promote findings from Environmental Transformation Fund (ETF) demonstration projects.	NNFCC	September 2011
31	WMA 2	Develop a set of tools that can be used by all those involved in planning, procuring, delivering and operating AD including local communities.	ADBA	March 2012
32	WMA 3	Establish a viable Challenge Fund to further the development of AD. The fund should cover the use of AD in all sectors and focus on challenging the cost of AD technology, and to develop improvements in the efficiency of AD. Funding will come from diverse sources.	WRAP	September 2011
33	WMA 4	Collate and publicise the range of industry awards for which AD is currently eligible and promote them via the AD portal. Establish a new, industry sponsored award for community AD projects.	CIWM	May 2012
34	WMB 1	A Paper will be produced by the Low Carbon Vehicle Partnership (LCVP) addressing: – Principal opportunities for and demand side barriers to the adoption of biomethane in transport for road haulage. – Model costs of fuel switching for different fleet operations. – Present alternatives for increasing the market for natural gas trucks and the potential impact of interventions. – Quantify carbon benefits of biomethane relative to diesel. – Non-financial barriers and how to address these.	LCVP	September 2011
35	WMB 2	DfT to undertake: – Analysis of UK subsidy environment for biomethane. – Examination of the costs of using biomethane/ CNG in the transport sector. – Establish the scale of the potential supply of biomethane for transport from various sources.	DfT	April 2012
36	WMR 1.1	To facilitate discussions between Office of the Gas and Electricity Markets (Ofgem) and industry to address the costs and complexity of injecting biomethane into the gas grid and connecting to the national grid for small scale electricity generators.	DECC	September 2011

No.	Ref.	Action Description	Primary Action owner	Due date
37	WMR 1.2	To promote to industry the benefits of schemes that will encourage and enable the use of biomethane injected into the grid.	Trade association	Ongoing
38	WMR 2.1	Hold a workshop on the sustainability and role of the use of purpose-grown crops as a feedstock for AD. A summary of the findings of the workshop will be produced and published.	Defra	September 2011
39	WMR 2.2	Develop and publicise an easy to use tool to calculate the lifecycle greenhouse gas savings associated with biomass feedstocks used in the generation of electricity, heat and combined heat and power.	DECC	September 2011
40	WMR 3	Establish a Defra led working group to consider the current opportunities for supporting good practice on-farms and the environmental benefits of on-farm AD.	Defra	September 2011
41	WMR 4	Produce and publish a brochure on the economic viability of small and micro scale AD.	IEA Task 37	April 2012
42	RFF 1.1	Compile and publicise a consolidated list of financial schemes available to AD projects. Promote access to these funds to industry.	ADBA	September 2011
43	RFF 1.2	Investigate the case for possible intervention, in the form of innovative financial products, to encourage investment in AD projects.	BIS	March 2012
44	RFF 1.3	Trade associations to collate and put forward evidence to Government to simplify the Enhanced Capital Allowances scheme by considering AD on a project basis.	ADBA	July 2011
45	RFF 1.4	Investigate other more standard financial products already available (e.g. for small scale wind) and establish whether any of the best practice/ structures can be used in the AD sector.	ADBA	December 2011
46	RFF 2	To help the development of additional AD capacity through new loan fund to help stimulate investment in AD infrastructure.	WRAP	September 2011
47	RFF 3	Provision of agreed standard due diligence templates and the production of a standard set of legal documentation for industry to use.	ADBA	September 2011
48	RFF 4	Deliver stakeholder meetings for the finance community for general communications, dispute resolution and proactive management of key issues.	ADBA	Ongoing

