Notice of Meeting

Climate Change Advisory Panel
Councillors Virgo, Mrs McKenzie-Boyle, Mrs Hayes MBE, Mrs Ingham, Kennedy, Leake, Mossom, Parker and Temperton

Thursday 27 January 2022, 6.30 pm
Online Only - Via Zoom

Bracknell Forest Council

Agenda

Item	Description	Page
1.	**Apologies for Absence**	
2.	**Declarations of Interest**	
	Members are asked to declare any disclosable pecuniary or affected interests in respect of any matter to be considered at this meeting. Any Member with a Disclosable Pecuniary Interest in a matter should withdraw from the meeting when the matter is under consideration and should notify the Democratic Services Officer in attendance that they are withdrawing as they have such an interest. If the Disclosable Pecuniary Interest is not entered on the register of Members interests the Monitoring Officer must be notified of the interest within 28 days. Any Member with an affected Interest in a matter must disclose the interest to the meeting. There is no requirement to withdraw from the meeting when the interest is only an affected interest, but the Monitoring Officer should be notified of the interest, if not previously notified of it, within 28 days of the meeting.	
3.	**Minutes**	1 - 6
	To approve as a correct record the minutes of the meeting of the Climate Change Panel on 3 November 2021.	
4.	**Urgent Items of Business**	
	Any other items which, pursuant to Section 100B(4)(b) of the Local Government Act 1972, the Chairman decides are urgent.	
5.	**Local Renewable Power Generation: Anaerobic Digestion Plant High Level Feasibility**	7 - 78
	To update Climate Change Advisory Panel on the outcome of the Atkins report into the high-level feasibility of building an anaerobic digestion (AD) plant in the Borough. **Reporting:** Kevin Gibbs	

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6.	**Feedback from Re3 visits**	79 - 92
	To received feedback on the visits to Lakeside Energy from Waste plant on the 30 November 2021 and Wallingford Anaerobic Digestor plant on the 1 December 2021.	
7.	**Feedback from the Anaerobic Digester visit**	93 - 98
	To receive feedback on the Anaerobic Digester visit at the Biogen facility in Dummer Hampshire on the 3 September 2021.	

Sound recording, photographing, filming and use of social media is permitted. Please contact Hannah Stevenson, 01344 352308, hannah.harding@bracknell-forest.gov.uk, so that any special arrangements can be made.

Published: 27 January 2022

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CLIMATE CHANGE ADVISORY PANEL
3 NOVEMBER 2021
6.30 - 8.36 PM

Present:
Councillors Virgo, Mrs McKenzie-Boyle, Mrs Hayes MBE, Mrs Ingham, Kennedy, Leake, Mossom, Parker and Temperton

21. **Declarations of Interest**

There were no declarations of interest.

22. **Minutes**

The minutes of the Climate Change Advisory Panel meeting held on 20 September 2021 were confirmed as a correct record.

Councillor Mrs Hayes reminded Members of the upcoming site visits and to confirm their attendance.

23. **Urgent Items of Business**

There were no urgent items of business.

24. **Chairman's Introduction**

Councillor Virgo introduced the Climate Change Advisory Panel and explained that this Advisory Panel meeting would be looking at Heat Pumps.

The Chairman made the following recommendations, which were seconded, to Councillor Mrs Hayes, the Executive Member for Environment, who would take them forward to the Executive.

1. The panel recommends that Bracknell Forest legitimise legislation in the SPD 2016 making all new development be fitted with a EV charging unit or at least electric cabling to a face plate on the exterior side of the building.

2. The panel recommends that Solar PV Panels be installed as standard on all new builds.

25. **Update on the Council's decarbonation plans**

Kevin Gibbs, Executive Director: Delivery, Hazel Hill, Energy Sustainability Officer and Laura Johnson, Executive Director (assets & growth) Silva Homes presented an update on the Council's decarbonation plans

The presentation covered the following highlights:

- The Bracknell Forest Website was kept upto date regarding the Councils Climate Change activity and could be accessed at any time.
- The Council had 4 principles to tackle climate change and would be measuring themselves against these principles.
- There were 42 projects across the council directorates.
- Big Green Week was held from19 – 26 September, which was also when the last meeting was held, the Council undertook a number of initiatives during the week.
- Property Services had been successful in a couple of Salix bids from the government.
- The greening our Waste Strategy had been successful, with the introduction of food waste which had been well used by residents.
- Recycling rates had increased above target at 58%
- Overview and Scrutiny Panel had undertaken a review to implement food waste recycling into flats across the borough which would be taken forward.
- The anti-idling project continued to move forward, and was now at the implementation stage.
- Work was also being undertaking with taxi drivers and taxi ranks.
- A number of trees were being planted as part of the Queens Jubilee celebrations
- The Bracknell Forest Giants took place in the Lexicon in August and gained national interest.
- A ground source heat pump system was being sought for Westmorland Park.
- The Panel discussed EV charging points in the last meeting, the council had secured £100k to roll out EV charging points.
- £160k of funding had been secured to look at cycling and walking plans.
- There had been15 press stories between April and August 2021.
- The food truck name video of “Dame Foodie Dench” had been very popular.
- Hazel maintained a database of 94% of houses across the borough of their energy efficiency ratings across the borough.
- The Green Deal Community project had run from 2014 – 216 and allowed residents to claim 50% of the money required to pay for energy efficiency projects.
- The Warfield Park Project 2017-18 had converted 482 park homes to mains gas saving an average of 40% of energy costs for residents. This was the largest undertaking by Cadent gas at the time.
- The Green Homes Grant Bid 1A delivered 123 retrofit measures to 99 homes and saved residents an average of £300.
- Flexible Home Improvement Loans were low interest flexible loans for homeowners over 60. Typical works include essential repairs and maintenance and new boilers.
- The Warm Home Scheme offered gas connection to homes who did not have mains gas. 28 houses had been connected across the Borough.
- Warm, Self and Well was a Public Health funded project funded over 2 years, The schemes helped those with underline health conditions and provided work such as insulation and boiler replacements.
- The Green Homes Grant bid 2 was run by the Greater South East Energy Hub and aimed to pay for “fabric first” measures.
- There was a Sustainable Warmth bid for £1.6m which had been unsuccessful.
- Lots of work had been undertaken supporting the Social Housing Decarbonising Fund with Silva Homes.
- Laura Johnson ,Silva Homes presented on the Social Housing Decarbonising Fund.

- The funding was first announced in the Conservative Manifesto in 2019, with clarification on how the funding should be used in 2020.
- £160m had been put forward for the first wave in 2021/22 and completed by 2023.
- Information regarding how the bid would be launched earlier in 2021, with guidance published on the 23 August 2021.
- The successful projects would be notified in December 2021.
- The project would start in January 2022 and completed in January 2023.
- The bases of the bid was Fabric First, Worst First, Least Regrets.
- The government were offering a mixed funding scheme, where Silva homes would put in a third and the government would put in two thirds.
- The cost caps for homes upgrades were based on the EPC performance of the home.
- The bids needed to be submitted by the local authority.
- Joint working took place to look at the requirements of the bid and the available stock data at Bracknell Forest and Silva Homes.
- External support had also been sought form the Social Housing Retrofit Accelerator.
- The bid depended on accurate EPC data.
- The bid covers 223 properties which covered a mix pf loft insulation, storage heating renewal, external wall insulation and photovoltaics.
- The total project cost was £584,175.50, the grant request was £351,650.50and Silva homes would contribute £232,525.
- The project turn around was tight, and it was important to get an appropriate contractor in place.
- The wave 2 funding was expecting to be release in Spring 2022, and this time it would not be necessary to go through the Local Authority.

As a result of the groups comments and questions, the following points were made:

- It was requested that the North of the Borough be looked at for cycling links.
- There had previously been a great plant a tree scheme – it would be great to do something similar. The Queens Jubilee would bring forward a number of new tree planting.
- Tree planting alone wouldn't combat climate issues alone in the borough.
- It was requested that coms issued around what individuals could to do change their behaviour.
- The Climate Change Officer was undertaking a regular blog regarding changes individuals could make.
- It was important that the fabric of dwellings was as airtight as possible for heat pumps. Residents were encouraged to contact Hazel who would be able to provide information on the property and even visit to give the best advice for the dwelling.
- There were no bids at present for air source heat pumps.
- The government had asked Councils to bid on funds rather than to give funding.
- The group praised all Hazel's hard work and expertise.
- Warm air heating would depend whether they were gas or electric provided and would have to be looked at on an individual basis.
- There were no new bid officers, it was built into current officer's workloads as and when required.
- Silva Homes had launched a new Strategy in July 2021 which has a focus on climate change.

- Silva Homes Climate Change Champion on the Executive Board was Rob Shaw, who was the Executive Director for People and Change.
- The data between two organisation was shared, and EPC ratings were regularly updated. If a house hadn't become vacant since 2013 then these hadn't been rated.
- The program was a national program, it was important to get a local contractor on board. It would take 3-4 months for a contractor to do loft insulations. All contractors had to be trustmarked, which not all contactors were.
- Silva Homes had an £8m programme for planned maintenance.
- £1m over next three years was being pledged as part of Silva Homes climate change strategy and £9m for the following seven years.

26. **Developers view on Heat Pumps**

Nick Rogers, Design Director for Taylor Wimpey, joined the panel to give a developers view on Heat Pumps.

The presentation covered the following highlights:

- Taylor Wimpey had an environment strategy with key targets for climate change. Key targets included reducing operational carbon emissions by 26% by 2025 and reducing carbon emissions from the supply chain and customer homes by 24% by 2030.
- In the last 8 years operational carbon emissions had already been reduced by 38%.
- There was a program to increase natural habitats by 10% on new developments.
- Taylor Wimpy aimed to cut their waste intensity by 15% by 2025 and use more upcycled materials.
- 59% emissions came from the supply chain.
- 40% emissions come from the customer's home.
- 2021 building regulations were hoped to be released in December, they were promised in 2020,it was expected that PVs would need to be put on all houses, increasing double glazing to triple glazing, install more efficient boilers with flue gas heat recovery, wastewater heat recovery systems, upgrade items around the fabric of the house.
- In four years time, it was expected the 2025 new build house would also include the air source heat pump, smart heating controls, increased wall insulation and underfloor heating instead of bigger radiators.
- It was expected that by 2025 EV charging points would be in all homes.
- Acknowledges that air source heat pumps are a large part of the solution. A lot of work would be required by 2025 to make sure it worked and it could be used successfully
- Regulations were not expected until 2023 which would give over a year to get ready.
- Work was already being done with suppliers.
- There were design issues that needed to be resolved, such as noise issues.
- Last year there had been 36000 insulation of heat pumps, the increase that the government required would affect the supply chain.
- Many suppliers required confirmation from the government before they started manufacturing.
- There was a huge issue with contractors and subcontractors in the industry at present, with people leaving the industry.

