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Anaerobic Digestion Potential Study – Briefing Paper

V1.0

Environmental and sustainability solutions provided to

Midlands Net Zero Hub (c/o Nottingham City Council)

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Author: Sophie Spouge John Cordall	Reviewer: Mark Richmond
 	

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1.0 INTRODUCTION

1.1 Introduction to Midlands Net Zero Hub

The Midlands Net Zero Hub (the MNZH), led by Nottingham City Council, has been established to support public and private sector organisations in identifying and developing local strategies and projects that support the UK's net zero agenda. Funded by the Department for Energy Security and Net Zero to support the Government's Clean Growth Strategy and the Ten Point Plan, the MNZH assists Local Enterprise Partnerships and local authorities operating in the Midlands region to:

- Increase the number, quality and scale of net zero projects delivered across the Midlands;
- Raise local awareness of the benefits of, and opportunities for, local decarbonisation projects; and,
- Enable local areas to attract private and public finance for their projects.

A key ambition of the MNZH is to assist local authorities across the Midlands to better understand anaerobic digestion (AD), and its crucial role in generating renewable energy, managing the processing of organic wastes and resolving issues in the renewable energy supply chain. Following the completion of a competitive tender exercise, MNZH appointed environmental and sustainability consultancy WRM to provide strategy development and project feasibility work for AD infrastructure in the region.

As the MNZH embarks on this project to determine the current and future landscape for AD in the Midlands, WRM have authored this briefing report to provide stakeholders with an understanding of several facets of AD, including the following:

- A full description of the AD process, including the different types of AD treatment deployed across Europe, and the products generated from the process;
- The fiscal, political and legislative strategy drivers for AD;
- The current landscape of AD across the Midlands;
- The locational factors that influence where an AD facility is to be sited; and,
- The potential adjacencies of AD with other markets, such as the horticultural sector.

The report is provided as an initial deliverable to aide understanding of the opportunities available to maximise the potential of AD as part of the Midland's energy mix and future circular economy approach.

2.0 POLICY CONTEXT AND INCENTIVES

This section of the report provides an overview of the legislative, regulatory, and policy context for anaerobic digestion before moving on to provide a description of the growth, development and potential for the UK anaerobic digestion sector.

2.1 Policy Context

The UK has a consistent and longstanding approach to climate change, decarbonisation and renewable energy production which has manifested in legislation, and in a variety of generic and sector specific strategies, policies and plans. The present range of climate change and energy legislation provides a framework for combating climate change and working towards and attaining net-zero carbon emissions. Such legislation supports the UK in meeting its international commitments and targets for greenhouse gas emissions and works to create market conditions to bring forward investment in renewable and low-carbon technologies.

The narrative below provides a brief chronology of pertinent legislation, strategy and plans that directly supports the need for the deployment of anaerobic digestion projects in the UK.

Climate Change Act (2008)

The Climate Change Act 2008 provides the legislative impetus for meeting net-zero carbon emissions, stipulating that the UK's net carbon balance for 2050 must be at least 100% lower than the 1990 baseline. The act creates the legislative framework for decarbonisation by obligating the UK Government to prepare and report on proposals and policies for meeting carbon budgets and places a duty on the UK Government to drive forward UK domestic action on climate change.

National Renewable Energy Action Plan (2010)

The UK’s renewable heat and transport targets were published in 2010, in a National Renewable Energy Action Plan aligned to the EU’s 2009 Renewable Energy Directive. The action plan established initial UK targets including sub-targets for electricity, heat, and transport, as stated below:

- 30% renewable energy,
- 12% renewable heat, and
- 10% renewable transport.

In 2024, renewable energy comprised approximately 42% of the UK's energy mix in the 12 months to January 2025, with 6.8% of renewable energy derived from biomass sources[1].

The Department for Energy Security and Net Zero publish a digest of UK energy statistics (DUKES) on an annual basis. The latest publicly available report, published in mid-2024, demonstrates that electricity represented the largest share of renewable fuel demand in 2023 (70%), heat derived from renewable sources accounts for 17% with transport biofuels comprising another 9.6% of the mix. Notably, biogas injected into the grid stood at 2.4% of the renewable energy mix[2].

The plan recognises that biogas and biomethane generated by anaerobic digestion has the ability to contribute towards each of the three targets.

Anaerobic Digestion Strategy and Action Plan (2011)

This technology specific strategy and action plan committed to increasing the production of energy from anaerobic digestion from a range of feedstock sources. The strategy sets out a vision for AD and was accompanied by an action plan that set out the actions and detail that are needed to bring about an increase in energy from processing waste through anaerobic digestion. The Strategy did not set specific targets or regional strategies for the adoption of AD but nevertheless recognised the importance of the biogas and digestate outputs in supporting a range of decarbonisation, energy security and farming priorities.

Ten Point Plan for a Green Industrial Revolution (2020)

Much of the contemporary national level strategy and policy on decarbonisation has been framed by the 2020 Ten Point Plan for a Green Industrial Revolution. This plan provided concise strategic priorities which worked to mobilise, advance or accelerate a range of ambitions. AD has clear potential to deliver on several of the strategic priorities including carbon capture, usage and storage, and protecting our natural environment, as well as also supporting hydrogen and low emission vehicle objectives.

[1] Uswitch.com. Renewable energy statistics 2025. [Accessed 23rd May 2025]. Available from: https://www.uswitch.com/gas-electricity/studies/renewable-statistics/#:~:text=The%20latest%20renewable%20energy%20statistics,three%20biggest%20renewable%20sources%20combined.

[2] Department for Energy Security and Net Zero. Digest of UK Energy Statistics. Annual data for UK, 2023. [Accessed 23rd May 2025] Available from: https://assets.publishing.service.gov.uk/media/66a7e14da3c2a28abb50d922/DUKES_2024_Chapters_1-7.pdf

Net Zero Strategy: Building Back Greener (2021)

This strategy sets out policies and proposals for decarbonising all sectors of the UK economy to meet our net zero target by 2050. This strategy describes the need for the UK to move away from fossil fuels and the need to expand production of innovative and low-carbon fuels, reduce demand for energy and carbon-intensive resources, and increase our resource use efficiency.

The strategy targets the removal of fossil fuels from the energy mix which will require the transformation of every sector of the global economy. It makes specific references to no longer burning fossil fuels for power or heating and places an emphasis on the supply of low carbon alternatives. Some of the specific objectives in the strategy that relate to anaerobic digestion include:

i. Working with the principle of consumer choice so that the transition can be made in a controlled manner;
ii. To fully decarbonise the power system by 2035;
iii. To scale up the production of low carbon alternatives such as hydrogen and biofuels, and,
iv. to mobilise additional public and private investment of at least £14 billion in industry, in line with the 2037 delivery pathway.

The Heat and Buildings Strategy (2021)

The 2021 Heat and Buildings Strategy outlines the UK's pathway to decarbonise homes, commercial, industrial, and public sector buildings in accordance with achieving net zero by 2050. Recognising the role of bioenergy, the strategy highlights the increased production of biomethane that is required to decarbonise the gas grid and underscores the application of bioenergy in decarbonising challenging-to-treat properties off the gas grid. It also acknowledges the imperative of maintaining environmental standards, including considerations for air quality and feedstock sustainability. The strategy recognises that Anaerobic Digestion can contribute to all three energy sectors (heat, power, and transport), especially those such as heating, that have historically been challenging to decarbonise.

COP26 Global Methane Pledge Signatory (2021)

The Global Methane Pledge was launched at COP 26 in November 2021 to catalyse action to reduce methane emissions which is 86 times more potent than CO2 over a 20-year period. The UK Government is a key signatory to the COP26 Global Methane Pledge which now forms a part of the UK approach to reducing greenhouse gas emissions.

At COP28, a coalition of international partners launched 'Lowering Organic Waste Methane' (LOW-Methane), a new initiative to jumpstart a dramatic scale-up of global action to cut methane emissions from the waste sector, which accounts for roughly 20 percent of global methane emissions from human activities.

Powering Up Britain: Energy Security Plan (2023)

The Energy Security Plan published in 2023, outlines the UK Government's long-term investment strategy for energy security. Aligned with the Net Zero Growth Plan, it emphasises a sustained trajectory toward decarbonisation.

A key component involves substantial, long-term investments in the methane gas network. This component of the plan aims to inject increasing volumes of domestically produced biomethane into the gas grid using the Green Gas Support Scheme ("GGSS") as a key market incentive. The GGSS is designed to reduce carbon emissions, diminish reliance on natural gas, and enhance gas supply diversity, ultimately providing enough biomethane to heat around 200,000 homes annually at peak production.

In October 2023, support for long-term investment in Biomethane received a further boost with the announcement that the Green Gas Support Scheme has been extended to 2028. The UK Government also plans to introduce a policy framework for biomethane from 2028 onwards, building on the progress being made in the current GGSS.

Powering Up Britain: Net Zero Growth Plan (2023)

The Net Zero Growth Plan of 2023 reinforces the ambition outlined in the 2021 Net Zero Strategy. It aims to deploy a minimum of 5 $MtCO_2$/year of engineered Greenhouse Gas Removals (GGRs) by 2030, with ambition to scale up to 23 $MtCO_2$/year by 2035.

Additionally, the government aims to achieve a substantial shift of 50 Terawatt hours (TWh) in industrial fuel consumption towards low carbon fuels by 2035. This transition is expected to primarily involve switching from fossil fuels to electricity and hydrogen, with contributions from bioenergy sources such as biomethane for additional carbon savings.

Biomass Strategy (2023)

The Biomass Strategy, published in 2023, sets out the role biomass can play in achieving net zero. The strategy defines Biomass as any material of biological origin, encompassing the biodegradable fraction of products, crops, wastes, and residues. The strategy emphasises the government's steadfast commitment to biomass sustainability and explores ways to prioritise biomass across various sectors of the economy.

The Biomass Strategy Policy Statement outlines the government's strategic view on the priorities for biomass use across the UK Economy. The principles included circular economy & resource efficiency, which recognises the AD process as a recycling activity, which implements the circular economy model.

Low Carbon Fuels Strategy (overdue)

The proposed Low Carbon Fuels Strategy, previously expected in 2024 although not yet published, will set out the deployment of low carbon fuels, including biofuels, across various transportation modes until 2050. Building upon the Net Zero Strategy and the earlier Transport Decarbonisation Plan, this strategy aligns with plans for the transport sector to achieve net zero, emphasising the use of low carbon fuels such as biofuels.

To ensure biomass use delivers its role in the UK's decarbonisation goals, the UK has already set mandatory stringent sustainability criteria in the power, heat, and transport sectors. Sector-specific legislation includes the Renewable Obligation Order (RO) 2015, Non-domestic Renewable Heat Incentive (RHI), Green Gas Support Scheme (GGSS), UK Emissions Trading Scheme (UK ETS), Renewable Transport Fuel Obligation (RTFO).

2.2 Environment Act 2021

The Environment Act 2021 is presented as a separate subheading of this report, due to it's key role in driving forward increased collection of food waste suitable for processing through anaerobic digestion.

The Environment Act 2021 establishes a legal framework and obligations for local authorities, packaging producers, and businesses by implementing and supporting key elements of the Resources and Waste Strategy 2018. The Environment Act 2021 mandates that all waste collection authorities in England must implement a weekly municipal kerbside food waste collection service by 31st March 2026. Furthermore, the Department for Environment, Food and Rural Affairs (DEFRA) has set the following service implementation deadlines:

- **31st March 2025**: Businesses and non-domestic premises (nursing home, hospital, educational establishments) should have arranged for the collection of core recyclable waste streams, including glass, metal, plastic, paper, card, and food waste. Garden waste collection is not expected to arrange for at this point;

- **31st March 2026**: Local authorities will be required to collect the core recyclable waste streams via kerbside collection for households. This includes the collection of weekly food waste, unless the local authority has a transitional arrangement; and,
- **31st March 2027**: Businesses, relevant non-domestic premises (companies with 10 employees or fewer) and houses will be introduced to kerbside plastic film collections. This involves packaging films and pouches made from mono-PE (polyethylene) and mixed PE/PP. Businesses with 10 employees or fewer will also be required to arrange for a food waste collection to be in place by this date.

In November 2024, DEFRA's Simpler Recycling policy update introduced an exemption to allow food and garden waste to be co-collected as a co-mingled stream, providing greater flexibility for local authorities and households. However, this flexibility may constrain the selection of viable treatment technologies, dependent on the selected collection method. For example, co-mingled garden and food waste is unsuitable for wet AD, which is only suitable for source segregated food waste. Co-mingled food and garden waste can be treated through Dry AD technology. Despite its adoption across mainland Europe, the technology is not widely deployed across the UK. Consequently, In-Vessel Composting (IVC) is often the preferred treatment route for co-mingled garden and food waste in the UK. IVC does not generate biomethane, so its greenhouse gas mitigation potential is lower than AD, although it remains an important technology for composting co-mingled waste and returning organic matter to soil.

In summary, the rollout of mandatory municipal, commercial and industrial food waste collections is anticipated to increase the tonnage of total food waste available for processing through wet anaerobic digestion at a regional and/or national level.

2.3 Fiscal Incentives for Anaerobic Digestion

The policy drivers for AD have been financially supported by government backed tariff-based schemes for the last 15 years. A summary of expired and ongoing tariff-based schemes that have applied to anaerobic digestion developments is explored below.

Feed In Tariffs (The Feed-in Tariffs (Specified Maximum Capacity and Functions) Order 2010)

This scheme is closed to new applications. The Feed-in Tariffs (FIT), introduced in 2010, was a scheme designed by government to promote the uptake of renewable and low-carbon electricity generation. The scheme provided a unitary based payment for electricity generated and exported by accredited installations. AD with an electrical output of up to 5MW was eligible for FIT, with payments being made against a series of bandings based on electrical output. At the time of writing, there are no incentive payments available for generating electricity, following the closure of the FiT scheme to new applicants on the 1st April 2019.

Renewable Heat Incentive (Renewable Heat Incentive Scheme Regulations 2011)

This scheme is closed to new applications, with the registration period closed on the 31st March 2021. The Non-Domestic Renewable Heat Incentive (NDRHI) is a government environmental programme designed to increase the uptake of renewable heat to help reduce carbon emissions and meet the UK's renewable energy targets. The scheme provides a unitary based payment for heat produced at anaerobic digestion facilities and/or biomethane injected into the gas grid by anaerobic digesters. Anaerobic digestion technology qualifies for RHI payments with payments being made for defined tranches of production, providing an adjustment mechanism for installations of different production capacity. Registered participants receive quarterly payments over a period of 20 years. It should be noted that this scheme is closed to new applications, having ended on the 31st March 2021.

Green Gas Support Scheme (Green Gas Support Scheme Regulations 2021)

The Green Gas Support Scheme (GGSS) is a government environmental scheme that provides financial incentives for new anaerobic digestion biomethane plants to increase the proportion of green gas in the gas grid. The scheme provides a unitary based payment for biomethane injected into the gas grid by anaerobic digesters.

The scheme is open to applicants in England, Scotland and Wales for four years from 30 November 2021. Registered participants will receive quarterly payments over a period of 15 years.

An application to be fully registered on the scheme, and therefore to receive periodic support payments for any eligible biomethane injected, may only be made at the point at which the equipment used to produce anaerobic digestion-derived biomethane is fully commissioned and operational and when the operator can demonstrate that it is capable of producing biomethane for injection into the gas grid. As it currently stands, the scheme will close to applicants on the 31st March 2028, which provides a key date for the development of any new anaerobic digestion infrastructure to receive tariff payments. With its 15-year tariff guarantee, published and index adjusted tariffs, and the precedent of many operational examples, the GGSS is currently viewed as the principal incentive support scheme for waste anaerobic digestion.

The GGSS is supported by the Green Gas Levy (GGL) places obligations on licensed gas suppliers, including a requirement to make quarterly levy payments, in order to fund the GGSS.

Renewable Transport Fuels Obligation & Certificates

The Renewable Transport Fuel Obligation (RTFO) launched on April 15, 2008 and is one of the Government's main policies for reducing greenhouse gas emissions from transport. The RTFO achieves greenhouse gas emission savings by promoting the availability of renewable fuels for use in the UK transport sector. Under the scheme, suppliers of eligible fuel types (petrol, diesel, gas oil or renewable fuel) in the UK must meet an annual obligation using tradeable certificates which are awarded for the supply of sustainable renewable fuel. In 2023 the renewable fuel supported by the RTFO accounted for 7.5% of the total transport fuel supplied, delivering greenhouse gas savings of 7.9 million tonnes of CO_2e.

The RTFO applies to fuel obligated suppliers who own fossil and/or renewable transport fuel at the point that it becomes liable for HMRC fuel duty (the 'duty point') and the relevant fuel totals 450,000 litres or more for use in a relevant transport mode per year. An obligated fuel supplier can obtain Renewable Transport Fuel Certificates (RTFCs) either by suppling renewable fuels or by buying them from renewable fuel suppliers. Waste anaerobic digestion sites who do not meet the criteria for obligated suppliers and who produce a biomethane gas which can be used as a transport fuel can sell the gas and/or certificates to those obligated suppliers.

Unlike the GGSS which provides a fixed tariff over a defined duration, the RTFO scheme is a cap-and-trade scheme and the value of a certificate is subject to market forces. Furthermore, the price per certificate can vary in line with supply of renewable fuels and/or demand for certificates. This makes the price for certificates dynamic and at times has resulted in a very high certificate price at times where obligated vehicle fuel suppliers have a high demand for certificates. This impact of this potential variability in the value of RTFO certificates can be partially mitigated in circumstances where transport fuel is self-generated for use in fleets as additional benefits such as a reduction in fuel duty (by a magnitude of c.50%) can be claimed on biomethane fuels. Given this fluctuation, many operators producing vehicle fuel rely upon the GGSS as a base revenue option (where they are injecting into the gas grid to supply vehicle refuelling stations) and then switch to RTFC payments where the value of that incentive exceeds the GGSS level. This provides a beneficial uplift in the value received for gas.

3.0 ANAEROBIC DIGESTION IN THE UNITED KINGDOM

The UK has an overarching target to achieve net-zero greenhouse gas emissions by 2050, a legally binding commitment that is enshrined in the Climate Change Act 2008. Consequently, emissions must be reduced by at least 100% compared to 1990 levels, and as such, a clear rationale exists for the decarbonisation of gas infrastructure through the production of renewable energy through technologies such as anaerobic digestion.

In Spring 2025, the Anaerobic Digestion and Bioresources Association (ADBA), a UK-based trade associated that represents the AD and biogas sector – announced that the UK's AD sector currently comprises 756 operational plants, generating 2,987 megawatts of biogas capacity. Of these plants, 17% (c.130) produce biomethane to be injected into the gas grid; a collective quantum totalling 117,310m^3/hour. Research conducted by Alder Bioinsights (formerly NNFCC) concludes that there is sufficient sustainable feedstock available to generate 50 TWh of biomethane in 2030, and up to 120 TWh by 2050. 50 TWh of biomethane would represent up to 8% of the UK's gas demand and 120 TWh would represent between 20% and 90% of gas demand nationally, contingent on other factors such as the scale of electrification that occurs.

This section of the report introduces the current landscape of AD across the Midlands region. It commences with a review of existing operational infrastructure, providing information on installed (total) and utilised capacity, set against target material (feedstock) derived from household, commercial and industrial and agricultural sources. The work then proceeds to examine the growth potential of each feedstock sector, contextualised against policy initiatives relevant to the AD sector.

3.1 Current AD Midlands infrastructure – Food Waste

A review of existing operational infrastructure has been conducted to identify merchant facilities that are permitted to process food wastes and agricultural wastes (collectively termed "feedstock"). The term 'merchant AD facilities' is used within this report to describe pre-existing AD facilities that accept third party waste as part of a merchant contract. Under this scenario, the third-party waste is normally managed as a cost per tonne gate fee (£/t) at a rate agreed between the waste producer and the AD operator.

Accreditation to the PAS 110 standard is seen as a key requirement for local authorities in acclaiming attribution towards their food waste recycling rate, and the scheme administrator for the associated ADQP has a useful database of accredited sites (accessed April 2025). Research from this database has been supported by a review of the UK biogas plant map

(accessed April 2025), that is maintained by the Anaerobic Digestion and Bioresources Association (ADBA) and the Environmental Permit Register, from which permitted capacities for waste-fed facilities can be ascertained. The location of the sites is set out in Figure 1 with the application of the facility search set out in Table 1 and
Table 2.