No.	Ref.	Action Description	Primary Action owner	Due date
49	RFR 1.1	Extend the availability of Standard Rules for AD. The EA have previously consulted on a revision of the standard rules permit for AD. The results of this consultation have now been published and revised standard rules will be published and will take effect from the begging of August 2011.	EA	August 2011
50	RFR 1.2	The EA will continue its work on the consideration of waste types for inclusion in AD. It will use its risk based regulatory approach to ensure the right outcomes and link this work to the consideration and revision of the AD QP.	EA	September 2011
51	RFR 1.3	Extend PAS110. The EA have now set up a Special Interest Group in order to progress submissions for new waste streams and end uses for digestate which allows PAS110 certification. The EA will update their website providing a proforma and guidance for additional waste and end use submissions.	EA	September 2011
52	RFR 1.4	Transfer of feedstock and digestate between farms. The EA will consider the recommendations that were raised by stakeholders and will complete a review and identify recommendations and actions to be taken forwards.	EA	September 2011
53	RFR 1.5	Ensure regulatory tools for AD are fit for purpose for delivering the Industrial Emissions Directive (IED). The EA will deliver proportional and risk-based delivery of the IED in advance of when the IED takes effect for new and existing AD operators.	EA	January 2013
54	RFR 1.6	Development of a quality protocol on biomethane to establish a point when biomethane produced from waste feedstocks can be used as a product and is no longer regarded as a waste. Work on this process has been started.	EA and EPOW	March 2012
55	RFR 2	Clarify the regulation of co-digestion of waste with sewage sludge at sewage treatment works. A task and finish group led by the EA and Water UK has been established. Once the results of this work are fully available, the EA and Defra will work together to further clarify the regulatory position.	Water UK and EA	April 2012
56	RFR 3	Facilitate a forum/hold regular meetings to discuss and understand planning reform as they affect AD.	DCLG	Ongoing

2.5 Communications

134 A number of the challenges faced by the industry are felt to be due to the confusing information landscape and the perception that there is a lack of clear guidance and technical information readily available for planners, financiers and project developers. There is a pressing need for clearly understandable guidance and information for these groups, but also for the general public, whose agreement or objections can be the difference between the success and failure of a project.

135 The emerging nature of the non-utility AD industry in England, the fast-paced movement in AD technology and a lack of a clear understanding of the potential of the industry have all been highlighted as possible barriers for uptake of projects and the development of the sector.

136 It is felt that there is limited information readily available and that a single source or point of reference for the industry and civil society would benefit the development of the sector.

137 There are a number of Actions which will provide greater levels of information and guidance. The Government has therefore decided to continue to fund the NNFCC AD portal as the key hub and tool for information dissemination on anaerobic digestion: http://www.biogas-info.co.uk/. This provides a first point of contact for information on AD for local authorities, businesses, farmers and the wider public. It provides direct links to a wide range of sources of information and advice.

138 The industry and Government as part of the workgroup process also agreed to undertake joint communication actions to ensure that AD, its benefits, technical guidance, information notes and publication of research and development is communicated more widely. As part of the ongoing monitoring and evaluation of the implementation of this Action Plan, communication strategies and activities will be monitored and reported.

2.6 Research base

139 We recognise that there is a great deal of completed and ongoing research and development on AD by Government, research bodies and industry in the UK and abroad. Defra commissioned a report giving an overview of evidence on completed and ongoing research into AD of food and other waste including assessment of the gaps where evidence is still needed (please see supporting document 2 – Report on the AD Research Gap Analysis). This report was commissioned in parallel to developing the actions to complement the AD Strategy and Action Plan.

140 The report indicates that a significant body of evidence exists on feedstocks, process optimisation/characterisation, biogas yields, as well as case studies of operational systems and community AD models. It also states that manure and purpose grown crops are feedstocks which are widely digested in the USA and Europe, hence they have been widely reported. The report therefore makes some recommendations to improve the accessibility of this research:

- Summarising key existing findings rather than 'new' research in areas such as technologies and feedstock and quantifying the wider benefits of AD.
- Translation of key scientific reports published in other languages, particularly German, into English.

- A critical review of published European case studies to identify the key success factors, including biogas as a transport fuel, and whether these could be transferrable to the UK.