- There were only 916 trained heat pump fitters that needed to increase ten fold by 2025.
- Grid capacity was an issue.
- Insulation costs still needed to be confirmed as they varied from £4000 - £10,000.
- Customer acceptance was also a challenge.
- Ground source heat pumps were not an option as they were difficult in dense sites.
- Developers didn't want to become utility providers.
- Heat networks were difficult on low density sites.

Arising from the group's questions, the following comments were made:

- Developers were beginning to understand what the end result would be, but were still waiting for the government guidance and regulations to be released. It was difficult to change the houses that were being built at present.
- Timber looked like the obvious building solution going forward, but there were capacity issues with timber. If all house structure in Europe was turned to timber then there would be issues with supply.

27. **Heat Pump Discussion**

Russell Julier, a Consultant Petroleum Engineer, joined the meeting to give his views on Heat Pumps and the challenges faced by home heating.

Russell's presentation covered the following points:

- Russell had had a heat pump since the early part of 2021.
- Russell had started his career with British Gas.
- CO2 emissions were down by 42% since 2005, the change was how to decarbonised home heating.
- Each home was emitting over 3 tonnes of CO2.
- Most of homes in Bracknell Forest (over 80%) were heated by gas or oil which meant 1000s of homes needed to be converted.
- Home insulation was very important, it was important that our homes were well insulated, this would increase the overall demand on the national grid.
- Over half our homes needed to be upgraded to an C grading EPC.
- The options to replace boilers included air and ground sourced heat pumps, storage heaters and thermal batteries which may be useful in some settings.
- Heat pumps were the governments preferred option, but were currently expensive to install.
- The pumps used refrigerant technology to extract low grade outside heat to create higher grade heat for home heating and hot water use.
- The pros that they were very energy efficient.
- The initial cost was £7500 - £15000.
- The running costs would be higher and this was the case for Russell.
- There were additional space requirements, outside there needed to be space for the heat pump and ground loop, inside there needed to be space for a hot water tank and thermal battery.
- Radiators may need to be changed to improve heat transfer.
- Russell was estimating that he would use 12,000kwh less per year since having his heat pump installed.
- The efficiency of his heat pump was 250%.

- Electric storage heaters were another way of heating a house without a boiler, but would be more expensive to run.
- Other technologies in development included thermal batteries which were a direct replacement for boilers. These require time of use tariffs to prevent high bills.

Arising from the groups comments and questions, the following points were made:

- Having worked in the energy industry it made sense to change to an air sourced heat pump and was involved in a government scheme to get one installed fairly quickly. It also helped with the understanding and effect that it would have on a house and how to get used to the pump.
- The heat pump was not without its compromises, including the temperature of water.
- The fabric of the house didn't have to be amended.
- The noise of the fan was no louder than the old gas boiler.

28. **Date of next Meeting**

The date of the next meeting of the Advisory Panel was 11 January 2022

CHAIRMAN

To: **Climate Change Advisory Panel**
27 January 2022

Local Renewable Power Generation:
Anaerobic Digestion Plant High Level Feasibility
Executive Director of Delivery

1 Purpose of Report

1.1 To update Climate Change Advisory Panel on the outcome of the Atkins report into the high-level feasibility of building an anaerobic digestion (AD) plant in the Borough.

2 Recommendation

2.1 For noting by the Panel

3 Reasons for Recommendation

3.1 The building of an AD plant in the Borough would be a very substantial decision. Whilst the attached reports from Atkins give some high-level information, the Executive have acknowledged that our role in this work is limited to supporting the private sector by encouraging the market to provide a facility within the borough.

4 Alternative Options Considered

4.1 The council could choose to invest in alternative local renewable energy power generation, such as:

- Solar
- Wind turbines
- Hydroelectric
- Micro-nuclear
- Micro combined heat and power
- Hydrogen fuel cell

4.2 The project has discounted solutions that have been badged as local renewable energy power generation, which in fact have been retail solutions. Many councils have been credited with innovative work in this area, however many of these schemes are simply local retail solutions that are buying "green" energy on the open market and selling this locally at a profit. Now that the energy costs have changed due to supply side issues across Europe, these schemes are generating substantial losses to these councils, as they are now victims of the current squeeze in energy costs. Local generation must be creating energy and not just distributing it.

5 Background information

5.1 The council, in formulating its Climate Change strategy, highlighted a deficit in the local production of renewable energy. This hasn't been an area of council focus, over and above the inclusion in new building schemes of PV Solar cells, and combined heating and power systems. However, the issue was highlighted as an area of development for the borough, by Friends of the Earth, in their borough-by-borough metadata assessment of local authorities, albeit that their assessment included retail green schemes.

5.2 The main areas for this work are Solar PV cells on an industrial scale (solar farms), which the council is also exploring, plus community wind turbines and community batteries. A hydroelectric solution would seem to be less viable for Bracknell Forest due to the lack of fast flowing watercourses. The council does use energy from waste, as one of the disposal routes currently employed by the council to dispose of waste that would have ended up in landfill. The council also uses, via the re3 waste disposal partnership, Anaerobic Digestion to process its food waste. So, the benefit sought from this paper is looking at the possibility of diverting some or all of this biowaste to address this in borough strategic green power need.

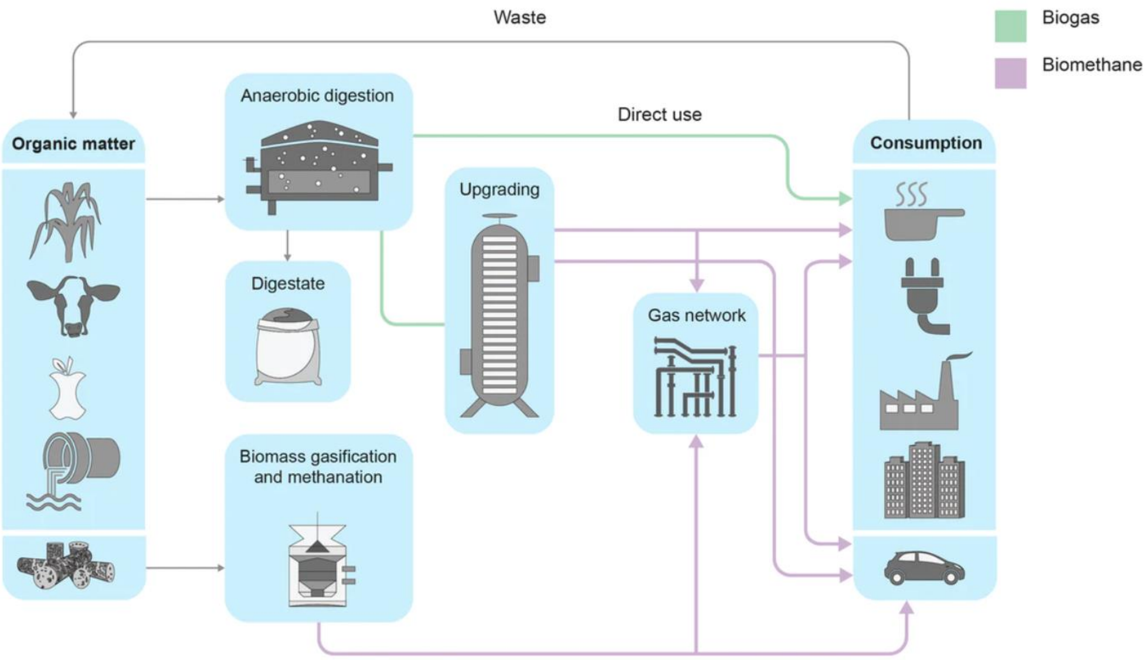
5.3 The disposal of food waste from the Borough is managed through the re3 partnership contract and is currently undertaken through a plant in Wallingford, Oxfordshire. These arrangements are contracted until 2031.

5.4 At COP26, 105 countries, including the UK, pledged to cut methane emissions by 30% by 2030. Significant amounts of this gas come from sources, such as livestock farming and decaying waste in landfill sites. The UK Anaerobic Digestion and Bioresources Association (ADBA) believes that "*… over 140 million tonnes of readily available organic wastes [is] still being left undigested in the UK every year. Left untreated, they release methane… directly into the atmosphere, which contributes to climate change and causes human health issues. Recycling these through AD instead means that these emissions are captured and the organic wastes turned into valuable bioresources, such as a storable, flexible green gas (biogas), a rich-in-nutrient bio-fertiliser (digestate), bioCO2 as well as other valuable bio-products. These products can help decarbonise carbon-intensive sectors such as heat, transport and agriculture*".

6. High level analysis

6.1 Anaerobic Digestion is a flexible technology for power generation. Plants can be built on many different scales, from large facilities treating sewage sludge or municipal waste, to smaller ones handling materials from a particular farm or a small community. Biogas, which is one of the end products of the AD process, is approximately 60% methane and 40% CO2 by volume.

6.2 This variation of biogas composition means that the energy content of biogas can vary; the lower heating value (LHV) is between 16 megajoules per cubic metre (MJ/m^3) and 28 MJ/m^3. One cubic metre of biogas at 60% methane content converts to 6.7 kWh energy. Biogas can be used directly to produce electricity, through a combined heat and power (CHP) unit, and heat or as a renewable energy source for cooking. Biogas is required to be upgraded for most uses and for injection into the gas grid as per the diagram below. https://www.iea.org/reports/outlook-for-biogas-and-biomethane-prospects-for-organic-growth/an-introduction-to-biogas-and-biomethane.



6.3 A single home uses an [average of 2,900kWh (£588 pa) of electricity and 12,000 KWh (£576 pa) of gas every year]. To scale this up, 2,000 houses would require circa 5,800,000 KWh (5,800 MWh) of electricity and 24,000,000 KWh (24,000 MWh) of gas per annum. 1 Kilowatt hour (kWh) is equal to 0.001 megawatt hour (MWh)

6.4 Feedstock is any input into an AD plant. In this example, for illustration, this report uses food waste as the feedstock for the calculations. The average village size is around [1]2,000 homes, and these would require ~0.7 MW_e electrical power or 5800 MWh_e/annum, which is around 17,000 tonnes of food waste (or other feed stock). This is just under the current annual re3 food waste tonnage of 19,000.

6.5 To build an electricity to grid AD plant would require circa £9m capex and a biomethane to grid circa £8.7m (excluding land costs). Opex costs would be circa £245k and £368k per annum respectively for a 19,000 tonne AD plant. Opex is made up of the day-to-day costs of running the plant. https://birchsolutions.co.uk/how-much-does-it-cost-to-build-a-biogas-plant/

6.6 If the energy is fed directly to a local settlement then additional costs of infrastructure would be required, and these would vary depending on location, type of energy, and distance from the plant to the relevant infrastructure. Clearly if this were a new settlement, the developer could include this within their scheme, however retrofitting would mean that the costs would either need to be picked up in the scheme development costs or could be a shared cost with the national grid.