Figure 1 - A map of operational AD facilities accepting food waste in the Midlands

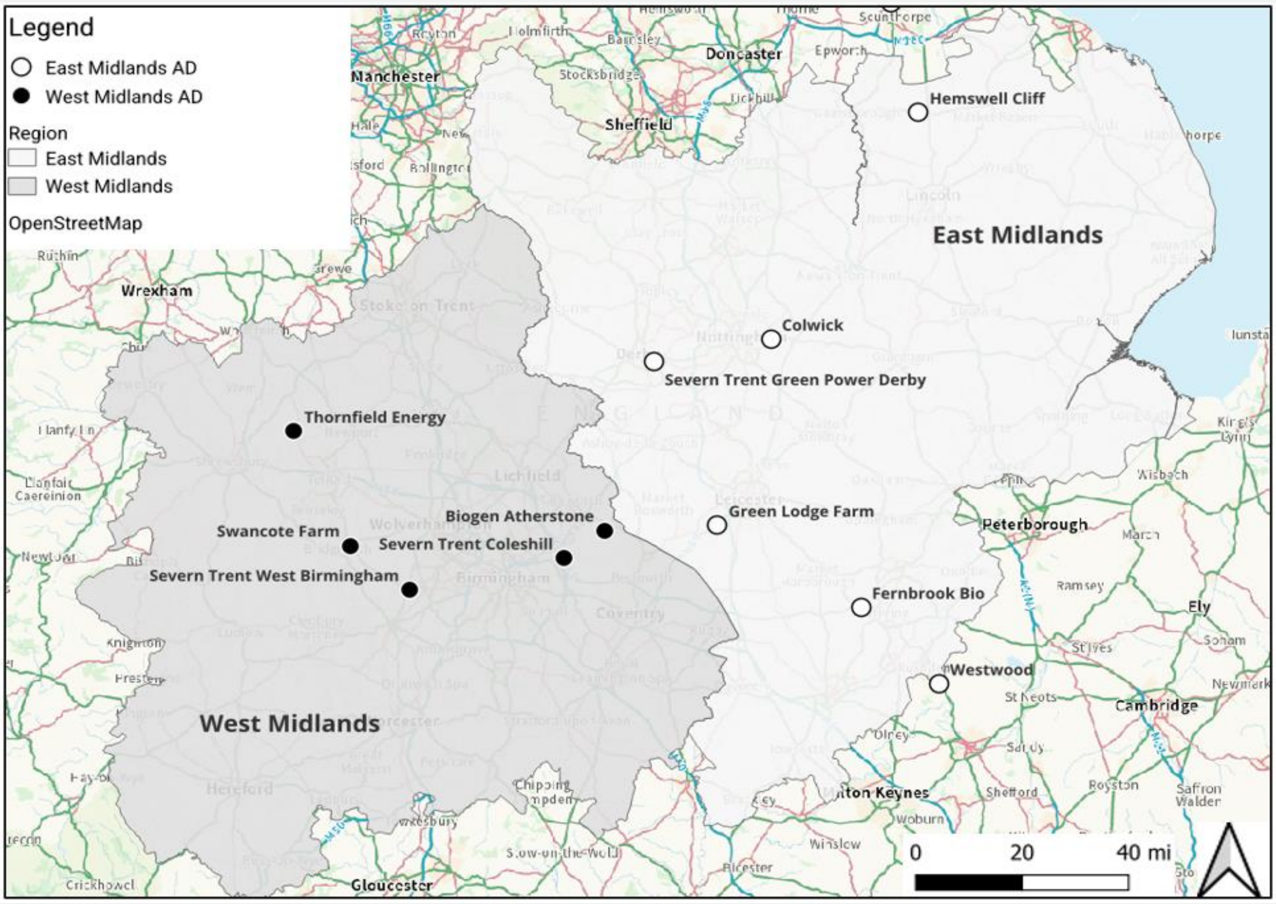

Table 1 -Operational AD facilities accepting food waste in the East Midlands

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
AC Shropshire	Green Lodge Farm	Green Lodge Farm, Forest Road, Huncote, Leicestershire, LE9 3LE	Blaby District Council	50,000	2.0
BioteCH4 Limited	Hemswell Cliffe	Helmswell Cliffe Anaerobic Digestion Facility, Gainsborough, DN21 5TU	West Lindsey District Council	145,000	3.6
Fernbrook Bio - Regen Holdings	Fernbrook AD Plant - Rothwell Lodge Farm - Fernbrook Bio	Rothwell Lodge Farm, Rothwell, Kettering, NN16 8XF	North Northamptonshire Council	100,000	1.6
Severn Trent Green Power	Severn Trent Green Power - Derby	Derby Treatment Works, Megaloughton Ln, Derby, DE21 7BR	Derby City Council	75,000	7.0
Biogen	Rushden - Westwood AD Plant	Bedford Road, Rushden, Northamptonshire, NN10 OSQ	North Northamptonshire Council	65,000	2.9
BioDynamic UK	Colwick Industrial Estate	Colwick Industrial Estate, Unit 1 Private Road, 4 Colwick Industrial Estate, Nottingham, NG4 2JT	Nottingham City Council	150,000	4
Total (Tonnes per annum)			**585,000**		**21.10**

Table 2 – Operational AD facilities accepting food waste in the West Midlands

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
BioteCH4 Limited	Thornfield Energy	Barnes Farm, Rowton Junction to Hillcrest Junction, Rowton, Telford, TF6 6QX	Telford and Wrekin Council	90,000	2.3
Swancote Energy Limited	Swancote Farm	Swancote Farm, Swancote, Bridgnorth, Shropshire, WV15 5HB	Shropshire Council	75,000	2.2
Severn Trent Green Power	West Birmingham AD Plant	Lloyd Way, off A449, Kinver, Stourbridge, DY7 6NZ	Dudley Metropolitan Borough Council	75,000	2.4
Biffa	Poplars Landfill and AD Facility	Lichfield Road, Cannock, Staffordshire, WS11 8NQ	Cannock Chase District Council	120,000	6.5
Severn Trent Green Power	Coleshill AD Facility	Marconi Way, Coleshill, Warwickishire, B46 1DG	North Warwickshire Borough Council	50,000	2.4

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Biogen	Biogen Atherstone (Merevale)	Merevale Lane, Baxterley, Atherstone, CV9 2LA	North Warwickshire Borough Council	45,000	2.7
Total (tonnes per annum)			**455,000**		**18.5**

The infrastructure analysis has identified 12 operational plants across the Midlands region, with a cumulative annual processing capacity exceeding 1 million tonnes per annum (1,040,000). 56% of this capacity is based in the East Midlands, with the remainder located in the West Midlands. It is noted that BioteCH4, Biogen and Severn Trent Green Power predominate the market structure, operating sites across both regions with a cumulative annual processing capacity of 545,000 tonnes, comprising some 52% of the total annual processing capacity of the Midlands region.

The electrical energy generation potential of food waste-fed plants across the Midlands region is an output of 39.60 MWe. For context, 1MWe can provide renewable power to approximately 2,000 homes for an hour[3], with some variance predicated on energy demand at certain times of the day. Applying this assumption, the electrical output stated here would be sufficient to power approximately 79,200 homes for one hour. Clearly, realising a maximum energy generation potential of 39.60 MWe is predicated on each plant running at near-maximum capacity at all times.

With the maximum annual processing capacity of food waste—fed plants now established, the work proceeds to estimate the indicative capacity utilisation of each AD plant; that is, the indicative quantum of tonnage that is physically processed through each plant, against their maximum capacity. Conducting such an exercise is useful for understanding the prevailing market for food-waste fed AD, and the level of competition that may exist between operational plants for target feedstocks.

To assess the utilisation of AD facilities in the Midlands, tonnage data has been reviewed from the 2023 Waste Data Interrogator (WDI). The WDI, published by the Environment Agency (EA), is a publicly available interactive spreadsheet that contains details of all wastes received and removed by permitted waste facilities in England and Wales. The tool is based on waste returns data, submitted by each regulated facility on an annual basis to the EA, and therefore provides a robust basis for market analysis for a given geography. Intel on known contractual arrangements where known is also supplied to provide context to the indicative capacity utilisation figures. The findings of this research are presented in Table 3 **Error! Reference source not found.**.

Table 3 - Capacity utilisation of established AD facilities accepting food waste within the Midlands region.

Operator	Site Name	Annual Permitted Capacity (Tonnes per annum)	Wastes Received – 2023 (Tonnes per annum)	Indicative capacity utilisation (%)	Known intel and comments
East Midlands					
AC Shropshire	Green Lodge Farm	50,000	30,900	62	Degree of indicative capacity available.
BioteCH4 Limited	Hemswell Cliffe	145,000	118,863	82	Contracted to process 50,000 tonnes of food waste per annum from Lincolnshire County Council from 2025 to 2034 (expected).
Fernbrook Bio - Regen Holdings	Fernbrook AD Plant - Rothwell Lodge Farm - Fernbrook Bio	100,000	28,642	29	Hold a contract for the processing of North Northants Kitchen Food Waste (March 2025 – March 2028).
Severn Trent Green Power	Severn Trent Green Power - Derby	75,000	18,915	25	Re-opened in October 2023 following extensive refurbishment. Awarded food waste processing contract from Derby Dales District Council (1,300 tonnes per annum), between 2024 and 2026.
Biogen	Rushden - Westwood AD Plant	65,000	53,139	82	Indicative available capacity appears to be limited.

[3] Ofgem. No Date. Electricity generation: facts and figures. [Accessed 14th May 2025] Available from: https://www.ofgem.gov.uk/sites/default/files/docs/2006/04/13537-elecgenfactsfs.pdf

Operator	Site Name	Annual Permitted Capacity (Tonnes per annum)	Wastes Received – 2023 (Tonnes per annum)	Indicative capacity utilisation (%)	Known intel and comments
BioDynamic UK	Colwick Industrial Estate	150,000	34,666	23	Good level of indicative capacity available.
Totals		**585,000**	**285,125**	**49 (Average)**	
West Midlands					
BioteCH4 Limited	Thornfield Energy	90,000	107,886	120	Current treatment facility for a proportion of Staffordshire County Council's food waste under a framework supplier agreement.
Swancote Energy Limited	Swancote Farm	75,000	49,282	66	Degree of indicative capacity available.
Severn Trent Green Power	West Birmingham AD Plant	75,000	57,670	77	Degree of indicative capacity available.
Biffa	Poplars Landfill and AD Facility	120,000	68,675	57	Current treatment facility for a proportion of Staffordshire County Council's food waste under a framework supplier agreement.
Severn Trent Green Power	Coleshill AD Facility	50,000	60,412	121	Apparent capacity over-utilisation. Processes 20,000 tonnes of food waster per year from Warwickshire Councils between February 2024 and February 2034 (anticipated).
Biogen	Biogen Atherstone (Merevale)	45,000	39,759	88	Indicative available capacity appears to be limited. Current treatment facility for a proportion of Staffordshire County Council's food waste under a framework supplier agreement. The facility will also service Coventry City Council's food waste treatment contract, due to start on the 1st April 2026.
Totals		**455,000**	**383,684**	**84 (Average)**	

Table 3 shows that some 668,809 tonnes of material were received for processing at the above facilities across the Midlands region. Effective capacity utilisation of the East Midlands region stands at 49%, whilst effective capacity utilisation in the West Midlands region stands at 84%.

Overall merchant AD capacity utilisation in the Midlands region stands at 67%. This finding infers that spare capacity presently exists, predominantly within the East Midlands region. The mandatory expansion of household and C&I food waste collections that is being introduced provides an opportunity for existing AD capacity to be better utilised, and for additional infrastructure to be developed to respond to increase treatment demand. The growth potential of these markets is discussed in latter sections of the report.

3.2 Agricultural Waste

The UK biogas plant map was again consulted to identify operational plants within the region that process agricultural feedstocks. The review identified 91 plants within the Midlands region, with a cumulative processing capacity of 2,733,099 tonnes per annum, and an energy generation potential of 59.12 MWe for the electricity grid. A full list of plants is presented in Appendix 1.

It should be noted that 950,000 tonnes of capacity is held collectively by nationwide food producers McCain and Princes, both of which process agricultural wastes generated from the food manufacturing processes at their central manufacturing facilities. Waste management company Veolia also operates a 250,000-tonne AD plant on behalf of brewing company, Heineken which processes apple pomace, generated through the apple pressing process from cider making. When this processing capacity is subtracted from the region’s cumulative processing capacity, the balance of capacity stands at 1,533,099 tonnes per annum.

The dynamics of feedstock markets for food waste when compared with agricultural wastes are very different. Food waste feedstock – if derived from local authority municipal collections – is typically secured by an AD facility as a result of a competitive tender exercise, conducted in accordance with the Procurement Act 2023. Conversely, agricultural plants typically buy in feedstock or receive manures and slurries, of which there is an abundance. As a result, capacity utilisation is not considered an issue for plants of this nature.

3.3 Treatment in the wastewater sector

Anaerobic digestion is the most prevalent form of treatment for sewage sludges, and infrastructure developed at wastewater treatment is comparable to a food waste treatment facility.

A review of the AD plant database identified 34 operational plants within the Midlands region, with a cumulative maximum processing capacity of 4,358,381 tonnes per annum, and a cumulative electrical energy generation potential of 39.72MWe. Of those plants, Severn Trent

Water (STW), the sewerage undertaker for the majority of the Midlands region, operate 85% (29) of those assets, including the Minworth Sewage Treatment Works, STW’s largest renewable energy asset, with a maximum processing capacity of 1,091,544 tonnes of feedstock per annum. The remaining assets are operated by Anglian Water (3 sites), Welsh Water and Yorkshire Water (1 site each), with cumulative maximum processing capacities of 575,093, 215,454 and 65,339 tonnes per annum respectively. The full list of Sewage AD treatment sites located in the Midlands region is presented in Appendix 2.

Notably, the West Birmingham AD facility, is co-located with the Roundhill Sewage Treatment Works. Operated by Severn Trent Green Power, the facility processes a range of municipal waste feedstocks but would not be considered suitable for the co-digestion of wastewater, despite the commonality in treatment technology employed. This is due to several regulatory hurdles, as described below:

1. Environmental regulatory regimes prevent the physical mixing of materials. The pathogen risk of the respective materials differs and consequently sewage sludge is not permissible in the PAS110 standard, and food waste is not permitted in the safe sludge matrix/sludge to agriculture regulations. This challenge can be overcome by designating segregated digestion lines in a sludge treatment facility; however,

2. OFWATs financial regulatory rules place limitations on the use of wastewater assets for commercial uses such as the treatment of third-party waste (e.g. local authority area food waste). The premise here is that assets subsidised by water bill payers cannot be used to generate commercial revenues unless the benefits of those revenues are passed back to those bill payers. To a degree, this diminishes the incentive of water companies to explore the commercial usage of available assets. One option that has been deployed by some water companies has been for the non-regulated/commercial arm of water companies to lease digestion assets from the regulated arm of the business at a market tested rate.

If the above challenges are overcome, water companies typically focus on gas and/or electricity production for energy use for water treatment processes, which may limit opportunities to develop circular solutions/adjacencies of AD that have been described in this report.

3.4 Energy Flow Assessment

Using the total estimates of household, commercial and industrial food waste tonnages, the following section assessed the potential to displace natural gas consumption with biomethane in the East and West Midlands. Furthermore, this section aims to quantify both the energy substitution potential and associated greenhouse gas (GHG) emissions benefits under various feedstock utilisation scenarios.

A summary of the approach that has been undertaken is described below:

1. **Household Baseline Determination:** 2021 census data, published by the Office for National Statistics (ONS), has been used to establish the total number of domestic households across the East Midlands and West Midlands regions;
2. **Households Not Connected to the Gas Grid:** a number of properties in the UK are not connected to the gas grid and would be unaffected by additional biomethane injected into the gas grid. Therefore, regional factors have been applied to account for the proportion of households in East Midlands and West Midlands that are not connected to the gas grid. The factors used are from the dataset titled *"subnational estimates of domestic properties not on the gas grid, Great Britain, 2015 - 2023"*, published by the Department for Energy Security and Net Zero (DESNZ);
3. **Total Domestic Gas Consumption:** total domestic gas consumption (kWh per annum) for the Midlands regions has been extrapolated from the publicly available dataset titled *"Subnational gas consumption, Great Britain, 2005 - 2023"* - published by DESNZ. These figures of gas consumption were then divided by the number of households connected to the gas grid to provide a gas use per household (kWh/HH/annum) within the area of search;
4. **Biomethane produced from Commercial and Industrial Feedstocks:** the propanated biomethane energy content has been calculated through an area wide mass balance model created by WRM. The mass balance model utilises the estimated C&I and household food waste tonnages, as calculated in section 6.1 and 6.2, and applies a range of technical and digestion factors. The energy content of the biomethane produced has then been applied to the gas use per household to understand the number of properties that can be supplied by biomethane produced from commercial and industrial feedstocks from the West and East Midlands;
5. **Carbon Savings** carbon savings have been calculated by applying relevant factors from *The UK Government Conversion Factors for greenhouse gas (GHG) reporting,* published by DESNZ in 2024.

The key input parameters for the energy flow assessment are presented in Table 4 **Error! Reference source not found.** below.

Table 4 - Technical inputs for energy flow assessment

Parameter	Value	Unit	Comments
Total propanated biomethane energy per annum (HH + C&I Waste)	642,506,034	kWh	WRM mass balance, based on HH + C&I food waste arisings. Assumes that 30% of biogas is used to meet the parasitic load of the facility, and the remaining 60% is further treated prior to injection into the gas grid.
No. Households East Midlands	2,037,332	No.	ONS 2021 Census
No. Households West Midlands	2,429,494	No.	ONS 2021 Census
Percentage of properties note connected to grid West Midlands	12.5%	%	Based on *"subnational estimates of domestic properties not on the gas grid, Great Britain, 2015 - 2023"*, published by DESNZ.
Percentage of properties not connected to grid East Midlands	11.4%	%	Based on *"subnational estimates of domestic properties not on the gas grid, Great Britain, 2015 - 2023"*, published by DESNZ.
Total gas consumption West Midlands (Domestic)	21,939,000,000	kWh	Based on *"Subnational gas consumption, Great Britain, 2005 - 2023"* - published by DESNZ
Total gas consumption West Midlands (Domestic)	25,998,200,000	kWh	Based on *"Subnational gas consumption, Great Britain, 2005 - 2023"* - published by DESNZ
Scope 1 Natural Gas CO2e	0.18449	CO2e/kWh	Factors from the *UK Government Conversion Factors for greenhouse gas (GHG) reporting*, published by DESNZ in 2024.

Parameter	Value	Unit	Comments
Scope 1 Biomethane CO2e	0.0003825	CO2e/kWh	Factors from the *UK Government Conversion Factors for greenhouse gas (GHG) reporting*, published by DESNZ in 2024.
Out of Scope Biomethane CO2e	0.199007841	CO2e/kWh	Factors from the *UK Government Conversion Factors for greenhouse gas (GHG) reporting*, published by DESNZ in 2024.

Table 5**Error! Reference source not found.Error! Reference source not found.** displays the results of the energy flow assessment, highlighting the number of properties that could be supplied by biomethane produced from anaerobic digestion of C&I and household food waste collected from within West Midlands and East Midlands.

Table 5 – Results from the energy flow assessment

Parameter	Value	Value	
		East Midlands	West Midlands
No. Households	No.	2,037,332	2,429,494
Percentage of Households that are off grid	%	13%	11%
No. Households Connected to the grid	No.	1,781,851	2,152,532
Total Gas Consumption (all households) per annum	kWh	21,939,000,000	25,998,200,000
Total Gas Consumption per household per annum	kWh	12,312	12,078
Total Propanated biomethane energy per annum (HH + C&I waste)	kWh	642,506,034	
No. Households supplied with Biomethane	No.	26,343	
Scope 1 emissions if supplied by natural gas	$kgCO_2e$	59,267,969	
Scope 1 emissions if supplied by biomethane	$kgCO_2e$	122,879	
Carbon Savings of biomethane to 26,343 properties compared with natural gas	$kgCO_2e$	59,145,090	
Out of scope emissions (biomethane)	$kgCO_2e$	63,931,869	

The results of the energy flow assessment within **Error! Reference source not found.** d emonstrates that if low capture rate scenario of the HH and C&I food waste tonnage estimates are processed through anaerobic digestion then this would produce sufficient quantities of biomethane to meet the gas demands of 26,343 domestic properties per annum (mostly for cooking and heating). The injection of biomethane into the gas district network would begin to displace the fossil fuel derived natural gas prevailing within the system. Furthermore, the gas energy demand of these properties would instead be met by renewable biomethane, a renewable energy alternative to the fossil fuel derived natural gas.

The displacement of fossil fuel derived natural gas equates to carbon savings of 59,145,090 kgCO_2e of scope 1 emissions. The DESNZ conversion factors guidance sets the CO_2 emissions value for Scope 1 biomethane as net '0' to account for the CO_2 absorbed by fast-growing bioenergy sources during their growth. Moreover, the CO_2e Scope 1 conversion factors for biofuels are limited to values for N_2O and CH_4 emissions (which are not absorbed during growth) and exclude CO_2. Although the Scope 1 conversion factors contain a '0' value for CO_2 emissions, the DESNZ guidance notes that organisations must account for the impact of the CO_2 released through combustion. However, the guidance notes that this should not be included within the emissions total but instead displayed separately within the emissions report for the purposes of transparency.

3.5 Planned infrastructure

Understanding where planned AD infrastructure is due to be sited is integral in contextualising the capacity, competition and feedstock dynamics of an area. The process also provides an opportunity to understand certain planning constraints or items of sensitivity that may influence the determination process, including for any facility developed in the future by MNZH partners. Such factors may include, but not be limited to:

- Number of vehicle movements to and from the permitted facility per annum;
- Restrictions on waste delivery hours to minimise fugitive emissions such as noise; and/or,
- A requirement to complete specific risk assessments prior to full operation.