141 The main areas in which the report recommends further work (which are not covered by the recommendations from industry) are:

i) Food waste feedstocks and digestion:

- Continue to investigate the long term implications of food waste digestion to understand the process parameters, operating conditions and outputs from the process.

ii) Collection interfaces with AD treatment:

- Assessment of wet versus dry AD systems, the best systems for different feedstocks and the interface with collection systems.

iii) Financial information:

- A review of self-built AD systems in Germany and the ways in which this could be transferrable to the UK in order to reduce capital costs for small-scale systems.
- Incorporate results from ongoing research into biogas yields from food wastes into existing process models, as this will enable better estimations of likely revenue from AD plants to be made.

iv) Stimulating the growth in AD technologies through different business models:

- Review the working models (contractual and economic) for the successful development of AD in other countries and the effects these have had on the growth and development of AD.

v) Training needs:

- Assess what training courses are available internationally, and assess the appropriateness of incorporating these into UK training.

vi) Regulatory issues:

- Further investigate key emissions and nuisance issues such as bioaerosols and odour from AD facilities.

vii) Applications of digestate:

- WRAP's current focus on food waste-derived digestate should be continued in order to ascertain benefits and identify if the long-term use of digestate on agricultural land may become problematic.
- A more detailed investigation looking into the potential hazards in digestate (e.g. pesticide residues, weed seeds/propagules and the pathogen Clostridium botulinum). This could complement WRAP's risk assessment work on composts.
- Outlets and environmental implications for digestate from residual treatment processes should be explored.
- Government and industry will use the findings in the R&D report to inform future research priorities.

2.7 Next steps

142 The Government has been delighted with the participation and engagement from industry that it has received during the creation of this document, and believes that this process has been of great benefit. In building on that enthusiasm and energy, Government proposes to continue with the Industry-Government Steering Group as the body overseeing progress on the implementation of the actions. Defra will be responsible for reporting on progress on the Action Plan. It will report regularly to the continuing Steering Group, and will publish a Progress Report annually, agreed with the Steering Group, to ensure that actions are successfully implemented. In particular it will examine the extent to which objectives are met, whether the planned levels of benefits are delivered and the original issues are addressed. This group will also enable Government and industry to consider additional new actions as they arise.

3. Appendices

Appendix A: Detailed process

143 The Government made a commitment to work towards a 'zero waste' economy in the Coalition Programme for Government of 20 May 2010, and to introduce measures to increase energy from waste through anaerobic digestion. The Government's Structural Reform Plans of 16 July 2010 therefore included an action to 'set out steps to promote increased energy from waste through anaerobic digestion'.[17] Defra incorporated this into its Business Plan, launched on 8 November 2010.[18] Priority 3.1.v of the Plan is to: 'Set out steps to promote increased energy from waste through anaerobic digestion, for consultation with stakeholders and industry', for completion by November 2010. Priority 3.1.vi is to: 'Publish detailed strategy to encourage anaerobic digestion measures', for completion by May 2011.

144 The Government then published on 30 November 2010 a Framework Document which aimed to set out the steps necessary to increase energy from waste through AD.[19] The Framework Document took into consideration the technical analyses provided in the Implementation Plan published in March 2010,[20] which built on the publication 'Anaerobic Digestion – Shared Goals' of February 2009 and the Task Force report 'Developing an Implementation Plan for Anaerobic Digestion' in July 2009.

145 The Framework Document included an invitation for stakeholders to work with Government on the strategy. A stakeholder conference was also held, on 16 December 2010.

146 128 replies were received to the publication of the Framework Document, from industry, trade associations, public bodies and community groups. All replies broadly supported the aims of the process and the Framework Document. The main issues raised at that stage were the difficulties AD operators encountered in gaining access to finance, and also the way in which the current regulatory regime works for AD, particularly for small-scale or farm-based operations.

147 Following on from the publication of the Framework Document and the stakeholder event, a Steering Group composed of representatives from both Government and industry was established. In addition, representatives from the bodies responding to the Framework Document were invited to join one of three thematic workgroups, each of which met three times during January and February 2011. The workgroups each considered specific areas. The 'Knowledge and Understanding'

17 http://www.number10.gov.uk/wp-content/uploads/defra-srp.pdf
18 http://www.defra.gov.uk/corporate/about/what/business-planning
19 http://www.defra.gov.uk/environment/economy/waste/
20 'Accelerating the Uptake of Anaerobic Digestion in England: an Implementation Plan', March 2010.