6.7 In Annex B the report details the key characteristics of process configurations for two different size AD plants. Processing food waste from 19,000 tonnes p/a requires a land space of approximately 0.8 hectares. If additional feed stocks were sourced to increase that tonnage to 50,000 p/a then a plant would need to be sited on land of approximately 2.1 hectares. This size plant would generates circa 3 MWh of

[1] Broadly, a village tends to have a population of between 500 and 2,500, making it larger than a hamlet but smaller than a town - https://www.designingbuildings.co.uk/wiki/Village_definition

electricity, which could power up to 6,000 homes (11% of the borough's housing stock).

6.8 Currently, to supply the Wallingford AD plant, Re3 has 780 (65 per month) vehicle movements to transport the 19,000 tonnes of food waste. It is estimated to supply a plant to power 6,000 homes, would need circa 700 (14 per week) movement per year.

6.9 The table below shows the average unit rate price change per kWh for gas and electricity prices from 2019 to 2022 prices. Trend is upward.

	2019	2020	2021	2022*
Gas pence/kWh	1.94p	2.07p	2.52p*	2.82p*
HH Electric pence/kWh	09.88p day, 05.81p night	12.797p day, 9.94p night	14.63p day, 10.91p night*	16.68p day, 12.22p night*

Average kWh unit rates for gas and electricity between 2019 to 2022 *Estimated CCS Basket Average Rates

6.10 Finding a suitable location for the plant would be a major task for any project. The value of land would vary significantly but an estimation from the Property team suggests that a 2-hectare plot of land would be worth circa £9m.

7 Conclusions

7.1 In terms of assessing the general proposal, from a "doable" standpoint, this report confirms the assertion that the basic business case does hang together as a solution to local sustainable power generation. However, even though this report points to the achievability of the project, from this piece of work a number of fundamental questions still need to be answered and hurdles addressed.

7.2 On the positives, the economics of power generation are such that the plant would make economic sense and a good business investment opportunity. Broadly the scheme would need £18m for land and build costs, plus the cost of connecting to the grid or wherever the power was going to be deployed to. Clearly if a developer were to provide the land as part of their scheme, then the economic business case improves considerably and many of the barriers to the project would be overcome. It also makes sense from both a waste disposal standpoint; costs would be no greater than our current solution (currently £7 per tonne) and savings would be generated with reduced road miles for disposal. The climate change credentials are very strong too, AD is seen as an efficient route to deal with biowaste and the associated greenhouse gas emissions that are methane; a gas that the UK has committed to reduce by 30%. A local solution that could be offered to agro-waste producers would, on a surface review, appear to be welcomed.

7.3 Of course the major consideration for the progression of a scheme is, should the council be engaged in this type of provision directly itself, using its own resources? Regardless of the finding of a pressure group, is this an appropriate space for a local authority to be engaged in? Is this something that the market could provide or with the council's help, something that the council could stimulate and nurture, rather than lead and provide? The recommendation from the Corporate Management Team, which was agreed by the Executive and was no. It is clear that the council, using it place making responsibilities, is better place in encouraging this type of provision, rather than looking to provide this itself. The council doesn’t have the leveller, either in surplus land, ability to access capital or in expertise, to be creditable in this space.

7.4 That said, the market is developing strongly and therefore, their only key issue is location. Location is key, and that the site will need to be acceptable to its neighbours, although its green credentials could help with this. Secondly the accessibility of the location, given the number of vehicle movements required to feed the plant. The example plant would need 14 feedstock vehicle movements per week as a minimum, and this will pose an issue everywhere in the borough. A 1-hectare size plant would accommodate the Re3 waste, setting the land costs at £3m, plus access roads and the connection to the grid (gas or electric).

7.5 The Executive have accepted that the skills needed to bring a scheme forward are not currently within the council. However, this is a good idea, to meet our need for local green power generation and to bring in new green technology jobs to the area. The next step is therefore to continue to engage with the market to ensure that they know that the council is supportive of schemes coming forward, albeit that they would be subject to the normal development control assesments.

8 Consultation and Other Considerations

Legal Advice

8.1 Nothing to add at this stage

Financial Advice

8.2 It is not possible at this stage to provide a detailed assessment of the potential financial implications to the Council of participating in such a proposal. As the report indicates, further specialist expertise would be required to undertake more detailed analysis of the high level options identified. In addition, recent and current consultations undertaken by CIPFA and DLUHC into proposed changes to the capital financing regime for local authorities have the potential to significantly restrict council investment in assets that are not directly related to core service delivery.

Other Consultation Responses

8.3 N/A

Equalities Impact Assessment

8.4 N/A at this stage

Strategic Risk Management Issues

8.5 Council investment in an AD scheme would be a significant risk. This report, having weighted the potentially long, costly and complex process have concluded that the direct provision by the council should not be pursued.

Climate Change Implications

8.6 To process the Borough’s (and potentially other Authorities) food waste at a location closer than currently is a positive move in relation to climate change. A reduction of miles travelled will result in a fuel and carbon saving. Using gas or electric generated by an AD plant is also a positive climate change impact particularly if done so locally.

Background Papers
Atkins – Anaerobic Digestion Feasibility Study

Contact for further information
Damian James, Assistant Director: Contract Services, Delivery Department - 01344 351325
Damian.james@Bracknell-forest.gov.uk

Kamay Toor, Assistant Director: Property, Delivery Department – 01344 355183
Kamay.toor@bracknell-forest.gov.uk

Anaerobic Digestion Feasibility Study

Bracknell AD Plant Technical Feasibility

Bracknell Forest Council

DATE 07 December 2021

Notice

This document and its contents have been prepared and are intended solely as information for Bracknell Forest Council and parties involved in the Anaerobic Digestion Plant Feasibility Study and is to be used in relation to this project only.

WS Atkins & Partners Overseas Engineering Consultants assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 37 pages including the cover.

Document History

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
Rev 1.0	Draft For Comments	J.Walker K.Dosumu T.Papalexandrou	R.Lancaster	G.Magklaras	S.Green	16/08/2021
Rev 2.0	Update	J.Walker K.Dosumu T.Papalexandrou	R.Lancaster	G.Magklaras	S.Green	08/11/2021
Rev 3.0	Final	R. Wilson				

Client Signoff

Client	Bracknell Forest Council
Project	Anaerobic Digestion Plant – Feasibility Study
Job Number	5205840
Client Signature / Date	

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Figures

Glossary of Terms

AD	Anaerobic Digestion
ADBA	Anaerobic Digestion and Bioresources Association
BtG	Biogas to Gas
BFC	Bracknell Forest Council
CAPEX	Capital Expenditure
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
COD	Chemical Oxygen Demand
CfD	Contract for Difference
EPR	Environmental Permitting Regulations
GGSS	Green Gas Support Scheme
GHG	Greenhouse Gas
IRR	Internal Rate of Return
LNG	Liquefied Natural Gas
NPV	Net Present Value
O&M	Operation and Maintenance
OPEX	Operational Expenditure
PFD	Process Flow Diagram
RTFO	Renewable Transport Fuel Obligation
SWOT	Strengths, Weaknesses, Opportunities and Threats
TDS	Tonnes Dry Solids
UK	United Kingdom
VOC	Volatile Organic Compound

Executive Summary

Bracknell Forest Council (BFC) is interested in the potential to use the food waste collected from BFC, Reading and Wokingham Councils and produce biogas. Atkins was commissioned by BFC to undertake a high-level Feasibility Study into the technical viability of a number of options including a potential development of its own Anaerobic Digestion (AD) plant. The intended purpose of the plant would be to treat collected food waste from approximately 47,000 households, that is currently disposed of through the re3 partnership with Wokingham and Reading Councils. 19,000 tonnes of food waste per year is the current collection expectation for 2021/22 for the combined total of the three councils.

The report is split into three main sections, firstly an introduction presenting the structure of the report, background information and scope of the study. Secondly, an assessment of three strategic options is investigated looking at the advantages and disadvantages of the following three options:

- Continue with current contract.
- Build own AD plant.
- Public/private partnership - collaborate with a third party

Lastly, an optioneering study assessing three different AD process configurations is performed, designed to inform BFC of the most desirable process option to employ in a scenario where the council decides to build their own AD plant.

The main conclusions and key findings for the strategic options assessment and the options evaluation are outlined below.

Strategic Options Assessment

Before BFC decides whether to go ahead with another option other than continue with the existing contract, it will be necessary to supplement the findings of this report with some further investigations including but not limited to the following:

- Gather data from commercial/industrial waste producers in Bracknell Forest Council and its surroundings to better understand the options of the potential third party who are already active in the AD industry and partner with BFC. The potential partners could be dairy farms, breweries, supermarkets, water treatment utilities and food production/processing facilities among others.
- Once the third party is identified, estimate the potential biogas yield from mixing the different feedstocks (BFC's food waste and third party's feedstock) which will determine the size of the plant, and any additional investment and capital costs but also additional revenues.
- Develop a more detailed understanding and certainty of existing and future incentive schemes and governmental support for the use of biogas especially in conjunction with the timescales necessary to develop, construct and commence an AD plant.
- If there is interest from BFC to go ahead, then a study would be needed to consider the practicalities and costs of logistics of bringing the materials to the AD plant's location.
- BFC should perform a study of how many vehicles they are need and how many they own that could transport food waste to the AD plant's location.
- Examine in more detail the regulatory framework for the digestate. The current regulatory framework is complex and fragmented separating Biosolids digestate (originating from the water industry) and waste digestate (originating from. The Environment Agency National Sludge Strategy, which is currently in consultation, intends to simplify the regulatory framework is in consultation.
- A cost-benefit analysis will be necessary, taking into account all the technical, financial and economic characteristics of the selected option which will estimate the investment's payback time, Net Present Value (NPV) and Internal Rate of Return (IRR) and ultimately inform BFC's business decision.

Options Evaluation

Atkins agreed an optioneering evaluation template with BFC and subsequently conducted an optioneering study based on the following shortlisted process options:

- Option 1: Anaerobic Digestion with Electricity to Grid
- Option 2: Anaerobic Digestion with Biomethane to Grid
- Option 3: Anaerobic Digestion with Biogas Export to Third Party

Supporting information such as process description, typical site layout, CAPEX, OPEX and revenue potential estimates are provided to facilitate the optioneering study. Summary of the key findings is portrayed in the table below.

Option	Footprint	CAPEX	OPEX	Annual Revenue Potential
1	9,755 m^2	£9,016,795	£255,000	£454,550
2	7,953 m^2	£8,734,359	£369,300	£1,398,314
3	7,556 m^2	£7,569,441	£255,000	£351,697*

*Note that this value is based on wholesale gas price. A premium would likely be agreed between BFC and the third party to distribute some for the revenue generated from sale of biomethane under the Green Gas Support Scheme (GGSS). The exact premium is subject to negotiation between both parties and therefore cannot be accounted during this assessment.