A review of local authority planning portals and the ADBA *database of active and planned plants in the UK* has been conducted, which estimates future known AD capacity growth. The review noted several legacy applications that have been granted planning approval, but do not appear to have been developed, and have therefore been excluded from review. Notably, the build time of an AD facility can range from six to twenty-four months, predicated on factors such as the size of the plant, its configuration and complexity, and lead time for equipment Consequently, only facilities that have been granted planning permission from 2023 onwards have been considered within Table 6.

Table 6 - Planned AD capacity within the Midlands region

Operator/Applicant	Site Name and Plant Location	Local Authority Area	Input Feedstock	Projected Capacity (Tonnes per annum)	Relevant Planning History
Manby BGE	Land at Manby Airfield, off Manby, Middlgate, Manby, LN11 8UZ	East Lindsey District Council	Straw-based cattle manure, Chicken litter and straw from farms.	304,000	**December 2023 –** Planning permission granted. Construction started in Q1 of 2025 and is expected to be completed Q3 in 2026.
Ironstone Energy Limited	Development East of Sewstern Industrial Estate, South of Sewstern Road, Gunby, Lincolnshire NG33 5RD.	South Kesteven District Council	Energy crops: Maize, Grass, Rye.	180,000	**January 2025 –** Planning permission granted for the erection of an AD facility with carbon capture technology.

The search returned two proposed developments, both sited within the county of Lincolnshire, with a cumulative processing capacity of 484,000 tonnes per annum of received agricultural wastes. Whilst the search yielded no results pertaining to planned developments processing food waste, WRM are aware of one development for which feasibility is being investigated. This is summarised below:

- **Dark Green Group** – Plan to develop 12 AD plants over the next five years at several urban industrial sites, including at Tyseley Energy Park in Birmingham. It is hope that the sites together could process over 700,000 tonnes of organic waste per year and power up to 80,000 homes with green gas.

4.0 AD TECHNOLOGY

This section of the report introduces two potential anaerobic digestion technologies for food waste processing: wet AD and dry AD. An overview of thermal hydrolysis is also provided, which can be used in conjunction with anaerobic digestion technology.

4.1 Context – AD a widely applied technology

Anaerobic digestion is a biological process that breaks down organic matter in the absence of oxygen, producing biogas (primarily methane and carbon dioxide) and digestate (a nutrient rich residue). Anaerobic digestion is a proven and well-established technology. As of 2024, the United Kingdom has approximately 756 operational plants, according to the Anaerobic Digestion and Bioresources Association (ADBA). These facilities process around 36 million tonnes of organic waste annually, converting it into approximately 21 terawatt hours (TWh) of biogas. This biogas is utilised for electricity and heat generation or upgraded to biomethane for injection into the national gas grid.

The 756 AD facilities in the UK target various feedstocks, as follows:

- **Waste Water Treatment** According to the European Biogas Association (EBA) country profile on the UK, the water industry has 146 biogas plants installed at wastewater treatment sites across the country, processing around 1.6 million tonnes of sludge annually;
- **Agricultural** or "farm-fed" AD facilities utilise feedstocks such as manure, slurry, purpose grown crops, waste crops and agricultural residues such as crop stalks, straw. According to DEFRA there were 408 operational farm fed AD facilities within the UK in 2023. The 2023 Farm Practices Survey indicates that 9% of UK farms were processing organic materials through anaerobic digestion; and,
- **Waste:** According to DEFRA there are 202 waste fed AD facilities currently in operation. Waste fed AD facilities include food waste derived from households, restaurants, and food industries. Other category 3 Animal By-Products, like edible animal parts rejected for commercial reasons, milk, or low-risk abattoir waste, can be used in anaerobic digestion.

Figure 2 below provides a breakdown of the proportion (%) of agricultural and non-water waste feedstock tonnages processed by anaerobic digestion facilities in the UK.

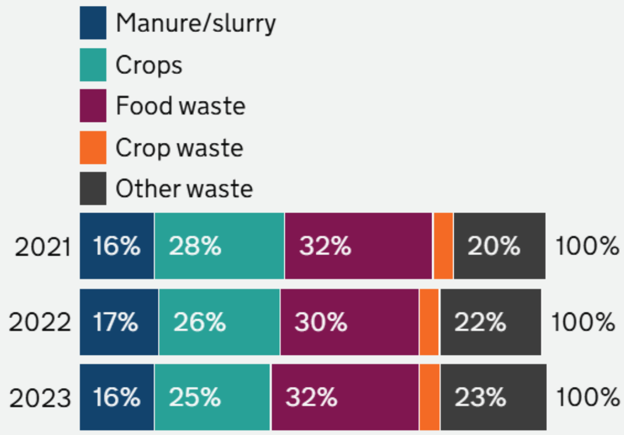

Figure 2 - use of feedstocks in operational AD plants by feedstock tonnage per annum, 2021 to 2023 Source: DESNZ. Agricultural Facts Summary [4]

4.2 Wet AD

'Wet' or conventional anaerobic digestion remains the most prevalent method of anaerobic digestion in the organic waste sector. Since the UK government introduced the Anaerobic Digestion strategy and Action Plan in 2009, the number of anaerobic digestion plants in the UK has increased significantly.

Wet anaerobic digestion systems are designed to process biodegradable feedstock into a digestate pumpable substrate that typically has a consistency of less than 15% dry matter content. If processed through a pre-treatment phase, several waste streams can be processed through wet anaerobic digestion.

Household, Commercial & Industrial Food Waste

Approximately a quarter of existing anaerobic digestion plants process municipal food waste, and the technology is established and recognised as the predominant technology for food waste treatment. When passed through a pre-treatment phase, source segregated household food waste can be effectively processed to create a number of outputs, depending upon plant configuration. Outputs include power and heat from the combustion of biogas in a gas engine, biomethane, digestate in either a whole or liquid and fibre fraction, contamination that has been screened out during the waste acceptance process, and other products such as CO_2.

The typical configuration of a wet anaerobic digestion plant capable of processing municipal food waste is as follows:

[4] Figure extracted from from *Bioenergy Crops in England and the UK: 2008-2023 (DEFRA, 2024).*

- **Reception and pre-treatment** – upon receipt at the anaerobic digestion plant, food waste feedstocks are inspected and passed through a pre-treatment line to remove physical contamination which in the municipal stream can include any inorganic substance such as packaging, cutlery, and non-biodegradable liners. The pre-treatment phase also monitors and controls dry matter content and dilutes this as required;

Figure 3 - Food waste de-packaging line receiving food waste at an anaerobic digestion site

- **Intermediary storage and blending** – pre-treated feedstocks are then commonly held in buffer tanks which allows different types or batches of feedstock to be blended. Anaerobic digestion systems benefit from a homogenous and consistent feed which is the purpose of this process phase. The feedstock substrate is often pre-heated in this phase ahead of feeding into the digestion tanks;

- **Anaerobic digestion** - the substrate is pumped into digestion tanks (Figure 4) maintained under anaerobic conditions where it is heated and stirred to prevent suspended solids from precipitating. Four cultures of microbes break down the organic matter, firstly into amino acids, which are then respired into methane gas which rises through the substrate enabling collection at the top of the tank. The substrate has a residence ranging from around 35-75 days depending on factors such as the temperature that the tank is maintained at and the rate at which the bacteria extract the biogas from the substrate;

Figure 4 - Wet anaerobic digestion tanks

- **Biogas and/or biomethane lines** – the methane rich biogas generated by the microbial activity is collected at the top of the digester, often in supported gas domes that give anaerobic digesters their characteristic appearance. A gas blower or compressor is then used to deliver the generated biogas into the gas treatment line. The raw biogas collected from the digester contains 60% methane with the remainder being a mixture of carbon dioxide, hydrogen sulphide and water vapour, and the gas treatment line seeks to remove contaminants, primarily the Hydrogen Sulphide which give the gas acidic and corrosive properties. A range of technologies and processes can be employed within this phase including water scrubbing, carbon filtration, and/or condensing. Following initial treatment, biogas can be combusted in a gas engine to produce power and heat; the latter in the form of hot water. Alternatively, the cleaned biogas can undergo further upgrading through filtration, odorant application and pressurisation to produce biomethane that meets the gas grid specification. Connecting the plant to a proximate gas grid connection then enables the bio-methane to be exported for use in place of fossil fuel sources of methane gas;

Figure 5 - Gas cleansing membranes converting raw biogas to biomethane

- **Pasteurisation** – following digestion, the liquid substrate is passed through a pasteurisation phase in which the material is held at a temperature of 70^{o}C for a minimum of one hour. The pasteurisers are shown below in Figure 6. This achieves a pathogen kill for species such as Salmonella and E.coli, which may be present in the food waste feedstock. The pasteurisation phase can occur before digestion as well, known as ‘pre digestion pasteurisation’. Following a sieve test or screen for contamination, the substrate is sent as digestate for storage;


Figure 6 - Pasteurisers treating food waste following digestion

- **Digestate processing and/or storage** – the raw substrate produced by the plant is referred to as digestate which is used as a nitrogen rich fertiliser in agriculture and field grown horticulture. Digestate may be stored at the processing site for a further residence time to collect any residual biogas, and for any further processing to take place. This can include separation of the whole digestate into a liquor and fibre fraction, although this practice is more commonplace in plants that process agricultural inputs.

The processes described above of reception, pasteurisation and digestion are applicable to all wet anaerobic digestion facilities that process food waste in the UK, although the selection and proportion of intended outputs such as bio-CNG, Carbon Dioxide and biomethane to grid can vary between anaerobic digestion systems. For example, an anaerobic digestion facility may be configured to provide high amounts of bio-CNG where vehicle demand is high. In another region, bio-CNG may not compatible with the vehicle fleet accessing the facility and the facility may instead decide to utilise 100% of bio-methane through injection into the gas grid network. Additionally, the annual processing capacity of wet anaerobic digestion systems is often heterogenous and it is not uncommon to see anaerobic digestion facility processing capacities range from 25,000 tpa to nearly 210,000 tonnes per annum.

Agricultural / Farm fed and Wastewater

The process stages for agricultural AD and wastewater AD broadly reflect the process described above for food waste, although with several key differences. Table 7 provides an overview of the key differences between the processing methods of these feedstocks.

Table 7 - Comparison of AD Facility Types

Parameter	Waste-fed AD	Agricultural AD	Wastewater AD
Primary Feedstocks	Food waste, C&I waste, ABPs, packaged & non packaged materials	Manure, slurry, silage, energy crops	Sewage sludge from wastewater treatment
Feedstock Regulation	Animal By-Products (ABP) Regulations. Animal and Plant Health Agency approval before feedstock processing can commence.	ABP regs may apply (if taking food/animal by-products). Animal and Plant Health Agency approval before feedstock processing can commence.	Regulated under water and sludge treatment standards
Pasteurisation required	Yes – to achieve relevant EU standards concerning pathogen kill (E.coli and salmonella).	No if only farm materials. If plant also accepts food waste: yes - to achieve relevant EU standards concerning pathogen	No, alternative heat treatment phase

Parameter	Waste-fed AD	Agricultural AD	Wastewater AD
		kill (E.coli and salmonella).	
Typical Operator	Commercial AD companies, local authorities. Often larger scale plants (>.80,000 tonnes per annum processing capacity to reflect treatment demand).	Farmers. Often smaller scale or micro-plants (<20,000 tonnes per annum processing capacity to meet on farm requirements).	Water companies – Abundant and/or large scale to meet sewage treatment requirements of customers.
Digestate Use	Fertiliser (if PAS 110 compliant – achieves end of waste status).	Biofertiliser spread on fields.	Often incinerated or undergoes further processing/refinement.
Main Objectives	Waste diversion, energy recovery, gate fee revenue. Renewable energy generation incentive payments.	Manure management, farm energy generation, nutrient recycling.	Sewage treatment, energy recovery, compliance.
Typical input contaminants	Packaging and plastics. Equipped with a de-packaging line to remove packaging at the front end. Screening apertures through feedstock processing phase to remove contaminants.	Minimal - removes the requirement for a de-packaging line at the front end of the process.	Grit, heavy metals, microplastics. Screening apertures through feedstock processing phase to remove contaminants.
Digestate restrictions	Must meet PAS 110 standards to be land-applied safely under end-of-waste regulations. Spread in accordance with the Farming Rules for Water (Reduction and Prevention of Agricultural Diffuse Pollution Regulations 2018).	Typically spread on site or nearby land. Spread in accordance with the Farming Rules for Water (Reduction and Prevention of Agricultural Diffuse Pollution Regulations 2018).	More limited use due to contaminant risk.

4.3 Wet AD Process Outputs

As discussed above, the outputs from the anaerobic digestion process, depending upon the specific anaerobic digestion plant configuration, are the following:

- **Electricity and heat** – from the combustion of biogas in a gas engine;
- **Biomethane** – where biogas is upgraded to remove the non-methane components of the biogas leaving only methane gas capable of being injected into the transmission grid;
- **Bio-CNG** – where biogas is upgraded to biomethane and further compressed and cooled to become biogenic compressed natural gas (CNG) which can be used as an alternative transport fuel;
- **Digestate** – in either a whole or separated liquid and fibre fraction. Digestate produced in line with the PAS110 and Digestate Quality Protocol standard meets end of waste criteria, which means that waste regulatory controls cease to apply;
- **Contamination** – inorganic substances within the feedstock that has been screened out during the waste acceptance process; and,
- **Carbon dioxide** – removed during biogas upgrading and can be captured for use in applications such as glasshouse horticulture. Identifying and accessing a viable market if often a challenge with this output, and it may instead be vented to atmosphere.

4.4 Dry AD

The concept of Dry AD refers to a set of treatment processes targeted at materials with a significantly higher solids content; typically in excess of 15% dry matter content. This makes the technology well suited to the processing of stackable materials, such as the collection of food and garden wastes within a comingled waste stream. The technology has also been deployed in the treatment of organic fines fractions that are generated by residual waste treatment processes (e.g. mechanical biological treatment).

Dry AD is less deployed than its wet AD counterpart, with just four plants within the UK. The low level of deployment of this specific technology within the UK often results in the perception that the technology is novel, or innovative, although the reality is that the technology has been operating over a number of decades across continental Europe. Previous Dry AD feasibility projects conducted by WRM have highlighted that leading engineering companies such as Eggersmann, Hitachi and Waste Treatment Technologies offer dry AD solutions which are supported by a strong list of reference projects and substantive process guarantees, thereby providing a good level of confidence that the technology can be deployable in the UK market.

Unlike wet AD systems, dry anaerobic digestion can operate on either a continuous feed plug-flow basis, or on a batch basis. In the former, the substrate is mechanically moved horizontally through the digester via augers or baffles, whilst the batch system uses a tunnel design into which feedstock is loaded and removed; in a similar way to in-vessel composting. Figure 7 illustrates the two types of dry anaerobic digestion system design; a batch processing system and horizontal plug-flow system.

Figure 7 - Dry anaerobic digestion systems: (L) batch-based tunnel digester; and, (R) horizontal continuous plug-flow digester

The general process phases occurring within these variants of dry AD broadly follows that of the wet anaerobic digestion system, but the key differences at each process stage are outlined below:

- **Reception and pre-treatment** – received co-mingled wastes are shredded to the target particle size alongside contamination removal;
- **Intermediary storage and blending** – in dry anaerobic digestion this can include blending fresh feedstock with re-circulated substrate to boost the presence and rate of microbial activity on the incoming material;
- **Pasteurisation** – stabilisation and pathogen kill within the substrate can be achieved through a number of different approaches including further tunnel treatment, composting or steam treatment. As with wet AD, pasteurisation can either occur prior to anaerobic digestion (pre-digestion) or following anaerobic digestion (post-

digestion), although the stage in the overall process within which pasteurisation occurs is contingent on the plant design and configuration;

- **Anaerobic digestion** – the process of anaerobic digestion is supported by the re-circulation of process liquor in which microbial cultures are held. Gas is collected within the digestion chamber, and also from intermediary storage tanks that re-circulate the process liquor;
- **Biogas and/or biomethane lines** – following gas collection, the cleaning and upgrade systems are the same as for wet anaerobic digestion;
- **Post AD conditioning** - Following primary anaerobic digestion, the homogenous organic output is loaded into In-Vessel Composting style tunnels for conditioning over a residence time of c.3 days. This conditioning phase reduces the moisture content of the digestate portion, and also captures ammonia emissions from the organic material;
- **Digestate processing and/or storage** – the output produced from a dry AD process resembles compost in its character and composition and requires further aerobic composting prior to being exported from the site for use in agriculture. The treatment process results in the creation of a product that meets the end of waste criteria for PAS 110.

The process outputs from dry anaerobic digestion are the same as those listed for wet AD, noting the key difference in digestate character which resembles an output similar to compost rather than liquid digestate.

4.5 Case studies

In addition to providing a technical description of each variant of AD, this project has also compiled three case studies which provide further insight to MNZH and its partners on the type and scale of AD facility deployed across the UK.

Case Study	**Small scale slurry digestion aligned to a single farm scale** 

	Small scale digester integrated within farmyard
Site	Moorhayes Farm
Operator	Keen's Cheddar
Location	Wincanton, Somerset
Feedstock	Dairy slurry & cheese whey
Outputs	44kW renewable electricity plus heat in the form of hot water
Detail	Keen's Cheddar are a premium producer of west country farmhouse cheddar cheese and supply products to retailers such as Waitrose. The creamery is adjacent to the dairy farm with the two operations producing a waste stream that combines dairy cow slurry and cheese whey permeate. This waste stream had historically been applied to land as a fertiliser until the company considered a small-scale anaerobic digester for the treatment of the waste. A Biolectric anaerobic digester was installed at the site in 2016 to capture methane rich biogas from the slurry and whey waste stream. The liquid characteristics of the waste stream enables fully automated loading of the digester, with the waste feedstock being pumped from a sump which in turn receives the waste streams. The single tank, which has a diameter of c.15 meters is fully integrated into the farm and is positioned next to an existing slurry tower. The digester provides a residence time of around 20 days for digestion of the slurry and whey waste stream and offers a biogas yield in the region of 25-30m^3/tonne of feedstock. Biogas produced by digestion is combusted in a small CHP which produces 44kW^e of power and heat in the form of hot water. Power is used to power farm machinery and the hot water is used as process heat in cheese making and for washing down tanks and equipment. The resulting digestate is then spread to grassland as a fertiliser. The scale of the slurry digester is well matched to Keen's energy requirements and has significantly reduced imported electricity and use of kerosene heating fuel. The anaerobic digester is part of the company's wider sustainability approach which also includes a variety of habitat initiatives.

	Mixed agricultural AD with a focus on manure feedstock
Case Study	 *Poultry litter, pig manure and apple pomace (l-r) awaiting digestion*

Site	Barley Brigg
Operator	Barley Brigg Biogas
Location	Eye, Suffolk
Feedstock	Pig manure, poultry litter, straw residues, cider apple pomace, grass silage, maize silage
Outputs	1.1MW electric plus heat
Detail	The Barley Brigg Biogas plant has been developed alongside existing agricultural enterprises, and is an excellent example of integration into a mixed (arable and livestock) farming operations. The plant processes around 30,000 tonnes per annum of feedstock which comprises poultry litter, straw mixed pig manure and apple pomace, a residue from local cider pressing. The energy potential of the feedstock is further boosted through an amount of locally grown whole crop maize being incorporated into the feedstock mix along with waste straw. The latter is a key ingredient in the feedstock mix as it provides a good source of carbon to complement the high nitrogen content of the poultry and pig manures. Rainwater is collected from hardstanding's around the farm to balance the moisture content of the feedstock. Biogas generated by the digester is combusted in CHP engines which produce 1.1MW of power. Heat from the engines is captures and used in a variety of co-located agricultural operations including crop drying, and the production of straw pellets for use in biomass boilers or as cat litter. Digestate from the anaerobic digester is applied to the extensive arable land holding as a biofertiliser. Barley Brigg provides an excellent example of integration of AD into mixed arable and livestock farm operations. Operationally, the site demonstrates how high nitrogen feedstocks such as manures and poultry litter can be processed successfully without encountering ammonia inhibition issues.