and 'Smarter Working Models' workgroups were chaired by industry representatives, whereas the workgroup on 'Regulation and Finance' was chaired by a Government official. The 'Knowledge and Understanding' workgroup covered three topics – understanding the AD landscape, building UK skills and building safe and secure markets for digestate. The 'Smarter Working Models' workgroup covered raising the awareness of AD including community AD and localism, AD in the rural community and the use of biomethane for transport. Lastly the 'regulation and finance' working group covered the issues around the regulatory framework for AD and issues that affect access to finance for developing AD projects. The chairs of the thematic work groups were assisted by rapporteurs who led the development of the outputs for each of the 8 work streams. Approximately 80 individuals from a very broad spectrum of departments and organisations were involved in these 3 workgroups. Lastly, a further 'virtual group' was established. This group comprised about 70 members who had expressed an interest in the initial consultation but could not be accommodated in the workgroups. The minutes and draft outputs of all the workgroups were posted on a website for online discussion, in which the 'virtual group' was able to take part.

148 Each workgroup discussed both the issues set out in the Framework Document and any additional issues raised in the consultation. Within each group, members agreed actions that industry and Government could take forwards to remove barriers to development and thus facilitate the uptake of energy from waste through AD. The results of the work of each of the workstreams are discussed in section 2 of this document. The Steering Group considered and discussed the recommendations of the workgroups and the AD Strategy and Action Plan has been produced as a result.

Appendix B: Members of the steering group

Anaerobic Digestion and Biogas Association (ADBA)

Cabinet Office

Chartered Institution of Wastes Management (CIWM)

Country Land and Business Association (CLA)

Department for Business, Innovation and Skills (BIS)

Department for Communities and Local Government (DCLG)

Department of Energy and Climate Change (DECC)

Department for Environment, Food and Rural Affairs (Defra)

Department for Transport (DfT)

Environmental Services Association (ESA)

National Grid

Renewable Energy Association (REA)

Her Majesty's Treasury (HMT)

Water UK

Appendix C: Core working group members

A

Anaerobic Digestion and Biogas Association (ADBA)

Association for Organics Recycling (AfOR)

AeroThermal Group

Acuity Capital Management

B

BiogenGreenfinch

Burdens

BioGroup

C

Chartered Institution of Wastes Management (CIWM)

C Spencer Ltd

Chilled Food

Community Composting Network (CCN)

Centrica/British Gas

D

Department for Environment, Food and Rural Affairs (Defra)

Department for Transport (DfT)

Department of Energy and Climate Change (DECC)

E

Energy & Utility Skills Ltd (EU Skills)

Environmental Services Association (ESA)

Environment Agency (EA)

Envitec Biogas UK

F

The Food and Environment Research Agency (FERA)

The Food and Drink Federation

Frith Resource Ltd

Foodchain & Biomass Renewables Association (Fabra)

G

Greater Manchester Waste Disposal Authority (GMWDA)

Grant Thornton

H

Health and Safety Executive (HSE)

I

Institution of Civil Engineers (ICE)

J

John Laing

London Waste and Recycling Board

KL

Low Carbon Vehicle Partnership (LCVP)

MN

National Non-Food Crops Centre (NNFCC)

National Farmers Union (NFU)

The National Energy Foundation (NEF)

Norfolk County Council

National Grid

O

Office of the Gas and Electricity Markets (Ofgem)

Office of Water Services (Ofwat)

P

PDM Group

QR

Renewable Energy Association (REA)

Reaseheath College

Royal Agricultural Society of England (RASE)

S

Scottish Agriculture College (SAC)

School of Environmental Biotechnology

Severn Trent Water

Scotia Gas Networks

Southeast Power Engineering

T

Transport and Travel Research Ltd

Thames Water

U

University of Newcastle upon Tyne

UK Environmental Law Association (UKELA)

United Utilities (UU)

V

Viridor

W

Waste and Resources Action Programme (WRAP)

Welsh Assembly Government

XYZ

Acronyms

A

ADBA	Anaerobic Digestion and Biogas Association
ABPR	Animal By-Products Regulations
AD	Anaerobic Digestion
AHVLA	Animal Health Veterinary Lab Agency

B

BIS	Department for Business, Innovation and Skills

C

CHP	Combined Heat and Power
CIWM	The Chartered Institution of Wastes Management
CLA	Country Land and Business Association
CO_2	Carbon dioxide
CNG	Compressed Natural Gas