A summary of the weighted options evaluation results is portrayed in the table below. It can be seen that Option 3 has the highest total weighted score, making it the recommended process option, in a scenario where BFC decides to build their own AD plant. This option has a moderate associated CAPEX and OPEX. It requires the least amount of footprint when compared to the alternative options. Moreover, it provides the unique opportunity for BFC to avoid operating the considerably complex biogas upgrading facility by exporting it to a third party.

Option	Process	Total Weighted Score	Ranking
1	Anaerobic Digestion with Electricity to Grid	70	3
2	Anaerobic Digestion with Biomethane to Grid	110	2
3	Anaerobic Digestion with Biogas Export to Third Party	125	1

1. Introduction

1.1. Structure of Report

The document provides a high-level pre-Feasibility Study, performed by Atkins for the potential development of Bracknell Forest Council's (BFC) own Anaerobic Digestion (AD) plant. Following this introduction, the report is set out in the following sections:

- Strategic Options Assessment – explores legal framework and policy associated with AD, assesses three strategic options and proposes a recommendation.
- Options Evaluation – describes the optioneering methodology employed and provides a summary of the options evaluation, as well as the recommended AD process options.

1.2. Background

BFC is interested in investigating the feasibility and viability of building its own AD plant in the Borough. The Borough has recently commenced food waste collections for 47,000 households. Currently, this food waste is disposed of through a re3 partnership with Wokingham and Reading Councils. Food waste is collected at doorstep and taken to sites in Bracknell (Longshot Lane HWRC) and Reading (Smallmead HWRC) for bulking before being transported to an AD plant in Wallingford, Oxfordshire. Current collection expectations for 21/22 would be around 19,000 tonnes for the combined total from the three Councils.

1.3. Scope of Work

Atkins scope is to complete optioneering of suitable food waste treatment alternatives, including 'do nothing or minimum option' for the potential AD plant.

Three strategic options were identified by Atkins and agreed with BFC prior to the commencement of the study. These are as follows:

- Continue with current contract.
- Build own AD plant.
- Public/private partnership- collaborate with a Water Utility (i.e. Thames Water, Severn Trent etc.) to share Capital Expenditure (CAPEX) investment and benefit from their operational expertise.

2. Strategic Options Assessment

This section provides a background to AD as a process, including details of desirable feedstock(s) for the AD process. The quantities and characteristics of waste available to BFC are then identified and assessed, along with an overview of the legislation regulations associated with AD. The concluding part of this section is a Strategic Options Analysis (SWOT), which looks to conclude which of the three strategic options identified, is most desirable for BFC at this time.

2.1. Anaerobic Digestion Process Overview

AD is based on the degradation of organic substances by micro-organisms in the absence of oxygen to produce methane (CH_4), carbon dioxide (CO_2), water (H_2O), digestate and other minority products. AD is a globally proven technology, well-suited to treating the effluent arising from many industrial processes and produce valuable by-products for example an soil conditioner/alternative fertiliser (digestate) and renewable fuels from Biogas and/ or renewable energy/heat from the burning of biogas produced.

AD is used to treat a wide range of biodegradable organic substances and especially in effluent treatment is used to reduce the Chemical Oxygen Demand (COD). Typically, AD can reduce the COD level of an effluent by up to around 90% thus, reducing the costs of effluent treatment with the additional benefit of biogas production.

AD can occur under cryophilic (<25ºC), mesophilic (25-45ºC) or thermophilic conditions (around 55ºC). The higher temperature processes are typically faster but less stable and require a higher level of instrumentation and control in order to maintain process conditions. However, the typical operating conditions for these processes employed to process industrial and domestic residuals are:

- Temperature range of 32 to 42ºC (i.e. mesophilic conditions);
- Retention time up to 20 days, depending on feedstock and process;
- Neutral pH value (e.g. pH 6.7 to 7.7);
- Ready supply of organic and inorganic nutrients in the form of degradable carbon, nitrogen, phosphorous, potassium and essential trace metals.

Depending on local conditions at site, the digester may require external heating or cooling in order to maintain a stable temperature. Performance of anaerobic systems can be adversely affected by the presence of toxic compounds in the effluents (e.g. cleaning agents).

Biogas generated in the process is typically rich in CH_4, (around 60%) and its chemical energy can be recovered using a gas engine, gas turbine or gas boiler. The biogas also contains other gases including CO_2, hydrogen sulphide (H_2S) and water vapour. Pre-treatment at either the pre-combustion or pre-digestion stage may be required to reduce H_2S and water levels to mitigate corrosion, operational problems and emissions to air resulting from combustion of the biogas.

Feedstocks for AD are commonly solid waste (Biosolids) from wastewater treatment processes and/or municipal or industrial solid waste (from this point to be referred to as organic waste) for example waste food, fats, oils. The AD of organic waste is undertaken at scale in both the water and waste industry across the globe. Co-digestion, mixing of organic waste with Biosolids, is technically feasible and can enhance digestibility. Co-digestion is more practicable when municipal and/or industrial organic waste is pre-conditioned, for example screened and mixed to form an organic 'soup' like substance in order to minimise the impact of variances in digestibility from one waste feedstock to another.

The basic principles of the process are outlined in the Process Flow Diagram (PFD) shown in Figure 2-1*.

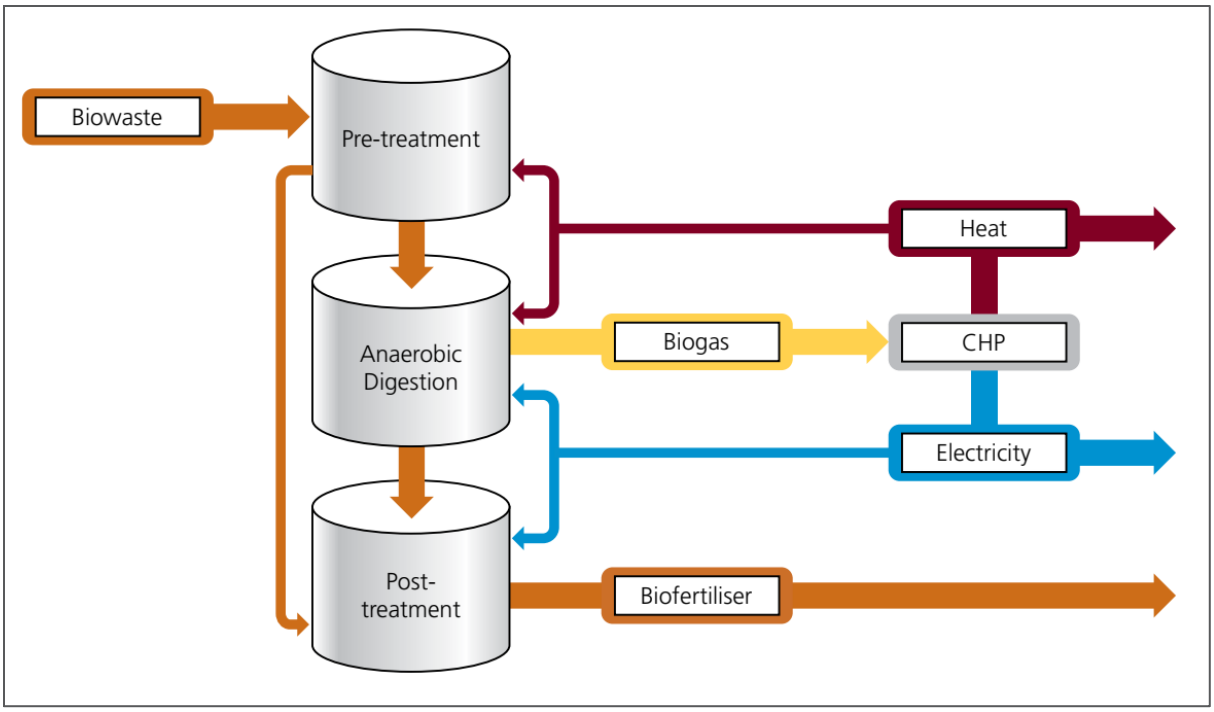

Figure 2-1 – Typical AD Process Flow Diagram

**CHP (Combined Heat and Power) engines has been highlighted in the schematic, there are however alternative approaches which could be deployed for example gas turbines, gas to grid or biofuel production especially if waste heat is not required in the treatment process.*

AD produces digestate, which can be a valuable bio-fertiliser depending upon the feedstocks used and has potential to be used as a renewable source of critical fertiliser elements such as nitrogen and phosphorus. The nutrient composition of the digestate depends on the feedstock but generally speaking, the digestate would be rich in nitrogen, phosphorus, potassium and trace elements.

Digestate contains nitrogen in a form that is readily available for crop uptake and can help reduce reliance on industrially produced sources of nitrogen. Inorganic phosphate fertilisers are derived from non-renewable sources and will become more expensive as increasing pressures are placed on limited current supplies. The phosphate content of digestates is likely to become increasingly attractive in the near to medium term. Use of digestate as renewable fertilisers offers a potential saving in Greenhouse Gas (GHG) emissions from the mining of and the transport and production activities associated with the manufacture of inorganic fertilisers.

The following list provides details on desirable feedstock properties for AD:

- Stable composition/properties- more consistent processing time, conditions and more reliable yield of biogas and consistent digestate.
- Steady and secure supply of feedstock.
- High energy content- the energy content will determine the biogas yield
- Low contaminants- ensures that bacteria in the AD are not poisoned and the digestate product is free from harmful contaminants.
- High organic content- sufficient organic content needs to be present for the process to be efficient.

- Controlled moisture content- there needs to be a minimum amount of moisture in the feedstock to sustain the moisture levels required for efficient AD to take place.

Co-digestion of biosolids, municipal and/or industrial organic waste is undertaken to varying degrees across the globe, this is primarily due to local waste collection strategies, National or Regional waste strategies and/or regulatory frameworks, rather than any specific barriers to the process.

2.2. Quantities and Characteristics of Feedstock Available

To determine whether an AD plant is feasible or not, it is important to first assess the quantities and characteristics of the inputs (or potential inputs) that would feed the AD plant. BFC have so far advised that 19,000 tonnes of collected food waste per year is currently available as feedstock (with potentially some extra when all properties are served, though this amount is understood to be minimal) from the three councils (Bracknell, Reading and Wokingham). BFC understands that it may be necessary to supplement this feedstock with other potential sources of waste in order to make the AD plant viable. No data has been made available to Atkins on the quality of the food waste collected by the re3 partnership at the time of writing this report. However, it is understood that to date no quantities of food waste have been rejected by the Contractor. It should be noted though, that pre-treatment of food waste is an integrated part of the feedstock's preparation before it enters the digester. Subject to the type of feedstock used, the pre-treatment includes size reduction, extraction of any impurities and/or harmful materials such as ferrous metals using a magnet and sand using a filter and floating particles (plastics, textiles, wood) by a hydraulically operated rake. The level of pre-treatment will impact also the quality of the digestate. Any contaminants that pass through the process and end up in the digestate will need to be minimised and provide a high-quality product to the end user.