Case Study	**Food & beverage manufacturing wastes**  *Brewdog brewery anaerobic digestion plant*
Site	Ellon Brewery
Operator	BrewDog

Location	Aberdeen, Scotland
Feedstock	Brewery wastewater, spent yeast.
Outputs	23,000MWh biomethane
Detail	The Brewdog Brewery at Ellon, Aberdeen is reported to produce some 200,000 litres of wastewater each year from brewing operations. This effluent, along with spent brewing grains provides the feedstock for an anaerobic digester that is co-located at the brewery site. The development of the anaerobic digester represented a £12 million investment for the company. As an integral part of the brewery process, the digester is dedicated to treating brewery wastes and does not process any third-party materials. Biomethane produced by the plant is combusted in biogas boilers to produce process heat for the brewing process, with surplus gas being upgraded and compressed to fuel the distribution fleet. Any further biomethane will be injected into the gas grid for use by local homes and businesses. The project has made a substantive contribution to BrewDog's wide ranging sustainability programme and is set to reduce emissions at the site by more than 7,500 tonnes annually once the plant is running at full capacity

Case Study	**Mixed municipal wastes**  *Delivery of food waste to West Birmingham Biogas*
Site	West Birmingham Biogas
Operator	Severn Trent Green Power
Location	Roundhill, Stourbridge
Feedstock	Food waste from municipal, industrial (food manufacture) and commercial sources
Outputs	Biomethane, power and heat, PAS110 certified digestate
Detail	Severn Trent Green Power's West Birmingham Biogas Plant processes a range of municipal waste feedstocks. This includes household collected wastes from several local authority collections as well as bulk food wastes generated by local food and drink manufacturing processes. A number of

	commercial waste collectors also deliver to the site, tipping food wastes generated by the retail, wholesale, food service and hospitality sectors. Received wastes are first passed through a de-packaging unit to removed physical contamination. This is predominantly packaging materials as well as items such as cutlery which are often accidentally disposed into the food waste stream. The site is permitted to receive and treat up to 75,000 tonnes of food waste per annum. The blended food waste is then digested to produce biomethane which is initially used in an onsite CHP to support the energy requirements of the plant. The bulk of generated biomethane is then injected into the gas grid. The site also produces as PAS110 certified digestate which is supplied as a biofertiliser to local agricultural markets. The attainment of the PAS110 and associated digestate quality protocol are vital to the management of municipal food waste as only materials treated to this standard can be claimed by a local authority as being 'recycled'.

4.6 Thermal hydrolysis

Thermal hydrolysis is a pre-treatment technology used in conjunction with anaerobic digestion. It is well suited to large amounts of homogeneous organic waste, although the most common feedstock is sewage sludge.

Originally, the thermal hydrolysis process (THP) was used to enhance the dewaterability of sludge, although it was found that, through exposing sewage sludge or other types of wet organic waste to high temperature and pressure, the THP simplifies the organic matter structures making the waste easier to break down through anaerobic digestion. THP aims to improve the digestibility of the biosolids and facilitate the energy recovery stage of the treatment process. The process stages are outlined below:

- **Pulper:** The pulper homogenises and pre-heats the sludge to about 100°C. It uses steam recovered from the flash tank for heating. From the pulper, warm sludge continuously is fed continuously to the reactors.
- **Pressuriser and Reactor:** The organic waste is diverted to special reactors. When they are full and sealed, steam is pumped in, raising the temperature to 160-180 °C at a pressure of 6 bar. The process normally takes 20 to 30 minutes. This is just enough time to kill the pathogens in the sludge;

- **Economiser:** When the hydrolysis is complete, the sludge enters a tank pressurised to atmospheric pressure. When the pressure drops, the organic matter cells are destroyed.
- **Anaerobic digestion:** The treated waste is cooled again to a typical temperature of anaerobic digestion and then then processed through this treatment method.

A process flow diagram of the THP process is outlined within Figure 8.

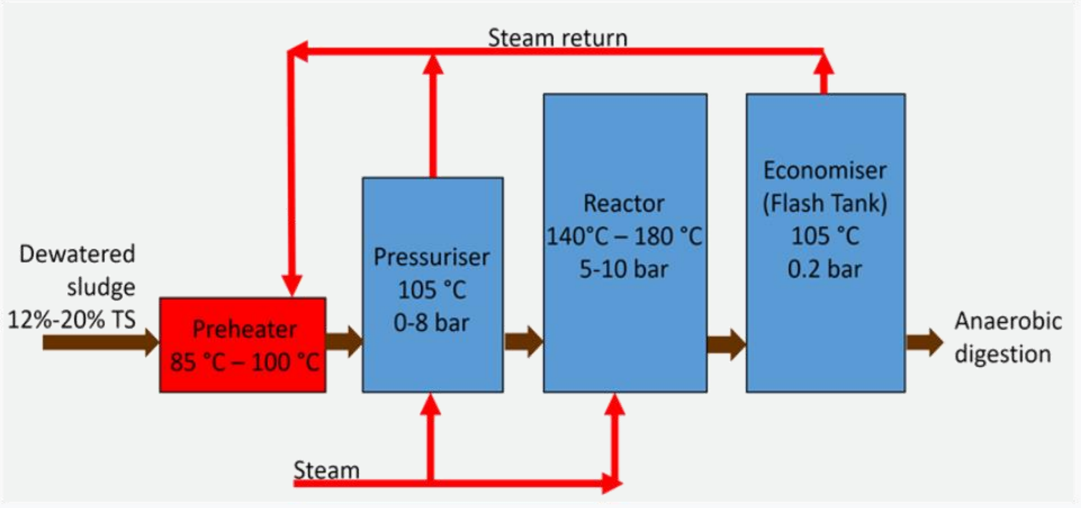

Figure 8 - THP system process

There are several potential benefits associated with the installation of THP at the front end of an AD system, including:

i. **Enhanced Methane Production**: THP improves the breakdown of complex organic materials, making them more accessible for microbial digestion. This results in a methane yield increase of approximately 15% to 25% compared to conventional anaerobic digestion.

ii. Improved Digestion Efficiency The process reduces viscosity of the feedstock, enabling anaerobic digesters to operate effectively at higher dry solids concentrations and organic loading rates. This also allows for shorter retention times while maintaining performance.

iii. Pathogen Reduction The high temperatures and pressure changes in THP destroy microbial cells, effectively sterilising and eliminating pathogens.

A number of THP facilities have been installed within the UK by technology provider Cambi UK Limited (Cambi), a leading global provider of thermal hydrolysis solutions for sewage sludge and organic waste management.

In 2008, Cambi delivered an international co-digestion facility with thermal hydrolysis for treating source-separated food waste, industrial biowaste, and wastewater solids. Cambi note that sometimes food waste is mixed with the on-site sludge. The co-digestion of food waste and sewage sludge is technically possible from a processing perspective, although the appetite to co-digest food waste with wastewater within the UK is complicated due the conflicting regulatory regimes that manage the use of the digestate output from these waste streams.

5.0 AD OUTPUTS & MARKETS

The production and sale of anaerobic digestion process outputs can deliver a multitude of commercial and environmental benefits. This section introduces and describe the various energy and material outputs that could be generated at an anaerobic digestion facility that treats food wastes, including local authority, commercial and industrial sources.

5.1 Electricity and Direct Heat Generation

Anaerobic digestion facilities can be paired with ancillary infrastructure to produce electricity and heat outputs. In these systems, raw biogas from the digestion process feeds into combined heat and power engines (CHP) to produce electricity. Additionally, the by-product of heat is captured in the form of hot water using a heat exchanger. A typical CHP engine is illustrated in Figure 9.

Figure 9 - A combined heat and power (CHP) engine

CHP engines have a net electrical efficiency in the region of 40% and the energy content ratio of electricity exported to biogas processed through the CHP engine reflects this efficiency rating. A further 40% of the energy content of biogas processed through a CHP engine is generated as heat. Heat exchangers capture this heat in the form of hot water which can be used in heating applications, such as industrial heating, district heating for buildings or used within the anaerobic digestion process.

The high levels of adoption of CHP engines within the initial wave of new anaerobic digestion plants (2009-2014) is attributed to several reasons. At that point in time the UK still relied heavily on coal and natural gas for electricity generation. Deploying CHP engines, which are readily available and used in other industry sectors (e.g. landfill gas, large process and heavy industry sites), was a relatively straightforward development option for the production of renewable electricity and supporting the UK in reaching renewable electricity targets. Furthermore, substantial incentives were available in the form of the Feed-In Tariffs; a fiscal incentive scheme which paid renewable electricity generators a unitary rate for the power they exported to grid.

However, the proportional increase in electricity generation from biogas has fallen in recent years. The UK has made commendable progress towards meeting renewable electricity targets; hence the focus has now shifted towards incentivising the production of biomethane for injection into the gas grid and the production of low carbon transport fuels, as discussed in subsequent sections of this report. Moreover, the UK terminated the Feed-in Tariff in 2019 and there are presently no financial subsidies available to anaerobic digestion plant operators in respect of renewable electricity production.

This shift in focus also reflects a push for increased optimisation of the renewable energy content of biogas. Furthermore, many of the anaerobic digestion facilities operating with a CHP engine are not located next to commercial or municipal premises with demands that equal the 40% heat output produced from the CHP engines, meaning that a large proportion of the latent (heat) energy was vented to atmosphere. As a hybrid solution, most anaerobic digestion plants continue to operate small CHP engines as part of their operations in order to service the heat and power demands of the anaerobic digestion plant. This demand is commonly referred to as the ‘parasitic load’.

5.2 Biomethane and Indirect Heat Generation

The process of heating buildings represents a substantial proportion of the national energy demand and carbon emissions, making it a focal point for renewable energy incentives. By incentivising renewable or low carbon sources of heat, the aim is to reduce reliance on fossil fuels in residential, commercial, and industrial heating applications.

Decarbonising heating systems presents several challenges due to the extensive infrastructure and variation of energy sources involved in heating systems. Traditionally heating systems rely heavily on fossil fuels, particularly natural gas, which is a major contributor to greenhouse gas emissions. Presently, biomethane, which is the upgraded and purified form of biogas, is viewed as a promising renewable gas option since it can meet a wide range of demand profiles from residential heating to industrial processes without alteration to that infrastructure (e.g. boiler replacement). Current UK strategies place biomethane production through anaerobic digestion as a key decarbonisation technology, with predictions that by 2030 biomethane production could treble from 2020 levels.

The Government has previously indicated anaerobic digestion as a preferred method for treating biodegradable material, due to the benefits associated with biomethane production and its role in decarbonising the UK gas grid. In March 2021, the Government launched the Green Gas Support Scheme (GGSS) to support the construction of new anaerobic digestion facilities. The GGSS supports this objective by providing a tariff on the price of biomethane injected into the gas grid at anaerobic digestion sites. This scheme follows on from the non-domestic Renewable Heat Incentive (RHI) and will pay unitary tariffs to certified producers of biomethane for a period of 15 years. The scheme is expected to help decarbonise the UK's gas supplies by increasing the proportion of 'green' gas in the grid.

During peak years of production, biomethane plants incentivised by the GGSS are expected to generate enough green gas to heat around 2 million homes.

An application to be fully registered on the scheme, and therefore to receive periodic support payments for any eligible biomethane injected, may only be made at the point at which the equipment used to produce anaerobic digestion-derived biomethane is fully commissioned and operational and when the operator can demonstrate that it is capable of producing biomethane for injection into the gas grid. As things stand, the scheme will close to applicants on the 31st of March 2028, which provides a key date for the development of new anaerobic digestion infrastructure. With its 15-year tariff guarantee, published and index adjusted tariffs, and the precedent of many operational examples, the GGSS is currently viewed as the principal incentive support scheme for waste anaerobic digestion.

5.3 PAS 110, the digestate quality protocol, and recycling standards

The ADQP is a set of guidelines developed to ensure that the digestate output of the AD process meets high quality standards, that allows for application in agriculture and field grown horticulture. PAS 110 and the digestate quality protocol place limits on feedstocks, operations and the use of the digestate to regulate digestate quality. Furthermore, digestate that is produced from source segregated food waste can be certified as an end of waste product under the PAS 110 Publicly Available Specification standard. PAS110 sets the minimum requirements for the quality and safety of digestate produced from anaerobic digestion of source-segregated biodegradable materials. Digestate certified under PAS110 can be applied to land as a fertiliser product and does not require an environmental permit.

PAS 110 specifically excludes sewage sludge or any waste derived from non-source-segregated municipal solid waste. Furthermore, digestate produced from sludge is highly regulated and requires an environmental permit for the land spreading of this digestate as it is still classified as a waste.

5.4 Vehicle Fuel

As described within section 2.0, the Renewable Transport Fuel Obligation (RTFO) places an obligation on major suppliers of relevant transport fuel in the UK to demonstrate that a percentage of the fuel they supply comes from renewable and sustainable sources. Where the specified percentage of sustainable fuels is not attained, the supplier can purchase Renewable Transport Fuel Certificates (RTFCs). Biomethane generated by anaerobic digestion facilities that has been compressed for use as a transport fuel qualifies for RTFC's. This provides a market for tradable certificates for operators of anaerobic digesters that produce biomethane.

Compressed Biomethane

Compressed natural gas (CNG) is a long-established transport fuel which is globally used in a variety of vehicle types. Biogas produced during the AD process can be upgraded to biomethane, by removing carbon dioxide, water vapor, and other trace gases which is chemically identical to natural gas (CH_4). When biomethane is compressed, it can be used as a transport fuel in the same way as CNG, becoming bio-CNG. Similarly to CNG, bio-CNG is an established and proven technology which has been implemented by several local authorities within England, such as Nottingham City Council which runs over 120 double-decker buses on bio-CNG, and Bristol City Council who launched their 77 new bio-methane powered gas bus scheme in 2020.

Biomethane powered RCVs mechanically operate in a similar way to diesel RCVs, although biomethane produces around 85-94% less scope 1 carbon dioxide-equivalent emissions than diesel across its lifecycle and has a fuel duty of approximately half of diesel used for vehicle fuelling. Indeed, the full retail price of biomethane is generally lower than the duty paid on an equivalent volume of diesel fuel. A further benefit of biomethane vehicles is a comparative reduction in nitrous oxide and particulate matter emissions which contributes to local air quality improvement objectives. Previous research has found that such reductions in nitrous oxide emissions can be as high as 90%. Additionally, biomethane that is produced and re-used locally will reduce emissions associated with fuel distribution, aligning with targeted air quality initiatives and emission reduction programs. For example, Birmingham has a Clean Air Zone (CAZ) strategy in place, where charges apply to high emitting vehicles, including cars, taxis, vans, and HGVs. Other local authorities such as Nottingham have focused on upgrading public transport fleets and council vehicles.

5.5 Implementation of BioCNG

While several waste collection authorities in the East and West Midlands are transitioning to alternative fuels to reduce emissions, the direct use of Bio-CNG (biomethane) to power their municipal waste collection fleets appears to be limited. Instead, local authorities such as Gedling Borough Council and Wychavon District Council have opted for using hydrotreated vegetable oils (HVO) as a transition fuel away from diesel. However, there has recently been an increased focus regarding the traceability HVO's, with direct links to deforestation, and local authorities may be more amenable to considering alternative, fully traceable transition fuels such as BioCNG.

Commercial and industrial waste collectors have been more forthcoming with the use of BioCNG in their waste collection fleet. For example, Keenan Recycling, who provide commercial and industrial waste collections in the West Midlands (including but not limited to the hospitality, healthcare, education, and retail sectors) have deployed a fleet of 100% biomethane-powered vehicles. These vehicles are fuelled by the biomethane produced through anaerobic digestion of the food waste that they collect, exemplifying a circular economy approach. Additionally, Severn Trent Water operates biomethane production facilities, such as the Minworth treatment plant, which produce biomethane from sewage waste. Severn Trent is currently exploring the use of biomethane for its fleet.

Adoption of gas-powered vehicles for waste collection authorities would require the procurement of a specific fleet of vehicles, as the economics of converting liquid fuelled vehicles to gas powered vehicles is not currently economically viable. Waste collection vehicles typically have a 7-8-year lifecycle. As such, local authorities may consider this option as vehicles approach their end of life. This would require the delivery of the refuelling infrastructure and would achieve improvements in air quality, such as a reduction in nitrogen oxides, particulate matter and carbon emissions associated with conventional diesel use.

The Bio-CNG vehicle refuelling station can either be located at the AD facility treating the waste (Figure 10), enabling the refuelling of RCV's whilst making feedstock deliveries to site, or installed at depot facilities, providing they have a medium or intermediate pressure gas grid connection. In the latter option, biomethane is injected into the gas grid network and is then extracted at the depot location. This transaction is supported by a Renewable Gas Guarantee of Origin certificate to track the gas through the grid network.

Figure 10 - Depot scale bio-CNG fuelling point

The cost of installing the smaller depot scale filling station equipment is in the region of £120,000, excluding the costs of connecting to the local gas grid which are a site-specific cost and can depend on factors such as the distance to the grid, and any encumbrances (e.g. land ownership, highway, railway, or watercourse crossings) that may escalate development costs. In one recent project, the total cost including civils work was in the region of £398,000. It is important to note that this order of cost would be incurred at each selected site for development of a Bio-CNG refuelling station.

Whilst the option of utilising the Bio-CNG to decarbonise local authority waste collection fleet is an attractive option with respect to the demonstrative circularity of such an approach, any surplus biomethane can be used by any other BioCNG compatible vehicle operator. Furthermore, a developer of and AD facility may wish to engage with other vehicle fleet operators in those areas to understand strategic alignment and therefore potential commercial opportunities for BioCNG fuel supply.

A further refuelling option for biomethane is to utilise an increasingly available network of refuelling stations which have arrangements with AD facilities for the supply of renewable gas. There are several public access CNG (including Bio-CNG) refuelling stations operated within the East and West Midlands, supporting the decarbonisation of HGVs and commercial fleets. These include:

- **Erdington, Birmingham:** operated by CNG Fuels and located on Standard Way, Erdington, Birmingham, B24 8DD;
- **Tyseley Energy Park, Birmingham:** developed and operated by Webster & Horsfall Ltd, in partnership with the University of Birmingham and Birmingham City Council; and located at Fordrough, Hay Mills, Birmingham, B25 8DW;
- **Corby, Northamptonshire:** operated by CNG Fuels and located on Steel Road, Corby, NN17 5XW;
- **Northampton:** operated by CNG Fuels and located Red Lion Truck Stop on Weedon Road, NN7 4DE; and,
- **Newark-on-Trent, Nottinghamshire:** operated by CNG Fuels and located on Stephenson Way, NG24 2TQ.

Vulcan Renewables, based in Doncaster, are a renewable energy developer operating an AD plant that generates in excess of 800m^3 of biomethane per hour, for injection into the gas grid. The company also liquefy the gas and transport it by road for use in various applications. Indeed the installation of a network of CNG fuelling points, coupled with gas transport options, such as that explained above emphasises the concept of a flexible/virtual gas grid, and may help to open up opportunities for sites that do not benefit from their own gas grid connection.

5.6 Hybrid gas and fuel options

A hybrid option increasingly being deployed at anaerobic digestion facilities is a combination of gas-grid export and Bio-CNG vehicle fuel production and/or trading capabilities. In such cases, the certainty of the GGSS provides stability and assurance on income over the project term and is used as the default option for upgraded biogas (biomethane). Having gas to grid as the default option but with having options to switching to the sale of RTFC provides a platform for options which includes:

- Channelling gas into vehicle fuel applications at time when the RTFC prices are higher than the GGSS tariff rates in order to maximise revenue; and/or,
- Using the GGSS as a guaranteed payment mechanism for any gas that is generated above and beyond the demands of an owner operated (i.e. partnership) fleet.

Carbon Capture Use and Storage

The UK carbon market is split into two categories, the Carbon Capture Storage (CCS) market and the Carbon Capture Usage (CCU) market. CCS includes a range of methods to reduce the amount of CO_2 in the atmosphere and store this CO_2 permanently, as opposed to CCU which is stored on a temporary basis. A credible permanent storage option includes injecting this captured CO_2 into geological formations. CCU is the process of capturing and storing CO_2 for a temporary period only and using this CO_2 within industrial sectors.

Figure 11 - CCS and CCUS pathways

The application of CCU has been long established in sectors such as the food and drinks manufacturing industry which have long relied on the CCU process to produce carbonated drinks. However, the development and application of CCS has only recently gained momentum. This additional pathway for captured carbon partially is in response to the UK government's net zero targets of becoming net zero by 2050, with initiatives in place to deploy CCUS at scale during the 2030s.

The markets for CCS and CCU offer a potential income stream for anaerobic digestion. Moreover, the carbon fraction of biogas can be separated during the biogas upgrading process, with capture rates of up to 99% observed. Moreover, this Biogenic carbon can then be extracted from the biogas by methods such as CO2 liquefaction via techniques such as water scrubbing and the use of a membrane system. The carbon can then either be stored permanently of used within an appropriate manufacturing application. The carbon within the biogas is originally absorbed by the biogenic feedstock during its growth phase. When the waste is digested, the result is biogas composed of approximately 50-60% methane (CH4), 25-35% carbon dioxide (CO_2) and other trace gases. Unlike other sources of CO2 from the burning of fossil fuels, the CO_2 captured during the growth stage of feedstock is an example of direct air carbon capture. Whereas this carbon is captured for a temporary period during the growth of the feedstock, anaerobic digestion provides an opportunity to permanently capture this CO_2 through CCS. As such, the process of CCS applied to the biogas upgrading process can be considered as direct air carbon capture and storage (DACCS), removing carbon from the atmosphere.

The following sections outline the market potential for carbon via CCS and CCU.

Carbon usage/utilisation market

A potential source of income for an anaerobic digestion facility is the selling of carbon for usage in a range of industries, including but not limited to:

- food and beverage sector, where CO_2 is required for carbonating drinks, beer fermentation, and dispensing drinks in the hospitality sector;
- poultry farming, where CO2 is used to improve animal welfare before slaughter by stunning;
- packaging, where CO_2 is used to extend shelf life of meats to prevent bacterial growth in meat, fresh, baked products;
- agriculture, where CO_2 can be pumped into storage to kill insects, ingredient for fertilisers, use in greenhouses;
- fire suppression and extinguishers, where CO_2 is used as a suppressions medium; and,
- Enhanced Oil Recovery (EOR), where CO_2 is injected into oil to extract additional crude oil.