D

DCLG	Department for Communities and Local Government
DECC	Department of Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport

E

EA	Environment Agency
EC	European Commission
EPOW	European Pathway to Zero Waste
ETF	Environmental Transformation Fund
EU	European Union

F

FITs	Feed-In Tariffs

G

GHG	Greenhouse Gas

H

H&S	Health & Safety
HGVs	Heavy Goods Vehicles

I

IEA	International Energy Agency
IED	Industrial Emissions Directive
IVC	In-Vessel Composting

JK

L

LCVP	Low Carbon Vehicle Partnership

M

Mt	Million tonnes
MWe	Megawatt electrical

N

NEF	The National Energy Foundation
NEWP	Natural Environment White Paper
NFU	National Farmers Union
NNFCC	National Non-Food Crops Centre

O

Ofgem	Office of the Gas and Electricity Markets
OFT	Office of Fair Trading

P

PAS100	Publicly Available Specification

Q

R

R&D	Research & Development
REA	Renewable Energy Association
RHI	Renewable Heat Incentive
RO	Renewables Obligation
ROC	Renewables Obligation Certificate
RTFCs	Renewable Transport Fuel Certificates
RTFO	Renewable Transport Fuel Obligation
rWFD	Revised Waste Framework Directive

S

SRF Solid Recovered Fuel

T

TWh Terrawatt hour(s)

UVW

WAMITAB Waste Management Industry Training and Advisory Board

WRAP Waste and Resources Action Programme

XYZ

Glossary of terms

AD	Anaerobic Digestion
Animal by-products	Products of animal origin
Biofertiliser	A natural fertilizer that helps to provide and keep in the soil all the nutrients and micro-organisms required for the benefits of the plants
Biogas	Mixture of gases produced by anaerobic digestion
Biomass	Any living or recently dead plant or animal material
Biosolids	Treated sewage sludge
Biowaste	Animal and vegetal waste arising from households, commerce and the food manufacturing industry
Biomethane	Pure methane produced from biogas
CHP	Combined heat and power
Co-digestion	A process whereby one or more waste types are digested in a mixture, in order to enhance digester efficiency and increase biogas yield
Co-digestate	Amended sewage sludge digestates
CNG	Compressed natural gas
Digestate	Nutrient-rich material left following anaerobic digestion
Digester	The tank in which anaerobic digestion takes place
Feedstock	The material that is put into the digester
Fertiliser	A substance added to soil to make it more fertile
Fibre	The solid part of digestate
Gate fee	Charge levied upon a given quantity of waste received at a Waste processing facility
GHG	Gases that trap heat in the atmosphere contributing to climate change
Inorganic	Material of mineral origin such as metal or glass
Lignocellulosic	Plant biomass that is composed of cellulose, hemicellulose, and lignin
Manures	Organic matter, including farm animal waste used as organic fertiliser in agriculture
Mesophilic	Organisms that grows best in moderate temperatures
Methane	A colourless, odourless gas with the formula CH_4
MWh	Megawatt hour
Organic	Material which comes from animal or plant sources
Purpose-grown crops	Biomass e.g. grass, maize etc
Quality Protocol	A Quality Protocol gives guidance on how to recover waste, remove it from the regulatory regime and relevant regulations
ROC	Renewables Obligation Certificate
Sludge	Residual, semi-solid material left from sewage treatment processes

Silage	Fermented, high-moisture fodder made from crops
Slurry	A semi-liquid mixture of manure and water
Solid Recovered Fuel	Fuel produced by shredding and dehydrating solid waste with waste converter technology
Source-segregated	Waste segregated at source e.g. households businesses or local authority which can be collected separately
SRF	See Solid Recovered Fuel
Thermophilic	Organisms that thrive at relatively high temperatures
TWh	Measure to describe how much energy is generated, sold or consumed

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List of supporting documents

These will be published alongside the Anaerobic Digestion Strategy and Action Plan.

Supporting Document 1	Detailed Actions
Supporting Document 2	Anaerobic Digestion Research Gap Analysis

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PB 13541