Other sources of food waste potentially suitable for supplementing the 19,000 tonnes/year food waste include:

- Food shops/supermarkets (separated food waste)
- Restaurants/Cafes
- Commercial properties that serve food such as hospitals, caterers, schools etc.
- Food production/processing facilities

In addition to food waste, there are other feedstocks that could be desirable to AD plants, though they will influence the process performance of the AD plant as well as end use of the digestate product. These include:

- Agricultural sources
- Dairy farms
- Production facilities for paper/wood/cardboard
- Green waste collected from kerbside
- Commercial green waste
- Sludge from Sewage Treatment Works.

BFC was not able to provide a list of industries within their borough that could supplement the 19,000 tonnes of food waste per year currently collected from the three councils. Nonetheless, to understand the feasibility of using the above feedstocks, an investigation would need to be carried out to determine the quantities and predicted characteristics of these types of waste that would be available to BFC and how it could impact the AD process. However, this investigation is outside the scope of this report.

From publicly available information it is noted that there are at least five waste AD plants within a 20 miles radius from BFC which process domestic and commercial food waste. Figure 2-2 depicts the waste AD plants on the map and Table 2-1 summaries a few key details of the AD plants. It is unknown if these five waste AD plants operate at their full capacity or if there is a headroom capacity available. In any case, they could be considered potential partners for the expansion of their own AD facilities and to process the additional food waste generated by the three councils.

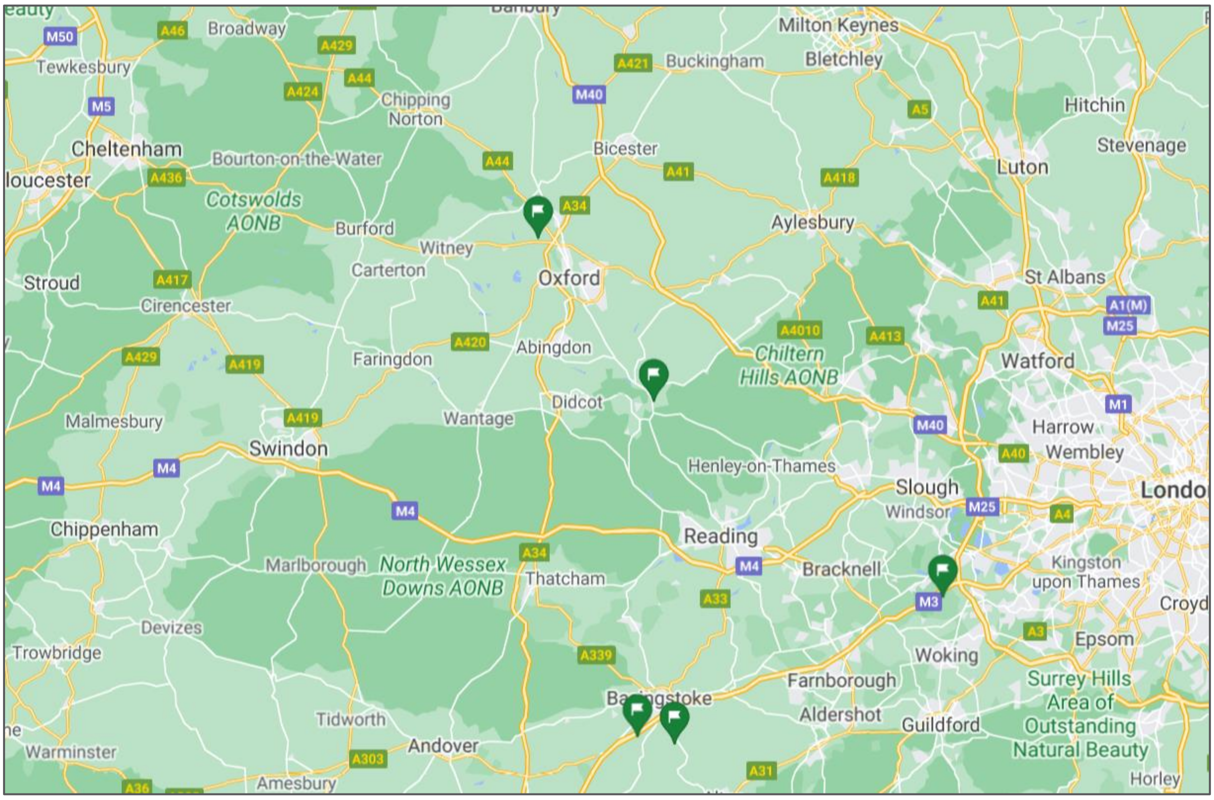

Figure 2-2 – Waste AD Plants within a 20 miles radius from Bracknell Forest Council

Table 2-1 – List of Waste AD Plants[1]

No.	Plant	Operator	Capacity (tonnes)	Technology	Electricity Generation Capacity (kW_e)	Specific Energy Generation (kWh/tonne)
1	Agrivert Wallingford AD Plant & Composting Site Benson Lane Wallingford OX10 6SQ	Severn Trent Green Power Limited	50,000	CHP	2400	420
2	Agrivert West Cassington AD Facility Worton Farm, Witney, Oxon, OX29 4FL	Severn Trent Green Power Limited	50,000	CHP	2100	370
3	Agrivert West London AD Facility Trumps Farm Kitsmead Lane Londcross KT16 0EF	Severn Trent Green Power Limited	48,500	CHP	2119	380

1 https://www.google.com/maps/d/u/0/viewer?mid=1PMuhQ28ZLIiZohXjQ0nhTUfLMZ2PvjQP&ll=51.55635166737446%2C-0.6843163286276965&z=9

4	Herriard AD Bio-Power Ltd Little Bushywarren Lane Herriard Basingstoke RG25 2NS	Herriard Bio Power Ltd	29,000	CHP	1195	360
5	Tamar Energy Limited Basingstoke AD Facility Dummer Basingstoke RG23 7LW	Biogen (UK) Limited	40,000	CHP	1430	315
6	Icknield Farm, Icknield Road, Ipsden, Oxfordshire, OX10 6AS	Green Gas Oxon	34,000	BtG and CHP	360	95

In addition to the waste AD plants listed above, Atkins identified the following facilities from Thames Water Utilities Limited (TWUL) which process sewage sludge in AD plants (Figure 2-3). These facilities could also be considered as potential facilities that could expand to accommodate the food waste from the three councils.

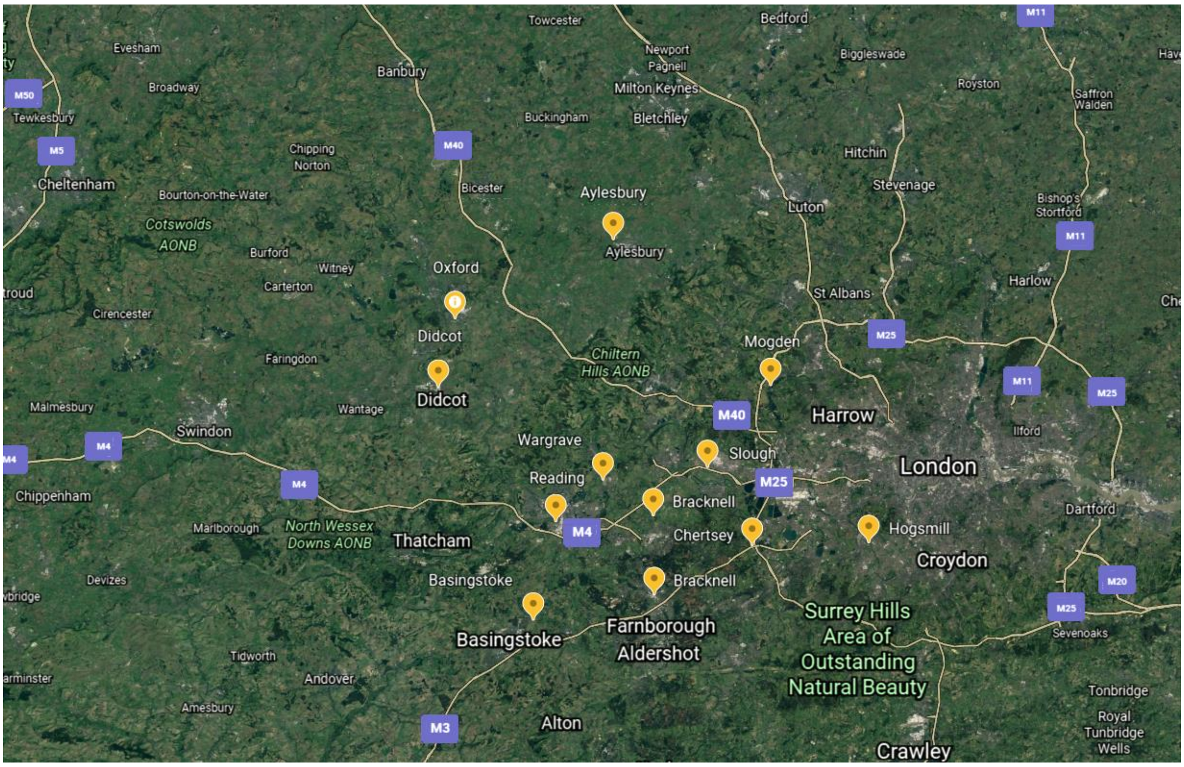

Figure 2-3 – Sewage sludge treatment centres with AD facilities

Table 2-2 summaries a few key details of the sewage sludge treatment centres with AD plants owned by Thames Water Utilities Limited (TWUL) including their headroom capacities. The closest facility in Bracknell has a capacity of 3,504 tonnes dry solids/annum (tds/a) which is equivalent to ym3/d feed; with a headroom capacity of only 356 tds/a. The largest AD plant is in Mogden with a capacity of 63,180 tds/a and a headroom capacity of 9,035 tds/a. The equivalent estimated tds of 19,000 tonnes of food waste would be approximately 4,700[2] tds. Hence, from that list, it is clear that there are a few sewage sludge treatment centres (Mogden, Oxford, Slough) with enough headroom capacity that could accommodate the required 4,700tds of food waste. However, considering the different types of feedstocks mixed in the process, certain upgrades would be necessary to be done including the erection of a pre-treatment centre for the removal of any impurities and perhaps the upscale of the equipment downstream of the digester as food waste would produce more biogas compared to sewage sludge. Considering that, an expansion would be required in all these sewage sludge treatment centres if it would be decided to partner with one of them to accommodate the food waste produced by the three councils. It should be noted that the identification of 'head room' in the table below is considered inconsistently across the industry. We have significant operational experience of operating and maintaining Biosolids digestion systems and recognise the requirement for Water Companies to maintain operational headroom to accommodate for seasonal fluctuations in Biosolids production, operational outages, and maintenance interventions across the fleet of assets. Thus, making predictions of head room is difficult to quantify at any given point. Hence, in order to gain a true sense of capacity further engagement with a preferred Water company is advised.