The opportunity for accessing the CCU market is by selling CO_2 directly to the food and beverage sector, which accounts for 60% of UK's CO_2 usage. This is followed by the use of CO_2 in fire extinguishers and suppressants, accounting for 20% of UK's CO_2 usage. Currently the CO_2 market is reliant on large companies such as Air Products, Linde, and CF Fertilisers to provide CO_2 for the above sectors, prompting concerns over the vulnerability of the supply chain. Furthermore, there is a market incentive for these manufacturers to diversify their supply chains to include CO_2 derived from smaller suppliers, including anaerobic digestion facility operators.

Carbon capture and storage market

An income source for anaerobic digestion operators can be from the CCS of liquefied carbon dioxide through the selling of carbon credits. Carbon credits are usually purchased by organisations who have large carbon footprints consisting of hard to abate emission sources, for example from industrial processes, where companies buy verified carbon credits to offset the carbon they produce. CCS via anaerobic digestion would involve capturing the carbon dioxide during the biogas upgrading process and transporting it to a CCS project – for example, the injection of carbon dioxide into geological formations. The permanency of this DACCS approach associated with anaerobic digestion that is paired with this CCS approach produces a credible source of carbon credits, making carbon dioxide captured by anaerobic digestion an appealing source for those purchasing carbon credits.

CCS projects have been a focus for the UK government as part of their *Plan for Change 2024* strategy, prompting a pledge of £22 billion to CCS projects for the next 25 years. An example of an ongoing CCS project is Net Zero Teesside, an integrated CCS and low-carbon hydrogen production project. The carbon infrastructure will be provided by the North Endurance Partnership (NEP) and will serve projects NZT Power, H2Teesside, and Teeside Hydrogen CO_2 capture. Construction is due to commence in 2025 with an expected completion date of 2028, and includes a CO_2 gathering network, onshore compression facilities, a 145km offshore pipeline. The CO_2 will then be injected into the Endurance saline aquifer, located approximately 1,000m below the seabed. The infrastructure is expected to transport and permanently store up to 2 million tonnes of CO_2 annually.

The Net Zero Teesside project provides a potential market outlet for carbon that is captured from anaerobic digestion plants to be permanently stored and for the anaerobic digestion operator to earn carbon credits which can be traded in the form of certificates.

Carbon credits can be purchased through voluntary carbon credit markets through third parties including (but not limited to):

- TR[1]BE – carbon credits available to buy from projects such as wind energy, biochar, carbon projects, WEEE refurbishments, etc;
- ClimatePartner – clients of ALDI, PUMA, Lufthansa, DHL, and more. Projects such as wind energy in Caribbean, Forest conservation in Kenya, Biogas plants in India; and,
- CNaught – Starts at $10 US dollars a tonne, involves projects of mangrove restoration, bio-oil sequestration, peatland preservations.

The market demand for carbon credits has recently experienced a significant increase, with a record high of 164 million carbon credit offsets being purchased in 2023; a 6% increase from 2022 figures. This shows the growing opportunities for anaerobic digestion plants to sell carbon credits through partnering with CCS projects such as the Net Zero Teesside project. However, this option remains at an early level of development and thus reliably estimating the future CCS value(s) of such carbon credits is challenging. Furthermore, the operator would potentially incur additional connection and storage costs associated with this option and it is unknown how these additional costs would balance against the incomes associated with carbon credits.

5.7 Anaerobic Digestate

Substrate exiting the anaerobic digester is referred to as digestate. It is widely recognised as a fertiliser product and additional processing may occur at the anaerobic digestion site prior to its delivery to agricultural off-takes. Digestate is the majority output from an anaerobic digester, accounting for between 90-95% of process outputs by mass.

Digestate can be produced in fractions which includes:

- A pumpable viscous liquid with a dry matter content of c.6%. This fraction is referred to as whole digestate; or,
- Separate fraction of digestate liquor which has a dry matter of c.1%, and a solid fibre that has a physical character resembling farmyard manure.
- The production of whole or separated fractions of digestate is mutually exclusive.

Digestate is rich in nitrogen, phosphorus and potassium and is therefore used as a Biofertiliser in arable and grassland agriculture.

6.0 FEEDSTOCK REVIEW

This section of the report reviews the sources of feedstock which may be available to be treated at an AD facility developed in the Midlands region. It commences with a presentation of estimates of household food waste arisings (expressed as tonnes per annum) within the administrative areas of the Midlands region (hereon referred to as the "area of search"). The total projected food waste arisings from the area of search are calculated and the opportunities and challenges of accessing these prospective sources of AD feedstock are assessed.

Secondly, commercial and industrial organic waste arisings have been estimated. This estimation exercise has been undertaken through the apportionment of waste generation factors to businesses of varying sizes, and WRM-derived benchmarks.

Finally, the section concludes with a review of the agricultural feedstock market. Commentary has been provided on agricultural feedstocks commonly treated through AD, including each feedstock's respective biogas yield, as well as contextualising feedstock distribution across the Midlands region.

6.1 Local authority food waste collection review

The Environment Act 2021 introduces a requirement for all local authorities in England to provide a separate weekly collection of food waste to all households within their administrative area. Each local authority is required to have this collection arrangement in place by the 31st March 2026 at the latest. The only exception to this rule is where a Transitional Arrangement applies for a local authority.

Estimation methodology

The methodology used to estimate the total municipal food waste tonnages within the area of search is based off the approach detailed within the Waste and Resources Action Plan (WRAP) publication titled *Evaluation of the WRAP separate food waste collection trials* (2009)[5]. The methodology draws upon the recorded performance of food waste recycling initiatives which were found to correlate to the index of multiple deprivation (IMD). Key parameters used in the methodology are as follows:

- the number of recorded households within each local authority's administrative area, based on the latest Council Tax: stock of properties, 2024;

[5] https://www.wrap.ngo/resources/report/evaluation-wrap-separate-food-waste-collection-trials#download-file

- IMD as collated by Office for National Statistics, where the variable 'Authority wide average IMD' was used; and,
- the use of the IMD and household data points in WRAP's estimation approach from the 2009 report.

The methodology described above produces a high, medium and low estimate of food waste arisings. WRM's experience of working with local authorities who collect food waste suggests that high level yield estimates are infrequently realised. One reason for this may be the increased awareness of food waste, and the subsequent minimisation behaviours that follow the introduction of a food waste recycling service. Therefore, only the low and mid-range estimates are presented.

Estimated tonnages

Annual tonnage estimates of source segregated household food waste within the area of search are set out at Table 8 and Table 10, with a summary provided where existing food waste collections exist. It should be noted that estimates are summed for each county where these exist within the East and West Midlands. The full calculations are presented in Appendix 3.

Table 8 - Projected food waste yields in the East Midlands

Council/County	Number of Households	Food Waste Collected	Collection Approach	Annual Tonnage Estimate (low)	Annual Tonnage Estimate (Mid-range)
Derby City Council	114,040	Yes	Comingled	6,631	8,410
Leicester City Council	144,660	No	N/A	7,589	9,846
North Northamptonshire	159,500	Corby - Yes, East - Yes, Wellingborough - No, Kettering - No	Source segregated	10,596	13,085
Nottingham City Council	146,610	No	N/A	7,242	9,529
Rutland County Council	18,030	No	N/A	1,452	1,733

Council/County	Number of Households	Food Waste Collected	Collection Approach	Annual Tonnage Estimate (low)	Annual Tonnage Estimate (Mid-range)
West Northamptonshire	184,060	Daventry, Northampton, South Northampton - Yes	Source Segregated	12,721	15,592
Derbyshire	381,160	6 of 8 collect food waste	5 (comingled) 1 (source-segregated)	25,946	31,892
Leicestershire	317,940	No	N/A	24,049	29,009
Lincolnshire	363,690	No	N/A	23,815	29,489
Nottinghamshire	384,940	No	N/A	25,891	31,896
East Midlands (Total)	**2,214,630**	**12 out of 40 collect food waste**	**-**	**145,936**	**180,484**

It is estimated that some 145,936 – 180,484 tonnes of food waste would be collected per annum as a result of kerbside food waste collections being implemented across all East Midlands local authority areas. However, it must be noted that eight local authorities within the Midlands region qualify for Transitional Arrangements. Transitional Arrangements have been granted by the Department for Environment, Food and Rural Affairs (DEFRA) instances where existing current long-term waste treatment/disposal contracts would be adversely affected by the implementation of a food waste collection on the 31st March 2026. The local authorities for which transitional arrangements apply, and the date for food waste collection implementation are presented in Table 9 below.

Table 9 - Transitional arrangements for local authorities in the East Midlands

Local Authority	Transitional Arrangements
Ashfield District Council	1st October 2027
Bassetlaw District Council	1st October 2027
Broxtowe Borough Council	1st October 2027
Gedling Borough Council	1st October 2027
Mansfield District Council	1st October 2027

Local Authority	Transitional Arrangements
Newark and Sherwood District Council	1st October 2027
Nottingham City Council	1st July 2030
Rushcliffe Borough Council	1st October 2027

A separate total, which excludes those local authorities that are operating under transitional arrangements, has been provided. The adjusted estimate is 120,045 - 148,588 tonnes of food waste that is suitable for treatment through AD.

Table 10 - Projected food waste yields in the West Midlands

Council/County	Number of Households	Food Waste Collected	Collection Approach	Annual Tonnage Estimate (low)	Annual Tonnage Estimate (Mid-range)
Herefordshire Council	89,790	No	N/A	6,054	7,454
Shropshire	151,230	No	N/A	10,524	12,883
Stoke-on-Trent City Council	119,510	No	N/A	5,903	7,768
Telford and Wrekin Council	83,280	Yes	Source Segregated	4,981	6,280
Staffordshire	401,740	Newcastle Under Lyme – Yes, Staffordshire Moorlands – Yes	Source segregated, co-mingled	28,263	34,530
Warwickshire	277,130	Yes	3 charged co-mingled, 1 source segregated	19,861	24,184
West Midlands (Met County)	1,219,860	Coventry – Yes Sandwell - Yes	Charged co-mingled and source segregated	65,704	84,734

Council/County	Number of Households	Food Waste Collected	Collection Approach	Annual Tonnage Estimate (low)	Annual Tonnage Estimate (Mid-range)
Worcestershire	277,350	No	N/A	18,985	23,312
West Midlands (Total)	**2,619,890**	**30**		**160,278**	**201,148**

It is estimated that some 160,278 – 201,148 tonnes of food waste would be collected per annum as a result of kerbside food waste collections being implemented across all West Midlands local authority areas.

6.2 Commercial and industrial food waste

Commercial and Industrial (C&I) waste that is potentially suitable for treatment by anaerobic digestion includes food waste produced from:

i. Food and drink manufacturing and processing operations;
ii. Food wholesale, retail and service; and;
iii. Food waste generated from food service activities.

Unlike municipal waste streams, there is limited open-source data available for C&I waste arisings due to a lack of statutory reporting requirements for waste operators. Visibility on regional C&I tonnage data is complicated further due to C&I waste streams being collected by a multitude of third-party waste management operators. The inaccessibility of historic C&I tonnage data requires an alternative methodological approach to estimate C&I waste arisings.

To produce C&I food waste estimates, data published by the Office for National Statistics (ONS) on *business size, location, and activity (2024)*[6] has been interrogated to identify the number of food waste producing businesses within the area of search. Food waste arising benchmarks have then been applied to the ONS data to provide a baseline estimate of total waste (all waste streams) tonnage produced per annum. Technical factors, such as compositional analysis (proportion of food waste suitable for anaerobic digestion) and

[6] UK business: activity, size and location – 2024 edition (see here)

probable capture rates have been applied to the baseline arising to provide a reasoned estimate tonnage of C&I food wastes collected per annum.

Commercial organic waste arisings

Commercial waste includes all waste streams from the wholesale, retail, accommodation and food service sectors. Commercial food waste from the area of search is a prospective target anaerobic digestion feedstock due to the historically limited number of food waste collections at a national level, relative to industrial food waste streams, and the growth of specific commercial collection services, driven by the mandatory food waste collections for businesses from March 2025.

The approach taken to estimating waste arisings is predicated on the use of waste generation factors for businesses, taking account of their size and market segment; split into wholesale, retail, accommodation and food services. The waste generation factors, displayed in Table 11, are derived from an industry report and their scope includes all waste streams, not just food waste. Applying the waste generation factors to ONS business activity, size and location datasets provides the basis for estimating total commercial waste arisings (all waste streams) from within the area of search. It should be noted that subsequent stages within the methodology are required to calculate the proportion of food waste that is produced and collected.

Table 11 - Commercial waste generation factors (all waste streams)

Business Size (Employee number)	0 - 4	5 - 9	10 - 19	20 - 49	50 - 99	100 - 249	250+
Wholesale and retail sector waste generation (Tpa)	3.96	20.67	29.19	68.09	169.27	334.52	1,095.05
Accommodation and food service sector waste generation (Tpa)	1.75	16.87	22.99	48.54	86.93	97.54	716.28

The waste generation benchmarks in Table 11 have been applied to ONS business numbers in the retail, wholesale, food service and accommodation sectors within the Midlands. The ONS business numbers are from the UK business; activity size and location dataset from 2024. The total estimated waste arisings from the retail, wholesale, food service and accommodation sectors from the Midlands, apportioned by East and West Midlands region, is presented in Table 12.

Table 12 - Estimation of total commercial waste arisings (all waste streams) from retail, wholesale, food service and accommodation sectors from within the area of search (tonnes per annum)

Local Authority	Sector	Business size							Total
		0-4	5-9	10-19	20-49	50-99	100-249	250+	
		Regional Apportionment by sector (tonnes per annum)							
East Midlands	Regional commercial waste arising from **wholesale** (tonnes per annum)	21,424	34,106	28,752	42,216	34,700	31,779	43,802	**236,779**
	Regional commercial waste arising from **retail** (tonnes per annum)	48,510	82,163	66,407	81,368	33,854	50,178	76,654	**439,134**
	Regional commercial waste arising **from accommodation and food** (tonnes per annum)	12,128	52,887	52,417	72,325	18,255	11,705	7,163	**226,880**
West Midlands	Regional commercial waste arising from **wholesale** (tonnes per annum)	26,195	41,650	38,239	55,153	43,164	36,797	49,277	**290,476**
	Regional commercial waste arising from **retail** (tonnes per annum)	63,855	98,183	82,462	88,857	48,242	60,214	93,079	**534,892**
	Regional commercial waste arising	16,109	64,781	56,440	84,460	29,122	12,680	10,744	**274,336**

Local Authority	Sector	Business size							Total
		0-4	5-9	10-19	20-49	50-99	100-249	250+	
		Regional Apportionment by sector (tonnes per annum)							
	from **accommodation and food** (tonnes per annum))								
	Regional commercial waste arising from **retail** (tonnes per annum))	8,378	14,612	12,243	14,128	6,773	8,180	12,172	**76,485**
	Regional commercial waste arising from **accommodation and food** (tonnes per annum)	2,215	10,333	9,073	12,047	3,700	1,970	1,550	**40,888**
Regional Apportionment for all above Sectors									
East Midlands		82,061	169,156	147,577	195,908	86,810	93,662	127,618	**902,792**
West Midlands		106,159	204,613	177,141	228,470	120,527	109,691	153,101	**1,099,703**
Midlands (Total)		**188,220**	**373,770**	**324,718**	**424,378**	**207,337**	**203,353**	**280,719**	**2,002,495**

Table 12 presents the total estimated commercial waste arisings (tonnes per annum) from the retail, wholesale, food and accommodation sectors within the area of search. It is estimated that 2,002,495 tonnes per annum of commercial waste is generated across the Midlands area; 1,099,703 tonnes per annum from the West Midlands area, and 902,792 tonnes per annum from the East Midlands area respectively.

However, these 2,002,495 tonnes of commercial waste contain waste which is non-biodegradable and therefore unsuitable for anaerobic digestion. Hence, factors are required to calculate the organic proportion of the overall waste tonnage estimates that is suitable for anaerobic digestion. Research undertaken by WRAP in 2020[7] suggests that food waste, and other similar materials which may be suitable for anaerobic digestion, comprise approximately 20.1% of total commercial waste arisings. A separate study by WRAP[8] notes

[7] Composition analysis of Commercial and Industrial waste in Wales – WRAP (2020)
[8] An overview of waste in the UK hospitality and food service sector – WRAP (2013)

that 32% of hospitality and food service sector waste arisings is food waste. The 20.1% and 32% food waste composition factors have been applied to the total commercial wholesale and retail waste arisings and the commercial accommodation and food service sector arisings, respectively. The output of this calculation is an estimation of the total tonnage of commercial food waste generated per annum from within the area of search and the results are presented in Table 13.

As not all organic wastes produced will be deposited by the producer correctly in containers and consequently collected, capture rates need to be applied to the total organic waste tonnages to estimate how much organic waste will arise to be sent for AD treatment. The capture rate for all waste streams is broadly estimated at 44% per the UK statistics on waste[9], therefore WRM have created a low, medium and high capture rate scenario for commercial food waste estimates, which are as follows:

- **Low scenario:** assuming a 40% capture rate is applied to the commercial food waste estimates;
- **Medium scenario**: assuming a 50% capture rate is applied to the commercial food waste estimates; and,
- **High scenario**: assuming a 60% capture rate is applied to the commercial food waste estimates.

A summary of the estimated total captured commercial food waste in tonnes per annum is presented within Table 13 below. The 'Market Growth Potential' column represents additional material that could be available as prospective anaerobic digestion feedstock in the future, if 100% of organic waste was captured from a baseline capture rate of 40%. Furthermore, it is reasonable to assume that the mandatory expansion of food waste collection services to all businesses by March 2025, in addition to the financial incentive for individual organisations to lower their disposal costs by improving the segregation of food waste, will produce an increase in the total tonnage of commercial organic waste captured per annum.

Table 13 - Estimated commercial waste and food waste arisings in the Midlands

Local Authority	Total Commercial Waste Arisings (TPA)	Total Organic Waste Arisings (TPA) 100% capture rate	Total Organic Waste Captured (TPA) 40% capture rate	Market Growth Potential (TPA) Low scenario
Derby	43,068	10,037	4,015	6,022

[9] UK statistics on waste – Gov.UK (2022)

Local Authority	Total Commercial Waste Arisings (TPA)	Total Organic Waste Arisings (TPA) 100% capture rate	Total Organic Waste Captured (TPA) 40% capture rate	Market Growth Potential (TPA) Low scenario
Leicester	83,909	19,027	7,611	11,416
North Northamptonshire	61,053	13,957	5,583	8,374
Nottingham	60,715	14,250	5,700	8,550
Rutland	8,978	2,119	848	1,271
West Northamptonshire	78,639	18,148	7,259	10,889
Derbyshire	148,581	34,739	13,896	20,843
Leicestershire	136,616	31,134	12,454	18,681
Lincolnshire	143,785	33,489	13,396	20,094
Nottinghamshire	137,447	31,559	12,623	18,935
East Midlands	**902,792**	**208,460**	**83,384**	**125,076**
Herefordshire	42,827	9,898	3,959	5,939
Shropshire	68,603	16,065	6,426	9,639
Stoke-on-Trent	41,653	9,487	3,795	5,692
Telford and Wrekin	30,389	6,965	2,786	4,179
Staffordshire	159,124	37,492	14,997	22,495
Warwickshire	114,667	26,917	10,767	16,150
West Midlands (County)	530,803	121,126	48,450	72,676
Worcestershire	111,636	25,737	10,295	15,442
West Midlands	**1,099,703**	**253,686**	**101,474**	**152,212**

In the Midlands area, of the 2,002,495 tonnes of waste expected to arise from commercial businesses, it is estimated that approximately 462,146 tonnes per annum is food waste. Of this total, 208,460 tonnes arises from the East Midlands, and 253,686 arises from the West Midlands. Through applying a baseline conservative capture rate of 40%, the total estimated organic waste captured from commercial businesses stands at 83,384 tonnes per annum from the East Midlands, and 101,474 tonnes per annum from the West Midlands. Market growth potential for the Midlands region is estimated to be in the region 277,288 tonnes per annum.

In the East Midlands, Derbyshire has the highest estimated organic waste arisings from the commercial sector of 34,739 tonnes per annum. Upon application of a 40% capture rate, estimated arisings are 13,896 tonnes per annum, with a market growth potential of 20,843 tonnes per annum.

In the West Midlands, West Midlands County has the highest estimated organic waste arisings from the commercial sector of 121,126 tonnes per annum. Upon application of a 40% capture rate, estimated arisings are 48,450 tonnes per annum, with a market growth potential of 72,676 tonnes per annum.

In West Midlands, West Midlands County represents the highest estimated organic waste arisings with an estimated 121,126 tonnes per annum. With a 40% capture rate applied estimates are 48,450 and has a market growth potential of 72,676 tonnes.