Table 2-2 – Sewage sludge treatment centres with AD facilities

No.	Facility Name	Technology	Capacity (tds)	Headroom capacity (tds)	Specific Electricity Generation (kWh/tds)
1	Aylesbury	Conventional AD	4,928	365	450-800
2	Basingstoke	Advanced AD	18,603	4,255	650-1000
3	Bracknell	Conventional AD	3,504	356	450-800
4	Camberley	Conventional AD	4,380	114	450-800
5	Chertsey	Advanced AD	10,179	2,333	650-1000
6	Didcot	Conventional AD	2,701	347	Gas to Grid
7	Hogsmill	Conventional AD	14,856	2,808	450-800
8	Mogden	Advanced AD	63,180	9,035	650-1000
9	Oxford	Advanced AD	23,517	4,946	650-1000
10	Reading	Advanced AD	10,670	2,707	650-1000
11	Slough	Conventional AD	15,221	7,738	450-800
12	Wargrave	Conventional AD	5,147	2,001	450-800
Total TDS			**176,884**	**37,006**	

Source: Thames Water Utilities Limited

[2] 19,000 tonnes x 26.2% of dry matter x 6% impurities

The UK Water industry are required to provide detailed market information on their Biosolids assets and operations by the regulator Ofwat as part of the drive to increase competition with the sector.

The drive for greater competition in the sector and the changing regulatory framework in England is leading to greater appetite within the Water industry to explore synergies with adjacent markets in order to leverage the benefits of co-treatment, to support funding to mitigate Biosolids growth and/or to leverage their experience to develop new business models.

2.3. Current Food Waste Disposal Contract

Although part of Atkins' scope was a high-level review of the existing food waste contract, that was not possible to be conducted as BFC advised that the contract could not be shared. However, through the QA process the following characteristics of the contract were understood:

1) Duration of the contract: From 2006 to 2031.
2) Baseline cost of existing arrangement (£ per tonne of waste processed) and scope included: £0p/t until end of March 2022, £7p/tonne from April 2022.
3) Details of any early termination clause (cost and minimum notice period): No termination clause in the food waste element.
4) Range of waste processed (minimum and maximum quantities per year): The arrangements were based on an expectation of 10ktpa. Current inputs will broadly double that. However, there are no minimum tonnages.
5) Signatory parties: Severn Trent Green Power and the Contractor

From a broader perspective from 2023 the Local Authorities in England will have to collect separately all the food waste produced in their jurisdictions. BFC advised that currently they do not collect food waste from flats, but it is expected not to dramatically increase the current volumes of food waste collected once collection commences. In terms of the baseline cost of the existing arrangement, in our view the disposal cost reported by BFC is very low (assuming that the quoted price refers to £7/tonne rather than 7p/tonne). As a comparison, based on Wrap's gate fees 2019/2020 report, the average gate fee paid by Local Authorities in AD plants was £35 per tonne[3] in 2019. For waste that contains packaging, an extra £5 to £15 per tonne should be considered for processing the food waste and managing the segregated packaging[4]. Hence, BFC's current disposal cost would be considered very competitive compared to the average market gate fee in other AD plants paid by other Local Authorities across the UK. It should be noted though that every contract is unique reflecting the market conditions at the time of signature, quantity and quality of waste, local competition and negotiations.

2.4. Legal Framework and Policy

As detailed on the government's Anaerobic Digestion Portal (run by the National Non-food Crops Centre (NNFCC), all anaerobic digestor operators in the UK must comply with regulations concerning[5]:

- Environmental Protection
- Animal by-products
- Duty of Care
- Health and Safety
- Waste Handling

[3] Excluding haulage costs
[4] https://wrap.org.uk/sites/default/files/2021-01/Gate-Fees-Report-2019-20.pdf
[5] Regulation | Anaerobic Digestion (biogas-info.co.uk)

2.4.1. Food waste AD Treatment and By-products Disposal Legislation Overview

All AD Plants that use any type of waste as feedstock currently fall under the scope of Environmental Permitting Regulations (EPR)[6]. In England, anaerobic digestion of waste is regulated by the Environment Agency and subsequently, the EPR (England and Wales) 2010. Operators of AD plants under these regulations, may fall under one of the following; Exemption, Standard Rules Permit, Bespoke Permit or Regulatory Position Statement. If building their own AD plant, BFC are likely to require a Standard Rules Permit, which is a fixed set of rules for common and defined activities and have fixed application fees. The scope of the EPR includes the handling, storage, disposal or use of any wastes produced through the AD process, including digestate unless it meets the relevant 'end of waste' criteria and is therefore no longer considered 'waste'. Currently end of waste can only be achieved if the waste is of source segregated origin. Thus, sewage sludge (considered non-source segregated at this time) would preclude end of waste status if co-treated. Any liquors produced or digestate returned via a sewer to a wastewater facility will need to meet Trade Effluent requirements and agreements made, and charges agreed with the relevant water company.

2.4.2. Environmental Impact (Benefits and Risks) of an AD plant Within the Borough

The key environmental impacts of an AD plant could be summarised in two main categories:

- GHG emissions
- Discharge of digestate

The GHG emissions associated with AD process includes methane and CO_2. Methane is the gas produced from the anaerobic degradation of organic matter. Methane emissions are estimated to be 23-28 times more powerful than CO_2 emissions in the global warming effect and therefore it is considered a gas of primary importance. Typically, methane being the main gaseous product of an AD process, is either combusted in a gas engine or is upgraded and injected into the gas grid to aid decarbonisation of the National Grid. However, methane can be released due to incomplete combustion or leak from the biogas storage and/or the digestate management.

CO_2 is produced primarily from the conversion of methane via the combustion process in a gas engine and to a lesser extent from the AD process itself. However, it should be noted that in both cases the CO_2 released from the AD process is considered as biogenic and therefore it does not account as fossil CO_2 and subsequently contributing to climate change.

For the GHG emissions flue gas treatment equipment is generally included in modern biogas equipment. In terms of CH_4, considering its global warming potential compared to CO_2 a flare is installed which ensures that CH_4 is always converted to CO_2 in case there is an excess of biogas which cannot be stored or used. Hence, flaring eliminates both environmental and safety risks.

Overall, from a GHG perspective, the use of biogas prevents the emission of GHG which would be generated from equivalent amount of GHG intensive fossil sources.

One of the main advantages of the AD process is the reduction of waste volume and associated costs for waste disposal. The main by-product of the process is the digestate which is typically rich in nitrogen, phosphorus and to a lesser extent potassium. Under certain circumstances the digestate can be spread in agricultural fields or forests as a manure.

Key risks associated with AD plants are those associated with bad practices and poor operation and maintenance which include: i) emissions to the aquatic environment - surface and ground water pollution due to a leakage, ii) emissions to the atmospheric environment - increased risks of CH_4 emissions due to leaks, iii) harm to the environment and human and animal health - increased risk of contamination through contamination of the product and odour pollution.

[6] https://adbioresources.org/policy-regulation/regulators/#1606603896037-5691895f-0cec

2.4.3. Project Sponsor, Governance and Resource Management.

The UK Government has made available a document list and procurement procedure created by Walker Morris[7]). It is advised that if BFC proceed with building their own AD facility that they consult this documentation for guidance on project governance and resource management.

2.4.4. Build/Procurement Options to Meet Legislative Requirements

For the development of an AD plant, there are a number of regulations that must be met, mainly with regards to the environment. Several regulatory controls are detailed below under the following headings: Duty of Care, Planning Permission, EIA Requirements, Permitting, Waste Management Licence and Animal By-Products regulations.

Environmental and regulatory impacts of AD of MSW depend to some extent on site specific issues and waste type considerations. The following subsections discuss the key legislation which will must be considered for most AD projects and to some extent is relevant for AD processes using other types of materials as well.

2.4.4.1. Duty of Care

Every holder of waste has a Duty of Care to ensure that any waste they have is removed and disposed of in a controlled and licensed manner. Waste transfer documents must be signed and it may be necessary to be a registered waste carrier if the waste material is to be transported.

2.4.4.2. Planning Permission

The Town and Country Planning Act 1990 (TCPA), as amended, provides the legislative framework in England and Wales requiring planning permission to be sought for a development or substantial change of use for a range of classes of activities or structures. Permission must be sought from the Local Planning Authority (LPA) in which the development is located which in this instance is Bracknell Forest Council (BFC).

An Environmental Impact Assessment may also be required; the types of development and the thresholds are defined in the Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations) (

As well as publicising the application in order to invite comments from third parties, the LPA may consult various other parties with relevant interests or expertise, depending on the location, size and likely impacts of the development, including statutory consultees such as the Environment Agency (EA), Natural England and Historic England. This consultation period could identify further areas that need to be considered during any planning application. LPAs have the power to grant conditional planning permission and to seek planning conditions from developers, in order to make development proposals acceptable which would otherwise be unacceptable. Planning conditions are used to ensure that a proposed development is made to accord with published local, regional or national policies.

2.4.4.3. EIA Requirement

A proposed AD facility is likely to be categorised as a Schedule 2 development under part 11 ‘Other projects’ in Schedule 2 of the EIA Regulations:

‘(b) Installations for the disposal of waste (unless included in Schedule 1);

(ii) the area of the development exceeds 0.5 hectare; or

(iii) the installation is to be sited within 100 metres of any controlled waters.

In order to determine if an EIA is required for Schedule 2 development a screening opinion could be requested from the planning department of BFC . BFC who would then decide if the project impacts warrant a full EIA having regard to the selection criteria in Schedule 3 of the EIA Regulations.

Schedule 4, of the EIA regulations, describes the requirements of an EIA and these are outlined below:

1. A description of the development, including in particular:
    a. a description of the location of the development;

[7] Precedent Document (biogas-info.co.uk)

   b. a description of the physical characteristics of the whole development, including, where relevant, requisite demolition works, and the land-use requirements during the construction and operational phases;
   c. a description of the main characteristics of the operational phase of the development (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used;
   d. an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation and quantities and types of waste produced during the construction and operation phases.
2. A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.
3. A description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge.
4. A description of the factors specified in regulation 4(2) likely to be significantly affected by the development: population, human health, biodiversity (for example fauna and flora), land (for example land take), soil (for example organic matter, erosion, compaction, sealing), water (for example hydromorphological changes, quantity and quality), air, climate (for example greenhouse gas emissions, impacts relevant to adaptation), material assets, cultural heritage, including architectural and archaeological aspects, and landscape.
5. A description of the likely significant effects of the development on the environment resulting from, inter alia:
   a. the construction and existence of the development, including, where relevant, demolition works;
   b. (b) the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources;
   c. (c) the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste;
   d. (d) the risks to human health, cultural heritage or the environment (for example due to accidents or disasters);
   e. (e) the cumulation of effects with other existing and/or approved projects, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected or the use of natural resources;
   f. (f) the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change;
   g. (g) the technologies and the substances used.
6. The description of the likely significant effects on the factors specified in regulation 4(2) should cover the direct effects and any indirect, secondary, cumulative, transboundary, short-term, medium-term and long-term, permanent and temporary, positive and negative effects of the development.
7. A description of the forecasting methods or evidence, used to identify and assess the significant effects on the environment, including details of difficulties (for example technical deficiencies or lack of knowledge) encountered compiling the required information and the main uncertainties involved.
8. A description of the measures envisaged to avoid, prevent, reduce or, if possible, offset any identified significant adverse effects on the environment and, where appropriate, of any proposed monitoring arrangements (for example the preparation of a post-project analysis). That description should explain the extent, to which significant adverse effects on the

environment are avoided, prevented, reduced or offset, and should cover both the construction and operational phases.

9. A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.
10. A non-technical summary of the information provided under paragraphs 1 to 8.
11. A reference list detailing the sources used for the descriptions and assessments included in the environmental statement.

The next stage of the EIA process is to request a scoping opinion from the LPA to determine which issues could potentially experience a significant effect from the project and therefore require assessment of the impact. Early consultation with statutory authorities is recommended to identify the requirements for specialist studies and to discuss alternative designs and methods that could reduce or remove the need for certain studies.

2.4.4.4. Permitting

In order to operate a waste treatment facility such as an AD plant the operator will be required to apply to the EA for a permit under the Environmental Permitting (England and Wales) Regulations 2018 (EP Regulations).

Regulation of the site will be dependent on the plant capacity. It is recommended that the exact type of permit is discussed with the Environment Agency prior to permit application via their pre application advice service.

There are two types of permit available, standard rules or bespoke. If the proposed plant is able to meet the rules and requirements set out for the Standard Rules Permit then the application should be quicker and easier to process. However, if the plant is determined to be more unusual or high risk then a bespoke permit will be required which will be a longer and more expensive process.

The EA is allowed a statutory period of four months to determine an application made under the EP Regulations once considered duly made. This does not include time to determine as duly made nor any time taken by the operator to respond to requests for further information. The Environmental Permit must be in place before commissioning starts on the site.

2.4.4.5. Waste Management

Various legislation relating to waste management will be applicable to the AD plant depending on the final design. The plant operator must ensure that anyone transporting waste to or from the AD plant must be registered with the EA as a Waste Carrier under the Controlled Waste (Registration of carriers and Seizure of Vehicles) Regulations 1991 (as amended), that waste is stored correctly onsite and that waste produced on site is removed by an authorised waste management company and disposed of correctly.

Digestate is the waste by-product resulting from the AD process. This can be disposed of via a number of routes including composting, agricultural land spreading, contaminated brownfield site remediation or simply sent to landfill. The AD process may also produce a liquid waste stream. This may require further treatment before discharge either to surface water or to the foul sewer system. Biosolids digestate is managed via the Sludge Use in Agriculture Regulations 1989 (amended 1990) associated Codes of Practice and Assurance schemes (Biosolids Assurance Scheme). If Biosolids and organic waste are mixed, then the digestate will be managed under the Environmental Permitting Regulations (England and Wales) Regulations 2018 (EP Regulations). Historically the transition to an alternative regulatory framework has reduced Water Companies interest in co-digestion, in addition impacts upon previous incentive schemes, for example Renewable Obligation Certificates have further reduced the desire. The Environment Agency National Sludge Strategy[8], which intends to modernise and simplify

[8] https://www.gov.uk/government/publications/environment-agency-strategy-for-safe-and-sustainable-sludge-use/environment-agency-strategy-for-safe-and-sustainable-sludge-use

the regulatory framework, namely bringing Biosolids digestate and waste digestate under the same regulatory framework is in consultation. The single regulatory framework and the Regulatory Market reform driven by Ofwat has already stimulated the interest of the Water industry in the organic waste opportunity.

2.4.5. Government Funding Opportunities and Commercial Exploitation of the Digestate

The UK government have designed various incentive schemes to support the deployment of renewable energy generation to help meet its target of 80% reduction in greenhouse gas emissions by 2050[9] . There are three incentives relevant to AD plants. They are:

1. **Green Gas Support Scheme (GGSS)**
   Following the closure of the Non-Domestic Renewable Heat Incentive Scheme for new applicants, on 31 March 2021, the British Government has recently completed the consultation period for the introduction of the Green Gas Support Scheme (GGSS). A new scheme which will further promote the decarbonisation of the gas grid via the incentivisation of AD biomethane injection into the gas grid through a 15-year fixed tariff per kWh. This scheme will be open for new applications from autumn 2021 until autumn 2025. The scheme will be based on a three-tier structure with the associated tariff for each tier:

   - Tier 1 limit to 60,000MWh: 5.51 p/kWh plus inflation
   - Tier 2 limit to 100,000MWh: 3.53 p/kWh plus inflation
   - Tier 3 limit above 100,000MWh 1.56 p/kWh plus inflation

   Please refer to section 3.3.1 for more information related to the description of the process converting biogas to biomethane.

2. **Green Gas Levy**
   In order to finance the GCSS, the British Government will introduce the Green Gas Levy and it will launch it alongside the GCSS in autumn 2021. This scheme will place a levy on all licenced fossil fuel gas suppliers. Gas suppliers who have provided between 95% to 100% of their methane with green gas will be exempt from the levy. Hence, it is expected that if BFC proceeds with the construction of their own AD plant (either individually or partnering with a third party) producing more than 95% biomethane, the plant will be exempt from the Green Gas Levy.

3. **Renewable Transport Fuel Obligation (RTFO)**
   The use of biomethane as a transport fuel is supported under the RTFO at a level of 3.8 Renewable Transport Fuels Certificates (RTFCs) per kilo of biomethane. The RFTO is a trading scheme, which requires fuel suppliers for road transport to deliver a certain level of biofuels as an obligation. Biofuel producers are awarded RFTCs, which can be traded in order to fulfill the obligations of non-renewable fuel suppliers. RTFCs are subject to market forces, which means that the price is variable although throughout 2020, RTFCs traded at circa £0.29 per certificate. The predicted incentive for biofuel suppliers until 2032 would be:
   £0.30 x 3.8 / kg biomethane
   The scheme and its continuation are subject to review in 2032. Claiming RFTCs requires opening an account with the Administrator, applying to a relevant certification scheme (or sourcing an appropriate external reviewer), and consistently capturing the required carbon and sustainability data to meet verification requirements. Please refer to section 3.3.1 for more information related to the description of the process converting biogas to biomethane.

4. **Contract for Difference (CfD)**
   The government's main mechanism for supporting new, low carbon electricity generation projects in the UK. This would involve a competitive auction process to bid for CfD allocation. This is done in 'pots', where if using Anaerobic Digestion (>5MWe), BFC would compete in Pot 2 (less

[9] Financial incentives | ADBA | Anaerobic Digestion & Bioresources Association (archive.org)

established technologies)[10]. However, it should be noted that the fourth CfD allocation round is scheduled for 2021. from a high-level estimate conducted by Atkins, an AD plant processing around 19,000 tonnes per year of food waste would be equivalent to a design capacity of approximately 850kW of gross electricity. As a comparison, in the UK, the average size of an AD plant is approximately 1.45MWe (excluding AD plants that process sewage sludge). Hence, it would not meet CfD's capacity threshold of 5MWe and would not be eligible to bid in a CfD auction. Please refer to section 3.2.1 for more information related to the description of the process converting biogas to electricity.

Commercial Exploitation of the Digestate

Typically, the digestate from AD is considered a waste product under Article 1(1)(a) of the EU Waste Framework Directive (WFD) (2006/12/EC) which means that it cannot be moved or sold without a waste exemption; this obviously limits the use of a potentially valuable resource. The Environment Agency (EA) has drafted a Quality Protocol to assure the quality of the digestate for use as a fertiliser that confirms to the business community what legal obligations they must comply with in order that the treated waste material is classified as a product rather than a waste.

Accreditation will involve using source segregated organic waste from a given list of acceptable sources with the additional keeping and retaining of records. The person using the digestate must be able to demonstrate that full account has been taken of the environmental impacts of using the digestate and this may include testing and record keeping. This represents a significant liberation of the industry and whilst the keeping of records and meeting the quality standards will require an amount of effort, it is not considered sufficiently onerous as to jeopardise the viability of AD schemes. Further information in the AD Quality Protocol is available at the EA Website. Nonetheless, for commercial sites, most often the digestate is provided either free of charge to off-site users or at a cost to the operator with a minority of AD plants profiting from the sale of digestate.

2.5. Strategic Options Analysis

This section presents a high-level evaluation of the three strategic options in the form of a Strengths, Weaknesses, Opportunities & Threats (SWOT) analysis.

2.5.1. Continue with Current Contract

This option evaluates the benefits and risks of carrying on with the existing Re3 contract. At the time of writing this report, the contract specifics were not shared with Atkins and where assumptions have been made, these have been highlighted.

Table 2-3 – SWOT Analysis for Continuing with Current Contract

Strengths	Weaknesses
• Requires least amount of resource. • Cheaper than incineration or landfill[11] • Management of digestate and liquors risk sits with AD Contractor • Health and Safety risk sits with AD Contractor • Simplistic operation requirement on BFC – contract management only	• Has limited contribution to BFC's 2050 Net Zero target • Energy or gas created not utilised in BFC • No opportunity to develop BFC capability • Benefits of digestion not owned by BFC • Missed incentive opportunity – timeframe limited
Opportunities	**Threats**

[10] Contracts for difference for low carbon electricity generation: consultation on proposed amendments to the scheme (publishing.service.gov.uk)

[11] BFC informed Atkins that the disposal cost of food waste under the re3 partnership contract is currently £0/tonne and will increase to £7p/tonne from April 2022. The landfill tax is currently £96.7/tonne with a typical landfill cost between £17 to £26 per tonne. The gate fee in a EfW plant is around £85 to £105 per tonne.

• To change contract to enhance BFC position due to limited retraction constraints	• Future change in contract T&Cs • Rising cost for disposal of food waste • Guarantee of additional capacity availability if food waste collection increases dramatically

2.5.2. Build Own AD Plant

This option evaluates the benefits and risks of BF Council building their own AD plant.