This section of the report has identified commercial food waste from within the Midlands as a significant tonnage of prospective anaerobic digestion feedstock, with a conservative estimate of 184,858 tonnes per annum. Furthermore, there is good potential for growth of this prospective feedstock within councils in the East and West Midlands. The anticipated growth in commercial food waste availability is due to the following factors:

i. the historically lower capture rates of commercial food waste, relative to industrial waste;
ii. the recent rollout of mandatory requirements for businesses to arrange for the weekly collection of their food waste in March 2025;
iii. financial incentives for businesses to improve the segregation of food waste – by recycling food waste, lowering disposal costs; and,
iv. national policy and strategy such as the Resources and Waste Strategy (2018) which has pledged to work towards eliminating food waste from landfill by 2030.

The factors above show a clear rationale for accessing the market growth potential for commercial food waste. However, it should be noted that both arisings and the potential for market growth do not present organic wastes which would be secured for the facility.

There are currently several third-party waste management organisations who deliver integrated commercial waste collection and processing services for businesses within the Midlands. As such, these organisations currently have a share of the commercial food waste market and the total available commercial food waste tonnage is fragmented into existing ownership, where access to this feedstock is controlled by a few organisations. Furthermore, engagement with such organisations providing these commercial collection services is required to understand how this segment of the food waste market may be penetrated and ultimately processed using a local anaerobic digestion facility. Furthermore, whilst there appears to be good market growth potential for the commercial food waste market, this growth is contingent on the availability of other merchant anaerobic digestion facilities within the area which may be favoured by commercial waste collectors due to existing contractual or business arrangements. Implementing early engagement with third-party waste management organisations and understanding the proximity of merchant facilities in the area can help provide insight on to the tonnages which may be available for the facility.

Industrial organic wastes

The food and beverage manufacturing sector typically has a high capture rate of organic wastes due to the ease of separation in production processes and the low packaging contamination. Much of the organic food waste generated is utilised in secondary markets (e.g., pet food production, or biofuel manufacture) along with existing high capture rates for anaerobic digestion treatment.

To calculate organic industrial waste arisings, food waste arising factors for food and drink production businesses (according to business size) have been applied to ONS data[10] on the number of regional industrial businesses within the Midlands. The industrial food waste generation factors, as shown in Table 14 are taken from an industry report by the Centre for Process Innovation (CPI) that draws from research undertaken within the Yorkshire and Humber region.

Table 14 - Food waste generation factors (industrial)

Business Size (Employee Numbers)	Food Waste Generation Factor (tonnes per annum)
5-9	23
10-49	58
50-249	3,130
250+	3,426

The capture rate for organic wastes, by-products and residues generated by the industrial food and drink sector is approximately 93%. Furthermore, WRM have created a ‘low’, ‘medium’ and ‘high’ capture rate scenarios for industrial food waste estimates, which are as follows:

- **Low scenario:** assuming an 88% capture rate is applied to industrial food waste estimates;

[10] UK business: activity, size, and location – ONS (2024)

- **Medium scenario:** assuming a 93% capture rate is applied to industrial food waste estimates; and,
- **High scenario:** assuming a 98% capture rate is applied to industrial food waste estimates.

Table 15 presents the food waste generation factors, business numbers and capture rates to provide an estimate of the total organic industrial waste produced and captured in the Midlands.

Table 15 - Estimates of industrial food waste arisings from manufacturing sectors within the Midlands (tonnes per annum)

Business Size (no. Employees)	Number of Businesses Located in Zone	Organic Waste Generation Factor	Total organic waste arisings	Organic waste arisings (88% capture rate)	Organic waste arisings (93% capture rate)	Organic waste arisings (98% capture rate)
East Midlands						
5-9	145	23	2,864	2,520	2,663	2,806
10-49	185	58	10,730	9,442	9,979	10,515
50-249	125	3,130	250,400	220,352	232,872	245,392
250+	60	3,426	205,560	180,893	191,171	201,449
West Midlands						
5-9	170	23	3,910	3,441	3,636	3,832
10-49	215	58	12,470	10,974	11,597	12,221
50-249	80	3,130	250,400	220,352	232,872	245,392
250+	35	3,426	119,910	92,871	111,516	117,512
Midlands (Total)						
5-9	315	46	6,774	5,961	6,299	6,638
10-49	400	116	23,200	20,416	21,576	22,736
50-249	205	6,260	500,800	440,704	465,744	490,784
250+	95	6,852	325,470	273,764	302,687	318,961
Total	**1,015**	**13,274**	**856,244**	**740,845**	**796,306**	**839,119**

Table 16 presents the number of food and beverage manufacturers from 5 to 250+ employees, the total organic waste arisings using the estimation approach, and the applied scenario's above to organic waste arisings for authorities in the Midlands. Organic wastes are estimated in tonnes per annum.

Table 16 - Summary of industrial organic waste arisings within the Midlands (tonnes per annum)

Local Authority	Number of Industrial Businesses located in Local Authority (Employees 5-250+)	Total Organic Waste Arisings (100%)	Total Organic Waste 88% capture rate	Total Organic Waste Captured 93% capture rate	Total Organic Waste Captured 98% rate
Derby	16	15,956	14,041	14,839	15,637
Leicester	41	40,569	35,701	37,729	39,758
North Northamptonshire	37	36,665	32,265	34,098	35,932
Nottingham	22	21,897	19,269	20,364	21,459
Rutland	4	4,074	3,585	3,789	3,992
West Northamptonshire	38	37,853	33,311	35,203	37,096
Derbyshire	92	91,832	80,812	85,404	89,996
Leicestershire	80	80,290	70,655	74,669	78,684
Lincolnshire	69	68,917	60,647	64,092	67,538
Nottinghamshire	72	71,972	63,335	66,934	70,533
East Midlands	**470**	**470,025**	**413,622**	**437,123**	**460,625**
Herefordshire	24	18,308	16,111	17,026	17,941
Shropshire	30	23,471	20,655	21,828	23,002
Stoke-on-Trent	20	15,726	13,839	14,625	15,411
Telford and Wrekin	17	13,496	11,876	12,551	13,226
Staffordshire	78	60,087	52,876	55,881	58,885
Warwickshire	55	42,248	37,179	39,291	41,403
West Midlands (Met County)	216	166,998	146,959	155,309	163,658
Worcestershire	60	46,356	40,793	43,111	45,429
West Midlands	**500**	**386,690**	**340,287**	**359,622**	**378,956**

Table 16 presents that there are an estimated 856,715 tonnes per annum of industrial organic wastes arising from 970 businesses in the Midlands. Out of the total waste produced, 796,745 tonnes per annum are captured through waste collections, assuming a 93% capture scenario. Under a 98% capture rate scenario, the market growth potential for industrial food waste is estimated to be an additional 42,836 tonnes per annum.

Industrial food waste is projected to experience lower levels of market growth in comparison to household and commercial food waste, aligning with previous remarks on the existing high capture rates of industrial waste. However, industrial food waste arisings are subjected to the same legislative and financial drivers to increase capture rates as described in the commercial arisings section, such as the rollout of a weekly food waste collection and lowering disposal costs from correct segregation of waste, which will bring captured tonnages closer to the 98% or 100% arisings value.

6.3 Agricultural feedstock review

With over half (54%) of the UK's AD sector comprising agricultural plants, there is clear rationale for ensuring feedstock security in agricultural settings. It should be noted that the Midlands region itself is vast; comprising 2.97 million hectares and dominated by a variety of land uses, owing to the mix of urban areas and agriculture that pervade the region. A large proportion of the East Midlands is used for farming, including arable land used to cultivate crops such as wheat, barley and oilseed rape, and some pastureland, occupied by livestock. In contrast, the West Midlands, particularly counties such as Herefordshire, Shropshire and Worcestershire, occupy more land for livestock grazing.

Common agricultural feedstocks

Agricultural feedstocks commonly sent for processing within AD systems can generally be categorised into the following feedstock types:

- Agricultural residues – composes of manures and slurries, and leftover production of crops such as damaged or misshapen fruit and vegetables, trimmings, and plant material which is not included in the end-harvest;

- Crop residues - leftover production of crops such as damaged or misshapen fruit and vegetables, trimmings, and plant material which is not included in the end-harvest, such as straws, leaves; and,

- Energy crops – crops such as barley, rye, grass silage and maize can be grown specifically for AD treatment and can be utilised in crop rotation.

Table 17 presents a summary of common feedstocks processed with an agricultural AD system, supported by typical biogas yields for each feedstock. Such benchmarks are drawn from a variety of sources, including the feedstock list supplied by the Official Information Portal on Anaerobic Digestion, and several on-farm AD feasibility projects that WRM have previously supported on.

Table 17 - Typical feedstocks and biogas parameters of the agricultural sector.

Feedstock	Description	Typical Biogas Yield (NM^3/ tonne)
Cattle slurry	Liquid manure from cattle waste, mixed with water. In line with NVZ, must be stored for long periods when not in use.	20
Pig slurry	Liquid manure from pig waste, leftover feed and water. In line with NVZ, must be stored for long periods when not in use.	21.25
Chicken litter	A mix of bedding material, chicken manure and feathers resulting from poultry production.	200
Grass silage	Fermented cut pasture grass for cattle to consume, or can be grown directly for use as an energy crop.	180
Straw	Agricultural byproduct, dry stalks of cereal plants and grains.	282
Maize silage	Fermented corn (maize). Made for feed for cattle or can be grown directly for use as an energy crop.	210
Wheat grain	Wheat beyond human consumption.	610
Wholecrop wheat	Harvesting of the entire wheat plant and has gone through fermentation.	185
Sugar beet	A type of crop which may be specifically cultivated for their high dry matter content, considered an energy crop	308

In order to provide further insight into the prevailing feedstocks of the Midlands region, WRM has analysed the prevailing use of agricultural land within the Midlands region. This is presented in Figure 2, of the report, but also depicted below for convenience (Figure 12).

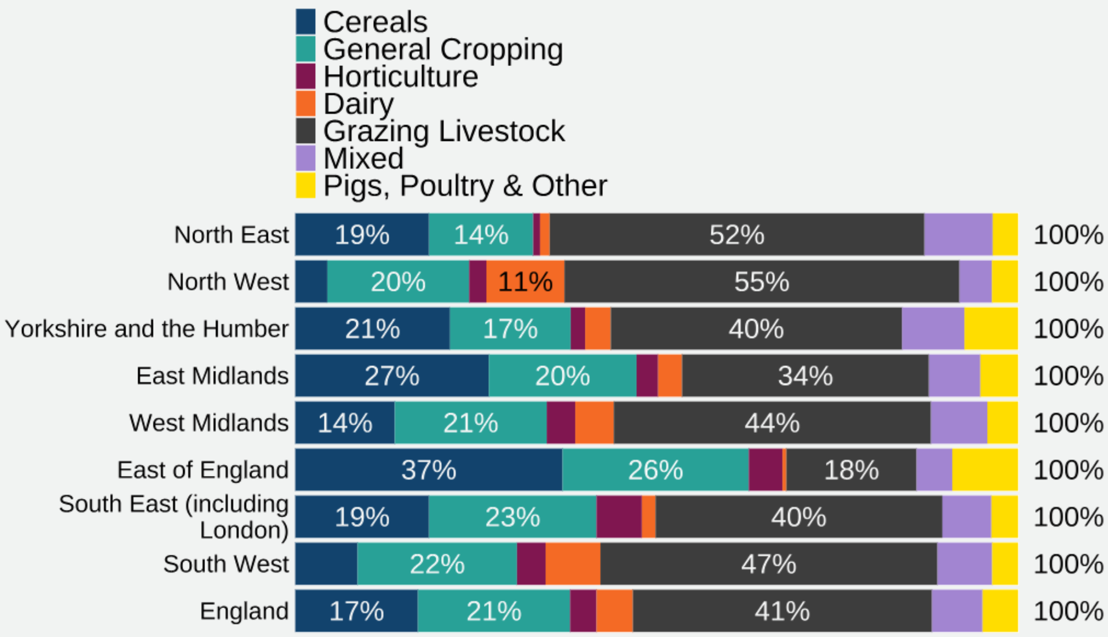

Figure 12 - Distribution of farms by type in 2023 (expressed as a percentage of farm holdings) Source: DESNZ. Agricultural Facts Summary.

[11]

Figure 12 confirms previous observations made and demonstrates that livestock grazing represents the greatest proportion of farm type in both the East and West Midlands, representing 34% and 44% of farm activity respectively. Notably, general cropping and the cultivation of cereals represents the second and third most commonly occurring farm type in the Midlands region. These findings infer an abundance of supply of manures and slurries, as well as crop residue and energy crop feedstocks.

Feedstock considerations

In reviewing the type and quantum of feedstock to be supplied to an AD plant, a number of factors warrant consideration. These are explained in further detail below:

- **Feedstock supply** – Clearly, the successful operation of the AD plant is predicated on a stable feedstock supply. Feedstocks such as manures and slurries – providing the material is captured – are abundant. Other target feedstock sources, including cereals, sugar beets and grass silage can also be used for other purposes, which may in turn,

[11] Agricultural facts: Summary. Figure 1.5 – Distribution of farms by type in 2023. [Accessed 19th May 2025]. Available from: https://www.gov.uk/government/statistics/agricultural-facts-england-regional-profiles/agricultural-facts-summary#section-1-key-statistics

inhibit their supply. As an example, grass silage can take the form of a valuable energy crop but can also be used as a food source for grazing cattle.

- **Feedstock dynamics –** The dynamics between energy crops and manures and slurries must be properly managed. Energy crops, such as sugar beet and maize, command a high price per tonne (c.£230/t) but also return a high biogas. Conversely manures and slurries are abundant in supply, and often free (excluding transport). They are, however, lower in energy yield.

- **Green Gas Support Scheme -** The Green Gas Support scheme mandates that a minimum of 50% of the biomethane produced by an AD plant must come from waste or residue feedstocks for an AD operator to be eligible claim support payments. The requirement serves to encourage the use of waste and residues, which generally have higher carbon savings and lower environmental impacts compared to using crops for biogas production.

- **Feedstock balancing requirements –** Research[12] has shown that the excessive use of high nitrogen manures such as pig and poultry manure can promote the formation of ammonia during digestion rather than biogas, as the carbon to nitrogen ratio is altered. This ammonia can acidify the digester, and a reduced pH can further inhibit digestion. Consequently, feedstock blends need to be carefully balanced; indeed, there may be limits on the quantities of these materials which can be incorporated into a feedstock blend for a digester.

- **Feedstock receipt requirement –** Many food waste-fed AD plants commonly receive food waste in packaged form, and, as such, are equipped with a de-packaging unit at the front end of the process (see Figure 3). Many agri plants are not equipped with a de-packaging phase, owing to the nature of the predominant feedstock accepted, and as such, the feedstock is fed directly into the digestion system.

- **Regulatory change –** At present, agricultural plants that do not accept materials classified as controlled wastes site outside of the environmental permitting regime. However, at the Renewable Energy Association's organics conference held in March 2025, the Environment Agency announced that crop-based AD sites would be moved into the permitting regime. No timeline has been provided on this change at the time of writing.

[12] https://www.frontiersin.org/journals/energy-research/articles/10.3389/fenrg.2021.740314/full

7.0 LOCATIONAL FACTORS

This section of the report discusses several factors that need to be considered from a technical feasibility and commercial viability perspective when selecting an appropriate development location for an AD facility. The locational factors include planning and permitting considerations, such as ensuring that the planned development accords with relevant national, regional and local sustainability and waste policies, and the proximity of the site to sensitive receptors, both human and environmental.

Other non-regulatory factors are considered, including the surrounding environmental setting and potential synergistic benefits of co-locating a facility with existing land uses. The section explains the importance of proximate gas and electricity grid connection infrastructure with available capacity for injection and sets out the methodology used to screen available energy grid connection approaches for individual sites. The section concludes with a review of the land within the area of search that is appropriate for spreading of digestate and calculates the quantity of digestate that may be spread to this land per year. This is compared with the volume of digestate that is produced from a reference AD facility.

7.1 Planning

National Planning Policy

The proposal to construct an AD facility(s) for the purposes of heat and power generation and biogas utilisation would need to meet the definition of renewable energy set out in the National Planning Policy Framework (NPPF) and the National Planning Practice Guidance (NPPG). The NPPF, on which local policy is based, has a presumption in favour of sustainable development. The NPPF states that there are three dimensions to this: economic, social and environmental. The environmental aspect includes objectives to:

- Protect and enhance our natural, built and historic environment;
- Use natural resources prudently;
- Minimise waste and pollution; and,
- Mitigate and adapt to climate change including moving to a low carbon economy.

The relevant sections of the NPPF to a potential AD facility development have been listed in Table 18.

Table 18 - Sections of the NPPF relevant to an AD facility

Section of the NPPF	Considerations directly relevant to AD
Section 6: Building a Strong, Competitive Economy	1) Planning policies and decisions should enable the sustainable growth and expansion of all types of businesses in rural areas; 2) Planning should enable the development and diversification of agricultural businesses
Section 13: Protecting Green Belt Land	1) Plans should give priority to previously developed land, then consider grey belt which is not previously developed; 2) Any planning application which is harmful to the Green Belt will not be approved unless in exceptional circumstances; 3) Renewable energy projects may comprise of inappropriate development on the Green Belt. In this case, the developer will need to demonstrate special circumstances if project is to proceed, including wider environmental benefits from increased renewable energy production.
Section 14: Meeting the Challenge of Climate Change, Flooding and Coastal Change	1) Providing a positive strategy for energy from renewable sources and ensuring adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); 2) Consider identifying areas for renewable and low carbon energy sources, supporting infrastructure; 3) Identify opportunities for development to draw energy from decentralised, renewable or a low carbon energy supply systems; 4) Identifying opportunities for co-locating potential heat customers and suppliers 5) Local planning authorities when reviewing planning applications should recognise that small-scale and community-led projects provide a contribution to cutting GHG's; 6) New developments should be planned to help reduce GHG's through factors such as location, orientation and design
Section 15: Conserving and enhancing the natural environment	1) Developments should not contribute to the risk of unacceptable levels of soil, air, water, noise pollution or land instability, and instead should help to improve local environmental conditions such as air and water quality; 2) Planning applications which cannot avoid significant harm to biodiversity should be refused;

Section of the NPPF	Considerations directly relevant to AD
	3) Development on or outside of a SSSI which poses an adverse effect should not be permitted, alongside development which results in a loss or deterioration of irreplaceable habitats

Table 18 illustrates several themes that should be considered in the design and siting of an AD facility, ensuring that the project meets the required criteria to be classed as sustainable development.

Regional and Local Planning Policy

Both the East Midlands and West Midlands regions operate under regional strategies, which set out the respective development strategies for the region. Notably, under the Planning and Compulsory Purchase Act 2004, it is a statutory requirement for all local authorities in England to produce a Local Development Scheme, with relevant development plan documents (local plans). The local plan seeks to set out a framework for the future development of the area and will address needs such as housing, economy, infrastructure and environmental protection. Local plans may also allocate specific zones of the administrative area and identify specific sites for development.

It should be noted that as the individual feasibility studies have not yet commenced, further commentary has not been provided on regional and local planning policy within this briefing report.

7.2 Permitting

Anaerobic digestion facilities that accept controlled wastes fall under the scope of the Environmental Permitting (England and Wales) Regulations 2016 which requires facilities to hold either a standard rules (generic) or bespoke permit – which is specific to the operator's individual activity - unless they fall under a specified exemption. Such permits are issued by the Environment Agency, who act as the regulator for the sector. These regulations aim to control operations and activities which may potentially pose harm to the environment and human health, ensuring that business practices are conducted in accordance with above regulation.

Standard rules permits provides a set of comprehensive criteria which must be met for a development to be approved. Consequently, this forms a useful starting point for assessing the outline feasibility of prospective developments. The consolidated list of questions posed is presented below:

- Will the combustion stack at the facility be within 200 metres of the nearest receptor?
- Will the site be 250 metres to the nearest sensitive receptor where any further treatment takes places by composting digestate in the open?
- Will the site be 500 metres to a European Site or a Site of Special Scientific Interest, including candidate or proposed sites or a marine conservation zone?
- Is the site in a groundwater source protection zone 1 or 2, or 50 metres to any well, spring or borehole used for human consumption?
- Is the site 250 metres from the presence of great crested newts?
- Is the site 10 metres to any watercourse?
- Is the site 50 metres from a Local Nature Reserve, Local Wildlife Site, Ancient Woodland or Scheduled Monument?
- Is the site 50 metres from a site which has species or habitats of principle importance that the EA considers at risk to this activity?
- Is the site within a specified Air Quality Management Area?

Where at least one of the requirements cannot be met, an operator must apply for a bespoke permit. An environmental permit application will be approved where the facility can demonstrate operation of the facility at a risk level deemed acceptable by the EA. Risk is mitigated through the development of a comprehensive management system, which is inspected and approved by the authorised officer determining the permitting application. Furthermore, accreditation to internationally recognised standards, such as ISO 9001, 14001 and 45001 are becoming more commonplace in the waste sector, and provide further verification and assurance that the processes an operator has in place ensure safe and efficient operation of the facility.

7.3 Environmental Setting

In addition to the planning and permitting factors described in sections 7.1 and 7.2, there are several non-regulatory factors used to determine the appropriateness of a site for AD development. Furthermore, the existing activities and/or use of land adjacent to a prospective development site needs to be identified, understood, and assessed with respect to potential challenges and opportunities within planning, construction and operational project phases.

Co-locating an AD facility within an existing industrial setting may be viewed as a preferential site location from a planning perspective, as this would closely align with the existing landscape character. The landscape character of an area is considered during the planning phases, where alignment to a local development plan development designation will be considered by a planning officer. Additionally, developing an AD facility within an industrial setting is more likely to elicit acceptance and approval of the surrounding community; in what is often referred to as a social licence to operate. This is not a formal planning consideration, although derisks a facility from potential negative consequences like protests, boycotts, or loss of public trust in AD infrastructure projects. A social licence to operate is less likely to be achieved in other residential, suburban or natural settings.

Furthermore, there are several commercial, environmental and social benefits of co-locating an AD facility close to the upstream and/or downstream supply chain, including (but not limited to):

- The co-location of an AD facility near a council waste transfer station would reduce the haulage distances associated with the transportation of input waste streams to the AD facility which would deliver several environmental, commercial and social benefits. Moreover, a diesel-powered HGV travelling a shorter distance would reduce the volume of diesel consumed, lowering the operational costs and emissions.
- Furthermore, this may provide options for direct delivery of food waste to the treatment facility, preventing the need for double handling of waste and associated operational costs.
- Similarly, the co-location of an AD facility in proximity to material output end destinations shall reduce the haulage distance associated with transporting material outputs from the AD facility off site, such as digestate, biogenic CO2 and contaminants.
- Locating an AD facility in proximity to an industrial setting means that a greater proportion of energy outputs (gas and electricity) would be consumed closer to the point of injection. The benefit of delivering this option would be a reduction in electricity and gas transmission losses, increasing the efficiency of energy systems;
- At times when electricity demand is high but heat demand is low, there may be options to divert this heat (contained within hot water) to neighbouring commercial facilities. The opposite may apply for a scenario where the heat demand of the AD facility is greater than the electricity demand, and direct line may be installed to deliver excess electricity to a neighbouring facility. WRM work closely with an AD operator located in the southwest that has such an arrangement in place.

7.4 Gas & Electricity Grid Connection

As discussed in section 5.2 of this report, biomethane is a significant AD process output from a mass balance and commercial perspective. Moreover, WRM's experience from a project undertaken within the last 12 months suggests that the injection of biomethane into the national gas grid comprises c.45% of the total revenue from an AD facility[13]. Furthermore, any excess electricity produced from the combustion of biogas through CHP engines on site can be injected into the electricity grid.

A grid connectivity screening exercise is a key stage within an AD feasibility assessment which aims to understand the technical and commercial challenges and opportunities of connecting to the gas and electricity district network. The availability and capacity of the surrounding gas and electricity grid network for the injection of electricity, and biomethane generated from an AD facility. Moreover, the location and design of any new AD facility is dependent on the capacity of the surrounding gas and electricity network. This is due to the majority of revenue from an AD facility being the injection of biomethane into the national gas grid.

An understanding of the proximity of development site options to potential biomethane and electricity injection points shall be achieved through consulting with district network operators (DNO's) within the region. The DNOs within the area of search are Cadent and the National Grid, for gas and electricity, respectively. Applications to Cadent shall involve submitting an initial network capacity check form, requiring a site description and estimated biomethane flow rates. Applications to the National Grid shall involve submitting a standard G99 form, including site location, site export requirements, summary of the CHP engines to be included on site and CHP unit data. This shall enable WRM to establish the location of grid injection points and the capacity of the network proximate to the development sites.

7.5 Landbank Requirements

The application of digestate as a fertiliser product is, as with all fertilising products, subject to environmental regulation including the Nitrate Vulnerable Zone (NVZ) regulations and Farming Rules for Water. These regulations place limits on the application rates of fertilisers based on soil and crop type, and restrictions on the timing of application in line with crop demand. The latter point on timing of application requires the operator of an anaerobic digestion plant, or its downstream supply chain, to hold at least nine months digestate storage capacity. This requirement is usually addressed by operators by arranging lagoon storage in

[13] When GGSS tariff is also applied.

the agricultural supply chain who receive digestate. The application of these regulations to digestate use has, in some areas, led to concerns on the landbank that is available for the recycling of digestate to land.

This section calculates the anticipated volume of digestate that may be produced in the area and provides insight into the scale of landbank available for spreading this digestate and the typical proximate landbank required to support compliant operation of a plant.

Calculation of Digestate Mass

Whole digestate produced by an AD plant is typically about 95% of the quantity of organic feedstock that is fed to the digester. The remaining 5% of mass is collected in gasses and condensate that evaporate off the waste mass during the digestion process, as well as collections of grit and sediment which may settle within the tank. Section 6.0 of this report identifies that 145,936 tonnes per annum of household food waste and 842,319 tonnes of C&I food may be available for processing through anaerobic digestion. Furthermore, following the removal of inorganic contaminants and loss of mass through digestion, it is estimated that 724,836 tonnes per annum of PAS110 certified digestate may be available for land spreading. Importantly, this scenario assumes that 100% of the captured food waste is processed through AD.

Review of Regional Land Use

The West and East Midlands together cover approximately 2.97 million hectares, with land use dominated by a mix of urban areas and agriculture. The East Midlands, particularly Lincolnshire, Nottinghamshire, and Leicestershire, has extensive arable farming, producing cereals, vegetables, and root crops. In contrast, the West Midlands, especially in counties like Shropshire, Staffordshire, and Warwickshire, features more pastureland used for livestock grazing. Overall, the East Midlands contains a higher proportion of arable land, while the West Midlands supports more permanent grassland and mixed farming systems.

Secondary data on land use has been attained from the Department for Energy Food and Rural Affairs (DEFRA) Survey of Agriculture and Horticulture in England, conducted annually on June 1st. This survey provides data on holdings and agricultural activity at the county and unitary authority level providing information on arable and horticultural cropping, land usage which has been used within the calculation s of landbank availability.

Table 19 provides a breakdown of the land use and arable crop areas within East Midlands and West Midlands.

Table 19 - Land use and arable crop areas adapted from Defra (2024)

Region	Unit	Temporary Grass (Under 5 years)	Permanent Pasture	Arable Crops & uncropped arable land	Crops for stockfeed	Wheat
East Midlands	Hectares	77,017	239,108	748,011	6,574	269,392
West Midlands	Hectares	114,670	317,260	378,921	8,045	135,910

Land Characteristics

Further research has identified that the East Midlands features a mix of soil types, but loamy and clay soils predominate, especially in counties like Nottinghamshire, Leicestershire, and Lincolnshire. The West Midlands contains a broader variety of soils, including clays, loams, and sandy soils, often influenced by local geology and topography. Excess winter rainfall[14] is mostly moderate(150-250mm) in the East Midlands and low (<=150mm) in the west midlands. The area is mostly within a nitrate vulnerable zone (NVZ). A NVZ is an area designated by government authorities where there's a risk of nitrate pollution from agricultural activities, particularly fertilizer and manure applications, exceeding certain thresholds in groundwater or surface water

These characteristics have been used to understand the likely nutrient demand of the West and East Midlands area so that digestate application rates can be calculated and the area of required landbank to receive digestate can be broadly estimated. As a demonstration of the scale of landbank available in the West Midlands and East Midlands, the exercise has focused solely on the land use category within Table 19 titled *"crops for stockfeed"*, which includes grasses, grains and root crops. Moreover, the relevant Section 3 Grass and Forage Crops has been used to guide landbank calculations.

Application of RB209 Approach

The RB209 Nutrient Management Guide produced by the Agriculture and Horticulture Development Board (AHDB) is the recognised reference document for making fertiliser recommendations. The grassland section of this document has been used to understand the nutrient requirement for multi-cut silage ground. Full use of this guide required a variety of detailed information at an individual field and farm level which is not available at this

[14] Excess winter rainfall (EWR) is the amount of rainfall the land receives after the soil profile becomes fully wetted in the autumn (field capacity) and before the end of drainage in the spring (around the end of March).

conceptual stage of an AD feasibility project. WRM has therefore made several reasoned and justified assumptions which include:

- Assumption that the area yields between 2 and 3 cuts of silage per year at a standard yield rate. The number of cuts in a given year is determined by annual differences in weather which affect the growing season. A two-cut regime is assumed so as not to overestimate realistic application rates;
- the grass growth class (GGC) is poor. This has been determined by applying the soil type against the average summer rainfall in accordance with Table 3.7 of the grassland section of RB209;
- the Soil Nitrogen Index (SNI) value is 2. This has been determined by applying the low rainfall scenario (500-600mm/annum) to the soil types within the crop types within table 3.15.

These justified assumptions listed above are taken forward to Table 3.8 of the grassland section of RB209 which recommends:

- poor/very poor GGC sites are likely to achieve DM yield levels towards the lower end of the range in most years within table 3.8
- An annual application rate 130 kg/ha of nitrogen of which:
    - 80 kg/ha is applied to the first cut; and,
    - 50 kg/ha is applied to the second cut.

An important sensitivity here is the number of cuts, as seasons in which a third cut of silage is taken would result in a higher nutrient demand. The calculations above have therefore been repeated for a three-cut system which recommends:

- An annual application rate 250 kg/ha of nitrogen of which:
    - 100 kg/ha is applied to the first cut,
    - 75 kg/ha is applied to the second cut; and,
    - 75 kg/ha is applied to the third cut.

The quantity of nitrogen supplied by the digestate is now evaluated to enable the calculation of the landbank require to receive the full quantity of digestate that would be produced by the processing the total captured C&I and HH food waste arisings The Organic Materials chapter of RB209 identifies that digestate from an AD plant processing food waste has a typical total nitrogen content of 4.9kg/tonne and calculates the application rates that are required for the nutrient content of the digestate to satisfy the nutrient demands as calculated by RB209. This calculation results in the estimation of the number of hectares that would be required to spread the full annual quantity of digestate produced by AD facilities.

Table 20 - Land use and arable crop areas adapted from Defra (2024)

Factor	Unit	Two cut silage system
Digestate produced	Tonnes per annum	724,836
Total nitrogen content of digestate per tonne	Kg/t	4.8
Nitrogen demand of crop	Kg/ha	150
Digestate application rate	t/ha	31
Land required to spread full digestate production at calculated application rate	ha	23,195

This analysis shows that an application rate of 31t/ha would be required to meet the annual nutrient demand of the grassland system. At the assumed maximum digestate production of 724,836 from AD facilities within the region, a landbank area of 23,195 hectares would be required for digestate spreading. The area for stockfeed within Table 19 equates to a total of 16,619 ha, which is below the calculated 23,195 hectares required for spreading. It is important to highlight that this exercise has focused on one of many different land types where digestate can be spread to. Furthermore, stocked represents only 1.3% of the Arable Crops & uncropped arable land within the West and East Midlands and 0.7% if total pastureland is included. As such, this exercise suggests that there is a surplus of arable and pastureland available for the application of digestate.

8.0 CONCLUSIONS

8.1 Final Remarks

This briefing report introduces anaerobic digestion, and the contextual landscape of AD within the Midlands region. This work is presented to the Midlands Net Zero Hub and partner local authorities and is intended to aide understanding of, and the strategy drivers underpinning, anaerobic digestion as a technology and net zero renewable energy solution.

8.2 Next Steps

This report will be issued to MNZH and its partner authorities, ahead of a local authority workshop, to be held on 9th July 2025. Representatives of WRM will be available throughout the month of June to provide further context to the project where required and answer any questions partners may have on the contents of the briefing report. Local authority colleagues shall, at this time, be invited to submit proposals for sites that they may wish to consider suitable for an anaerobic digestion development.

A workshop session is scheduled to be held on 9th July, where representatives from WRM will be present to address and field any final questions related to the briefing paper. Within this workshop, WRM will reveal the sites shortlisted to be taken forward for consideration prior to commencement of the feasibility studies.

APPENDIX 1 – OPERATIONAL PLANTS PROCESSING AGRICULUTRAL WASTES WITHIN THE MIDLANDS REGION

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
PH BioEnergy	Valley House (Park House Farm)	Valley House, Park House Farm, Castle Bytham, Grantham, NG33 4RS	South Kesteven District Council	8,663	0.20
A G & H Barnett & Son	New Buildings Farm AD	New Buildings Farm, Boarding Kennels, Cresswell Road, Hilderstone, ST15 8SL	Stafford Borough Council	1,354	0.05
A. V. Sheardown & Sons	Land at Woolsthorpe Lane	A. V. Sheardown & Sons, Grange Farm, Woolsthorpe, NG32 1NU	South Kesteven District Council	15,000	0.20
Abbotsmoor Farm (Ms Catherine Suckley)	Abbotsmoor Farm	Abbotsmoor Farm, Haughton, West Felton, Shropshire, SY11 4HF	Shropshire Council	22,000	1.00
Advantage Biogas Limited	Whitchurch Biogas Ltd - Broughall Fields Farm	Broughall Fields Farm, Ash Road, Whitchurch, Shropshire SY13 4DE	Shropshire Council	43,000	2.55
AE Lenton (AEL Biogas)	AE Lenton	AE Lenton Anaerobic Digestion Plant, East Kirby Airfield, PE23 4BU	East Lindsey District Council	26,325	1.20
Agrivert	Blisworth Hill Farm	Blisworth Hill Farm, Stoke Road, Blisworth, NN7 3DB	West Northamptonshire Council	5,182	0.25
Agrivert	Manor Farm	Brigg Road, Caistor LN7 6RT	West Lindsey District Council	9,850	0.50
Agrivert	Tuxford - Old Great North Road AD - farm waste	Old Great North Road AD, Tuxford, Nottinghamshire, NG22 0NE	Bassetlaw District Council	15,000	0.50

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Agrivert	Stragglethorpe Biogas AD plant (Samworth Farms)	Stragglethorpe AD facility, Cropwell Bishop, Nottinghamshire, NG12 2JU	Rushcliffe Borough Council	20,000	0.50
Agrogren Limited	Agrogen AD	Batchacre Hall, Shay Lane, Shebdon, Stafford, ST20 0PX	Stafford Borough Council	6,610	
Andrew Dale	Newnham Farm	Newnham Farm, Yockleton, Shrewsbury, SY5 9PX	Shropshire Council	1,354	0.05
Arlington Farming Ltd	Dean Hall Farm	Dean Hall Farm, Ollerton Road, NG23 6BB	Newark and Sherwood District Council	20,000	0.20
Bedstone Growers (Phillip Mann)	Heath Farm/ Bedstone Growers	Heath Farm, Hopton Heath, Hopton Heath, Shropshire, SY7 0QB	Shropshire Council	6,000	0.35
Belmont Farms Ltd	Belmont Farms	Belmont Farms, Stygate lane, Melton Mowbray, LE14 2QN	Melton Borough Council	5,309	0.20
Biogen	Holbeach AD Plant	Manor Farm, Holbeach Hurn, Spalding, Lincolnshire, PE12 8LW	South Holland Distict Council	30,000	1.50
Biogen	Retford AD Plant	Sutton Cum Lound, Retford, Nottinghamshire, DN22 8SB	Bassetlaw District Council	45,000	3.00
Birch Solutions - Birch Energy - Singleton Birch	Willoughton	Limestone Farming, Laynes Farm Piggery, Willoughton, DN21 5SN	West Lindsey District Council	17,411	0.50
Birch Solutions - Birch Energy - Singleton Birch	Northwold	Worlaby Top, Brigg, DN20 0NS	West Lindsey District Council	17,412	0.50

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Birch Solutions - Birch Energy - Singleton Birch	Melton Ross Quarries	Barnetby, DN38 6AE	North Lincolnshire Council	30,000	2.00
Bowley Storage and Marketing	Bowley Court Farm AD	Bowley Court Farm, Hope Under Dinmore, Leominster, HR6 0PL	Herefordshire Council	13,725	0.50
Branston	Branston Potatoes	Branston Potatoes, Mere Road, Branston, LN4 1NJ	East Staffordshire Borough Council	10,000	0.30
Brinklow Biogas	Highwood Farm (Brinklow)	Highwood Farm, Coventry Road, Brinklow, Rugby, CV23 0NJ	Rugby Borough Council	41,000	-
British Sugar Plc	NEWARK SUGAR FACTORY	Newark Sugar Factory, Great N Rd, Newark, NG24 1DL	Newark and Sherwood District Council	50,000	2.17
BROOKFIELD FARMS LIMITED	Brookfield Lodge AD	Brookfield Lodge Farm, Hackmans Gate Lane, Belbroughton, Stourbridge, DY9 0DL	Dudley Metropolitan Borough Council	1,354	0.05
Channing Digester	Brandon Grange AD	Brandon Grange Farm, Bretford Road, Coventry, CV8 3GE	Rugby Borough Council	11,000	0.50
Cranford Management Ltd	Cranford	Cranford Farming Co, Cranford Hall, Cranford, Kettering, Northamptonshire, NN14 4AL	North Northamptonshire Council	2,964	0.12
DJ & HM Morgan	Penllan Farm	Penllan Farm, Peterchurch, Hereford, HR2 0SU	Herefordshire Council	10,800	0.25

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Dyson Farming (Prev. Beeswax Farming)	Nocton Fen Farm	Nocton Anaerobic Digestion Facility, Land off Nocton Fen Lane, Nocton	North Kesteven District Council	40,000	2.00
Dyson Farming (Prev. Beeswax Farming)	Carrington Farm AD	Carrington Farms Ltd, The Estates Office, Beeches Lane, CARRINGTON, BOSTON, LINCOLNSHIRE, PE22 7JD	East Lindsey District Council	55,000	3.00
Easom & Sons (Broom House Farm)	Broom House Farm Anaerobic Digester (Farm AD)	Easom & Sons Oakerthorpe, Broom House Farm, Furnace, Oakethorpe, Alfreton, Derbyshire, DE55 7LL	Amber Valley Borough Council	14,600	0.25
Edward Morris (Milton Farm) / Herefordshire Biogas	Milton Farm / Kingspan Insulation Ltd - farm waste	Milton Farm AD, Pembridge, Leominster, HR6 9LA	Herefordshire Council	33,000	2.00
Ermine Farms	Heath Farm AD Plant	Heath Farm, Main Street, Normanby By Spital, LN8 2AE	West Lindsey District Council	7,418	0.13
Evergreen Gas	BMAD	Barretts Mill, Woofferton, Ludlow, Shropshire, SY8 4AH	Shropshire Council	300	0.01
FKB Ltd	Sleaford AD (Holdingham Biogas)	Sleaford AD (Holdingham Biogas), Holdingham, Sleaford, NG34 8JG	North Kesteven District Council	69,340	2.00
Future Biogas	Heath Farm Energy Ltd - Metheringham	Heath Farm, Metheringham, Lincolnshire, LN4 2AL	North Kesteven District Council	31,124	0.50

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Future Biogas	Merlin Renewables - Hibaldstow	Merlin Renewables, Redbourne Road, Hibaldstow, North Lincolnshire, DN20 9NN	North Lincolnshire Council	31,557	0.50
Future Biogas	Grange Farm Energy - Scampton - Spridlington	Grange Farm, Cliff Road, Spridlington, Market Rasen, Lincolnshire, LN8 2DN	West Lindsey District Council	43,897	0.50
Future Biogas	Biogas Meden - Former Welbeck Colliery	Welbeck Colliery, Budby Road, Cuckney, Mansfield, Nottinghamshire, NG20 9PU	Mansfield District Council	45,000	0.36
Grange Farm Energy	Grange Farm	Cliff Road, Spridlington, Lincolnshire, LN8 2DN	West Lindsey District Council	16,000	0.25
Grimscote (Manor Farm)	Grimscote (Manor Farm)	Manor Farm, Grimscote, Towcester, Northamptonshire, NN12 8LN	West Northamptonshire Council	2,808	0.13
Hall Farm	Hall Farm	Hall Farm, Snitton, Ludlow, Shropshire, SY8 3EZ	Shropshire Council	5,000	-
Herefordshire Biogas Ltd	HBLAD1	Herefordshire Biogas Ltd, Pembridge Industrial Estate, Pembridge, Leominster, HR6 9LA	Herefordshire Council	13,246	0.50
Home Farm (Stretton Energy AD)	Stretton Energy AD	Stretton Energy AD, Home Farm, Leebotwood, CHURCH STRETTON, SY6 6LX	Shropshire Council	13,300	0.50

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Honeypot Farm	Honeypot	Honeypot Energy Limited, South Lodge Farm, Lobthorpe, Grantham, Lincolnshire, NG33 5LS	South Kesteven District Council	5,501	0.20
Hopes Ash Farm	Hopes Ash Farm	Hopes Ash Farm Hope Mansell Lane Hope Mansell Herefordshire HR9 5TJ	Herefordshire Council	800	0.03
J. L. Jones & Co	Manor Farm	Manor Farm, Wistanstow, Craven Arms, SY7 8DG	Shropshire Council	4,830	0.25
Jason Bayley	Biolectric Plant Ladyleys Farm	Ladyleys Farm, Lullington, South Derbyshire, Swadlincote, DE12 8EE	South Derbshire District Council	1,354	0.05
JR Willoughby	White House Farm	White House Farm, Spilsby Road, Thorpe St Peter, Skegness, PE24 4PU	East Lindsey District Council	5,600	0.20
Keisby Estate	Keisby Estate	Keisby Estate, Villa Farm, Keisby, Bourne, PE10 0RZ	South Kesteven District Council	4,495	0.17
Lea Hall Farm	Lea Hall Farm	Lea Hall Farm, The Lea, Lea Cross, Shrewsbury, SY5 8HY	Shropshire Council	10,500	0.50
Little On Farm/ Midland Pig Producers AD	Wheaton Aston Farm/ Little Onn Farm	Wheaton Aston Farm, Little Onn, Stafford, ST20 0AU	Stafford Borough Council	8,268	0.10
Ludlow Bio Energy	Woofferton Sawmill	Woofferton Sawmill, Ludlow, SY8 4AW	Shropshire Council	9,500	0.48
McCain	PAS (Grantham) Ltd	PAS Grantham Ltd, Easton, Grantham, Lincolnshire, NG33 5AY	South Kesteven District Council	700,000	1.49
ME Furniss & Sons (Farms)	New House AD	New House Farm, Chester Road, Chetwynd, Newport, TF10 8BN	Telford and Wrekin Council	11,800	0.23

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Mr. & Mrs. S. Hughes	Grindley House Farm	Grindley House Farm, A518, Grindley, Stafford, ST18 9LR	Stafford Borough Council	41,000	-
Mr. R. Turner	Barr Farm	Mr. R. Turner, Barr Farm, Main Road, Deeping St. Nicholas, Spalding, PE11 3HA	South Holland Distict Council	3,250	0.10
Much Fawley Farm	Much Fawley Farm	Much Fawley Farm, Fawley, Hereford, HR1 4SP	Herefordshire Council	12,500	0.20
Oakfields Farm	Oakfields Farm	Oakfields Farm, Brington Road, East Haddon, Northampton, NN6 8DS	West Northamptonshire Council	3,692	0.13
Orchard House Foods	Orchard House Foods	Orchard House Foods, Corby, NN17 4SW	North Northamptonshire Council	20,000	0.50
Park House Farm (Robert Pinches)	Park House Farm	Park House Farm, Habberley, Pontesbury, Shrewsbury, Shropshire, SY5 0TW	Shropshire Council	3,000	0.50
Pickstock Telford Ltd	Hortonwood 45	Pickstock Telford Ltd, Hortonwood 45, Telford, TF1 7FA	Telford and Wrekin Council	14,800	0.49
Preston Boats Farm (Mr Robert Burton)	Preston Boats Farm (Farm AD)	Preston Boats Farm, Preston on Severn, Uffington, Shrewsbury, Shropshire, SY4 4TB	Shropshire Council	8,200	0.50
Princes Ltd - Long Sutton	Princes Ltd - Long Sutton	Princes Ltd, Bridge Rd, Long Sutton, Spalding, PE12 9EQ	South Holland Distict Council	250,000	2.17

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Priors Halton Farm	Priors Halton	Priors Halton, Bromfield, Ludlow, Shropshire, SY8 2JN	Shropshire Council	4,600	0.13
R A Williams	Wrinehill AD	Wrinehill Hall Farm, Mill Lane, Wrinehill, Crewe, CW3 9DE	Newcastle-under-Lyme District Council	1,354	0.05
R H-J (Farms) Ltd	Hare Hills Farm	Hare Hills Farm, Fen Road, Toynton St. Peter, Spilsby, PE23 5AY	East Lindsey District Council	13,500	0.24
Roden Renewables Ltd	Roden Renewables	Roden Renewables, New House Farm, Minsterley, Shrewsbury, SY5 0HR	Shropshire Council	5,309	0.20
Severn Trent Green Power	Stoke Bardolph energy crop (Farm AD)	Burton Joyce, Nottingham ,NG14 5HL	Gedling Borough Council	62,000	2.00
Shedfield Growers	The Leen Digester	The Leen, Pembridge, Leominster, Herefordshire, HR6 9HN	Herefordshire Council	15,500	0.45
Simon Lifely	The Farm CHP	Simon Lifely, The Farm, Moreton Jeffries, Hereford, HR1 3QY	Herefordshire Council	2,655	0.10
Staples	Marsh Farm (Farm AD)	Sea Lane, Wrangle, Boston, Lincolnshire, PE22 9HE	Boston Borough Council	37,164	1.40
Staples Brothers Ltd	Staples Anaerobic Digestion CHP Plant (Waste AD)	Staples Bros Limited, Station Farm, Station Road, Boston, Lincolnshire, PE22 0SE	East Lindsey District Council	51,000	4.90
STL Energy Limited	Hampton Bishop/Court farm	Court Farm, Hampton Bishop, Hereford, HR1 4JU	Herefordshire Council	32,100	1.50

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
Thornfield 003	Thornfield 003	Abertanat, Llanyblodwel, Oswestry, SY10 8NA, Shropshire	Shropshire Council	15,250	0.76
Thornfield 008 Ltd	Lower Drayton Farm	Lower Drayton Farm, Penkridge, Stafford, ST19 5RE	South Staffordshire Council	41,000	-
Tomkinson Farms Limited	Tomkinson Farms AD	Coton End Farm, Gnosall, ST20 0EA	Stafford Borough Council	1,354	0.05
Two Hoots Farm	Two Hoots Farm	Two Hoots Farm, Green Lane, Bromyard, HR7 4RS	Herefordshire Council	12,000	0.50
Unilever	Burton Marmite factory	Burton Marmite factory, Burton Plant, Wellington Road, Burton-on-Trent, Staffordshire, DE14 2AB	East Staffordshire Borough Council	18,000	1.00
Vale Green Energy	Springhill AD Plant	Springhill Nurseries Ltd, Salters Lane, Lowermoor, Pershore, WR10 2PE	Wychavon District Council	25,550	0.50
Vale Green Energy	Throckmorton - Vale Green 2 (Rotherdale)	Rotherdale Farm, Long Lane, Tilesford, Pershore, WR10 2LA	Wychavon District Council	17,600	-
Veolia	HEINEKEN Ledbury Cider Mill	Robertson's Business Park, Little Marcle Lane, Ledbury, Herefordshire, HR8 2JT	Herefordshire Council	250,000	0.40
Walford & North Shropshire College Farm	Walford & North Shropshire College Farm	Walford & North Shropshire College Farm, Baschurch, Shrewsbury, SY4 2HL	Shropshire Council	6,000	0.10
Warden Farming Company	Grayingham Grange Farm AD Plant	Grayingham Grange Farm, Grayingham, Gainsborough, DN21 4JD	West Lindsey District Council	7,418	0.13

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts-electric)
WG GH & M BROOKES	Nothill Farm AD	Nothill Farm, Creighton, Stramshall, Uttoxeter, ST14 5AT	East Staffordshire Borough Council	1,354	0.05
Wharton Farms Ltd	Wharton Court	Wharton Farms Ltd, Wharton Court, Leominster, Herefordshire, HR6 0NX	Herefordshire Council	9,000	0.30
Wigley Farm (R. Gough & Son)	Wigley Farm - R. Gough & Son	R. Gough & Son, Wigley Farm, Wigley Drive, Wigley, Ludlow, Shropshire, SY8 3DR	Shropshire Council	12,000	1.10
William Corbett Farms Ltd	Austrey House Farm	Austrey House Farm, Orton Lane, Austrey, Atherstone, CV9 3EA	North Warwickshire Borough Council	25,000	1.50
Works Farm (Merrivale Energy)	Works Farm	Works Farm, Plungar, NG13 9JN	Rushcliffe Borough Council	11,800	0.50
Wykey Farm	Wykey Farm (Farm AD)	Wykey Farm, Wykey, Ruyton-XI-Towns, Shropshire, SY4 1JA	Shropshire Council	22,900	1.00
Ynergy Ltd	Great Ynys Farm	Great Ynys Farm, Orcop, Hereford, HR2 8EP	Herefordshire Council	4,700	0.20

APPENDIX 2 – OPERATIONAL WASTEWATER TREATMENT PLANTS PROCESSING SEWAGE SLUDGE IN THE MIDLANDS REGION

Operator	Site Name	Plant Location	Local Authority Area	Annual Permitted Capacity (tonnes per annum)	Energy Generation Potential (Megawatts electric)
Dwr Cymru Welsh Water	Eign CHP - A, C, D, E	Eign Waste Water Treatment Works, Eign Road, Hereford, HR1 1RY.	Herefordshire Council	215,454	1.96
Yorkshire Water	Old Whittington WWTC - A C D	Old Whittington W W T W, Station Lane, Chesterfield, Derbyshire, S41 9HY	Chesterfield Borough Council	65,339	0.60
Anglian Water Services	Pyewipe Waste Water Treatment	Pyewipe Waste Water Treatment Works, Moody Lane, Grimsby, DN31 2SY	Shropshire Council	79,395	0.72
Anglian Water Services	Checkley STW - A,C,D	Checkley STW (23/10/4) - A,C,D, Checkley Sewage Treatment Works, Deadmans Green, Uttoxeter Road,	Staffordshire Moorlands	38,435	0.35
Anglian Water Services	Great Billing STW CHP Plant	Great Billing STW - A,B,C,D - 23 Crow Lane, Little Billing, Northampton, NN3 9BX	West Northamptonshire	457,263	4.16
Severn Trent Water Ltd	Minworth Generating Station	Minworth Generating Station, Severn Trent Water Ltd Generating Station, Kinsbury Road, Sutton, Coldfield,	Birmingham City Council	1,091,544	9.94
Severn Trent Water Ltd	Wanlip STW	Wanlip Sewage Treatment Works, Fillingate, Wanlip, Leicester, LE7 4PF	Charnwood Borough Council	340,421	3.10
Severn Trent Water Ltd	Strongford Sewage Treatment	Strongford Sewage Treatment Works - A,C, Barlaston Old Road, Barlaston, Stoke on Trent, England, ST12	Stafford Borough Council	230,169	2.10
Severn Trent Water Ltd	Finham 2 STW - A,C,D	Finham 2 STW Generating Station - A,C,D, St Martins Road, Finham, Coventry, CV3 6SD	Warwick District Council	230,169	2.10
Severn Trent Water Ltd	Derby Island STW Generating	Derby Island STW Generating Station, Derby Island Megaloughton Lane, Spondon, Derby, DE21 7BR.	Derby City Council	215,454	1.96
Severn Trent Water Ltd	Claymills STW - A, C	Claymills Sewage Treatment Works, Meadow Lane, Stretton, Burton on Trent, Staffordshire, DE13 0DB	East Staffordshire Borough	208,755	1.90
Severn Trent Water Ltd	Roundhill STW Generating Station -	Gibbet Lane, Kinver, Stourbridge, West Midlands, DY7 2QU	Dudley Metropolitan Borough	115,084	1.05
Severn Trent Water Ltd	Alfreton Sewage Treatment Works -	Westhouses Rd, Alfreton, Derbyshire, DE55 7FF	Amber Valley Borough Council	94,439	0.86
Severn Trent Water Ltd	Worksop sewage gas CHP	Rayton Lane, Worksop, Nottinghamshire, S81 0UD	North East Lincolnshire Council	88,290	0.80
Severn Trent Water Ltd	Rushmoor 2 STW	Rushmoor Lane, Allscott, Telford, Shropshire, TF6 5EX	Telford and Wrekin Council	78,517	0.72
Severn Trent Water Ltd	Spernal (Redditch) STW - D	Spernal Lane, Spernal Ash, Redditch, Warwickshire, B80 7EU	Stratford-on-Avon District	68,633	0.63
Severn Trent Water Ltd	Barnhurst STW - D	Oxley Moor Road, Wolverhampton, Staffordshire, WV9 5HN	City of Wolverhampton Council	68,633	0.63
Severn Trent Water Ltd	Worcester STW	Aston Road, Bromsgrove, Birmingham, Worcestershire, B60 3EX	Bromsgrove District Council	68,633	0.63
Severn Trent Water Ltd	Yaddlethorpe STW- A, D	Yaddlethorpe STW, North Moor Lane, Yaddlethorpe, Scunthorpe, North Lincolnshire, DN17 2BU.	North Lincolnshire Council	68,633	0.63
Severn Trent Water Ltd	Melton Mowbray STW - A,C,D	Lake Terrace Melton Mowbray, Leicestershire, LE13 0BZ	Melton Borough Council	56,005	0.51
Severn Trent Water Ltd	Monkmoor STW Generating Station	Monkmoor Lane, Monkmoor, Shrewsbury, Shropshire, SY2 5TL	Shropshire Council	53,589	0.49
Severn Trent Water Ltd	Rugby STW - A,C,D	Newbold Road, Rugby, Warwickshire, CV21 1HF	Rugby Borough Council	46,671	0.43
Severn Trent Water Ltd	Mansfield STW Generating station -	Bath Lane, Mansfield, Nottinghamshire, NG18 2BU	Mansfield District Council	43,925	0.40
Severn Trent Water Ltd	Kidderminster STW - A,C,D	Stourport Road, Oldington, Kidderminster, Worcestershire, DY11 7QL	Wyre Forest District Council	42,827	0.39
Severn Trent Water Ltd	Newthorpe STW - A,C, D	Halls Lane, Newthorpe, Nottinghamshire, NG16 2DE	Broxtowe Borough Council	42,827	0.39
Severn Trent Water Ltd	Hartshill STW - A,C,D	Woodford Lane, Hartshill, Nuneaton, Warwickshire, CV10 0SA	North Warwickshire Borough	41,729	0.38
Severn Trent Water Ltd	Brancote STW Generating Station	Tixall Road, Stafford, Staffordshire, ST18 0XX	Stafford Borough Council	38,435	0.35
Severn Trent Water Ltd	Loughborough STW - A,C,D	Festival Drive, Loughborough, Leicestershire, LE11 0AJ	Charnwood Borough Council	38,435	0.35
Severn Trent Water Ltd	Toton Sewage Treatment Works A,	Toton Sewage Treatment Works, Off Barton Lane, Attenborough, Beeston, Nottinghamshire, NG9 6DY	Broxtowe Borough Council	31,846	0.29
Severn Trent Water Ltd	Coalport STW Generating Station -	Coalport STW Generating Station, Severn Trent Water Ltd, Coalport Sewage Treatment,Telford	Telford and Wrekin Council	29,650	0.27
Severn Trent Water Ltd	Barston STW - A, D	Friday Lane, Eastcote, Solihull, West Midlands, B92 0HY	Solihull Metropolitan Borough	26,355	0.24
Severn Trent Water Ltd	Hinckley STW - A,C,D	Hinckley Road, Ibstock, Coalville, LE67 6PB	North West Leicestershire	20,865	0.19
Severn Trent Water Ltd	Four Ashes STW - A, D	Four Ashes Sewage Treatment, Deepmore Lane, Wolverhampton, WV10 7DG	South Staffordshire Council	10,981	0.10
Severn Trent Water Ltd	Gainsborough STW - A, D	Wildsworth Sewage Treatment Works, Carr Lane, Wildsworth, Gainsborough, Lincolnshire, DN21 3ED	West Lindsey District Council	10,981	0.10

APPENDIX 3 – FOOD WASTE ESTIMATION FIGURES USING WRAP READY RECKONER MODEL FOR EAST AND WEST MIDLANDS

Local authority	Number of Households	Food Waste Collected	Collection Approach	Tonnage Estimate (low)	Tonnage Estimate (standard)
Amber Valley Borough Council	60,470	No	N/A	4,147	5,090
Ashfield District Council	57,720	No	N/A	3,357	4,258
Bassetlaw District Council	56,740	No	N/A	3,564	4,449
Blaby District Council	44,570	No	N/A	3,465	4,160
Bolsover District Council	38,550	Yes	Comingled	2,303	2,904
Boston Borough Council	31,720	No	N/A	1,977	2,472
Broxtowe Borough Council	51,750	No	N/A	3,790	4,597
Charnwood Borough Council	78,990	No	N/A	5,883	7,115
Chesterfield Borough Council	51,050	Yes	Comingled	3,058	3,854
Derby City Council	114,040	Yes	Comingled	6,631	8,410
Derbyshire County Council	0	N/A	0	-	-
Derbyshire Dales District Council	35,500	Yes	Source	2,704	3,257
East Lindsey District Council	72,170	No	N/A	3,875	5,001
Erewash Borough Council	53,140	No	N/A	3,588	4,417
Gedling Borough Council	54,800	No	N/A	3,968	4,823
Harborough District Council	44,440	No	N/A	3,600	4,293
High Peak Borough Council	43,660	Yes	Comingled	3,121	3,802
Hinckley and Bosworth Borough	52,330	No	N/A	3,883	4,699
Leicester City Council	144,660	No	N/A	7,590	9,846
Leicestershire County Council	0	N/A	0	-	-
Lincoln City Council	47,620	No	N/A	2,735	3,478
Lincolnshire County Council	0	N/A	0	-	-
Mansfield District Council	51,320	No	N/A	2,845	3,645
Melton Borough Council	24,700	No	N/A	1,861	2,247
Newark and Sherwood District	57,930	No	N/A	3,882	4,785
North Northamptonshire	159,500	Corby - Yes, East - Yes,	Source	10,597	13,085

Local authority	Number of Households	Food Waste Collected	Collection Approach	Tonnage Estimate (low)	Tonnage Estimate (standard)
North East Derbyshire District	48,560	Yes	Comingled	3,365	4,122
North Kesteven District Council	54,580	No	N/A	4,180	5,031
North West Leicestershire District	48,550	No	N/A	3,535	4,292
Northamptonshire County Council	0	N/A	0	-	-
Nottingham City Council	146,610	No	N/A	7,243	9,530
Nottinghamshire County Council	0	N/A	0	-	-
Oadby and Wigston Borough Council	24,360	No	N/A	1,823	2,203
Rushcliffe Borough Council	54,680	No	N/A	4,486	5,339
Rutland County Council	18,030	No	N/A	1,452	1,733
South Derbyshire District Council	50,230	Yes	Comingled	3,662	4,446
South Holland District Council	44,240	No	N/A	3,038	3,728
South Kesteven District Council	67,100	No	N/A	4,976	6,022
West Northamptonshire	184,060	Yes	Source	12,721	15,593
West Lindsey District Council	46,260	No	N/A	3,035	3,756
East Midlands (Total)	**2,214,630**	**-**	**-**	**145,936**	**180,485**

Local authority	Number of Households	Food Waste Collected	Collection Approach	Tonnage Estimate (low)	Tonnage Estimate (standard)
Birmingham City Council	461,670	No	N/A	22,806	30,009
Bromsgrove District Council	43,020	No	N/A	3,287	3,958
Cannock Chase Council	45,980	No	N/A	3,012	3,729
Coventry City Council	152,970	Yes	Comingled	9,031	11,417
Dudley MBC	141,490	No	N/A	8,619	10,827
East Staffordshire Borough	55,750	No	N/A	3,749	4,619
Herefordshire Council	89,790	No	N/A	6,054	7,455
Lichfield District Council	48,910	No	N/A	3,684	4,447
Malvern Hills District Council	38,320	No	N/A	2,719	3,317

Local authority	Number of Households	Food Waste Collected	Collection Approach	Tonnage Estimate (low)	Tonnage Estimate (standard)
Newcastle-under-Lyme Borough	58,320	Yes	Source Segregated	3,929	4,839
North Warwickshire Borough	29,580	Yes	Comingled	2,031	2,492
Nuneaton and Bedworth Borough	60,800	Yes	Comingled	3,747	4,695
Redditch Borough Council	37,860	No	N/A	2,381	2,972
Rugby Borough Council	51,230	Yes	Comingled	3,759	4,558
Sandwell MBC	136,380	Yes	Source Segregated	6,737	8,865
Shropshire	151,230	Yes	Comingled	10,525	12,884
Solihull MBC	95,500	No	N/A	6,620	8,110
South Staffordshire Council	49,210	No	N/A	3,672	4,440
Stafford Borough Council	63,720	No	N/A	4,711	5,705
Staffordshire County Council	-	-	-	-	-
Staffordshire Moorlands District	45,010	Yes	Comingled	3,251	3,953
Stoke-on-Trent City Council	119,510	Yes	Comingled	5,904	7,768
Stratford-on-Avon District Council	66,440	Yes	Comingled	5,074	6,110
Tamworth Borough Council	34,840	No	N/A	2,255	2,798
Telford and Wrekin Council	83,280	Yes	Source Segregated	4,981	6,281
Walsall MBC	118,170	No	N/A	6,100	7,943
Warwick District Council	69,080	Yes	Comingled	5,251	6,329
Warwickshire County Council	-	-	-	-	-
Wolverhampton MBC	113,680	No	N/A	5,790	7,564
Worcester City Council	47,610	No	N/A	3,120	3,862
Worcestershire County Council	-	-	-	-	-
Wychavon District Council	61,900	No	N/A	4,415	5,381
Wyre Forest District Council	48,640	No	N/A	3,064	3,823
West Midlands (Total)	**2,619,890**	**-**	**-**	**160,278**	**201,149**