Table 2-4 – SWOT Analysis for Building Own AD Plant

Strengths	Weaknesses
• Can profit from AD plant subject to a cost-benefit analysis • Contribute towards Net Zero 2050 target • Can generate income from other councils paying for food waste disposal. • Atkins understands that there is no commercial penalty if the three councils stop sending their food waste to the AD contractor	• Capital expenditure required which sits with BFC • Operational cost sits with BFC • Potential complexity regarding availability of a suitable site that could accommodate an AD plant • Lack of council's expertise with regards to development, construction and operation of an AD plant
Opportunities	**Threats**
• Different types of process options, CHP, Gas to Grid etc. • Flexible technology, room to incorporate new feedstocks at a later date. Modular design would leave room for • Gate fee from provision of capacity to manage other organic waste • Stakeholder – excellent example to other Councils of BFC green credentials • Production of renewable energy or gas for potential utilization in vehicles in BFC fleet	• Requires expertise outside of those currently within BFC • Potentially insufficient feedstock to provide required rate of return on investment • Requires permit applications approvals • Stakeholder perception of waste management facility in BFC region treating waste from other Councils • Duty of care sits with BFC – for waste management and disposal.

2.5.3. New Partnership

This option evaluates the benefits and risks of entering into a new contract with an external partner to either combine sources of feedstocks and/or to utilise existing assets that the external partner owns.

Table 2-5 – SWOT Analysis for New Partnership

Strengths	Weaknesses
• Share capital/operational cost • Expertise from partner company can be utilized • Would ensure sufficient quantity of feedstock for AD facility viability. • Potential access to existing site or expansion of existing facility • BFC benefit from incentives and revenues • Controls risk • Shared investment risk • Shared operational risk	• May involve mixing feedstocks of different qualities which can negatively impact biogas yield if not managed effectively • Mixing different qualities of feedstock could lead to increased pre-treatment capex and Opex to create a homogenous mix of feedstock • Digestate end use may be limited if mixing feedstocks
Opportunities	**Threats**
• Could utilize existing assets of partner if applicable (e.g. AD plants at Sewage Treatment Works) • Economies of scale favour larger plants and in some cases it may be beneficial for several farms to club together and have a Centralised Anaerobic Digestion (CAD) plant. Larger plants have far lower cost per operational hour and return on investments can be more safely assured, reducing the associated financial risk • Potential to expedite delivery	• Potential mix of feedstocks leading to limited end use of digestate product • Negotiation of contract to ensure both parties benefit

2.6. Indicative Programme

Figure 2-4 presents an indicative development schedule (from planning up to commencement of operations) of an AD plant for strategic options 2 and 3. For strategic option 3 (partner with a third party for the construction of an AD plant) it is assumed that the duration is the same as if a new plant would have to be constructed. However, the actual construction schedule will be determined by a plethora of factors including the site location (greenfield or brownfield), size of the plant, any unplanned delays in the planning and construction phase, any changes in the legislation, the contractual arrangement and the competence of the project company and the contractors. In addition, the programme does not include the time for securing a site (lease of purchase) and any pre-existing contamination as this is very project specific.

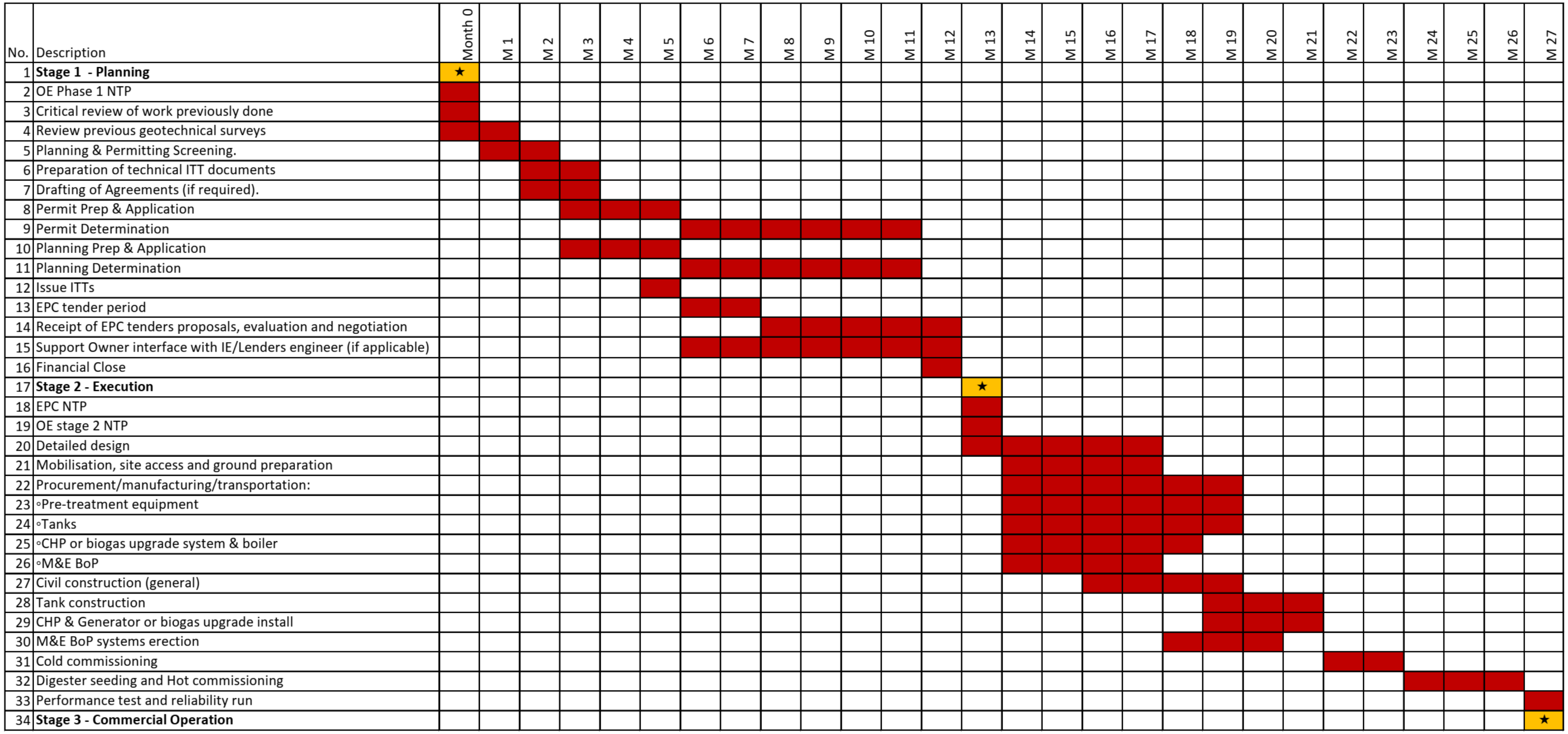

Figure 2-4 – Typical project schedule of an AD plant

2.7. Conclusions

Before BFC decides whether to go ahead with another option other than continue with the existing contract, it will be necessary to supplement the findings of this report with some further investigations including but not limited to the following:

- Gather data from commercial/industrial waste producers in Bracknell Forest Council and its surroundings to better understand the options of the potential third party who are already active in the AD industry and partner with BFC. The potential partners could be dairy farms, breweries, supermarkets, water treatment utilities and food production/processing facilities among others.
- Once the third party is identified, estimate the potential biogas yield from mixing the different feedstocks (BFC's food waste and third party's feedstock) which will determine the size of the plant, and any additional investment and capital costs but also additional revenues.
- Develop a more detailed understanding and certainty of existing and future incentive schemes and governmental support for the use of biogas especially in conjunction with the time necessary to develop and build an AD plant.
- If there is interest from BFC to go ahead, then a study would be needed to consider the practicalities and costs of logistics of bringing the materials to the AD plant's location.
- BFC should perform a study of how many vehicles they are needed and how many they own that could transport food waste to the AD plant's location.
- Examine in more detail the regulatory framework for the digestate. As it was mentioned, the current regulatory framework is complex and fragmented separating Biosolids digestate (originating from the water industry) and waste digestate. The Environment Agency National Sludge Strategy, which is currently in consultation, intends to simplify the regulatory framework.
- A cost-benefit analysis will be necessary, taking into account all the technical, financial and economic characteristics of the selected option which will estimate the investment's payback time, Net Present Value (NPV) and Internal Rate of Return (IRR) and ultimately inform BFC's business decision.

3. Options Evaluation

This section discusses the optioneering methodology employed. Process options are subsequently presented with supporting information such as process description, typical site layout, CAPEX, OPEX and revenue potential estimates. An optioneering exercise, consisting of the process options was conducted, and the results are discussed. This section concludes with a recommendation with regards to the most desirable process option for BFC, in a scenario where the council decides to build their own AD plant.

3.1. Optioneering Methodology

The optioneering methodology employed involved the use of an options evaluation template which was derived following a workshop discussion with BFC on Monday, 12 July 2021. A number of key criteria were identified against which a score of 1 to 5 was given for each high-level process option. The criteria were then each allocated a weighting of 1 to 5, and the raw score multiplied by that factor. The weighted score for each high-level process option were then summed and total scores for the options produced. The key criteria and weightings used are presented in Table 3-1.

Table 3-1 – Evaluation Criteria and Weightings

Key Criteria	Weighting
Capex (1-Very High to 5-Very Low)	5
Opex (1-Very High to 5-Very Low)	5
Revenue Potential (1-Low to 5-High)	5
Complexity of Operation (1-Difficult to 5-Easy)	3
Footprint (1-Large to 5-Small)	5
Constructability (1-Difficult to 5-Easy)	2
Environmental Impact (1-High to 5-Low)	5

The following process options were shortlisted for the optioneering process, based on Atkin's engineering judgement:

- Option 1: AD with Electricity to Grid
- Option 2: AD with Biomethane to Grid
- Option 3: AD with Biogas Export to Third Party.

The optioneering evaluation results are presented in Section 3.5

3.2. Option 1 – AD with Electricity to Grid

3.2.1. Process Description

AD plants typically operate under mesophilic conditions, where a temperature range of 25-45ºC must be maintained. To satisfy this heating requirement, some AD plants fully consume the biogas produced onsite in a CHP system to simultaneously produce heat and electricity. The electricity generated in a CHP can be consumed onsite but it is generally exported to the national grid to gain revenue.

There are several CHP technologies available such as internal combustion engines, micro-turbines and fuel cells. For the purposes of this feasibility study, Atkins chose to explore internal combustion engines due to the elimination of biogas pre-treatment requirement and it being the current industry's technology of choice when compared to alternatives.

In an internal combustion engine facility, raw biogas from the AD plant is directly fed into the internal combustion engine without the need for biogas pre-treatment. A safety flare system is installed on the feed line to the internal combustion engine to provide emergency pressure relief when required. Atmospheric air is compressed, heated and subsequently fed into the internal combustion engine, where it produces an air-biogas mixture which is burnt to convert chemical energy into kinetic and thermal energy. The internal combustion engine is connected to a generator which converts the kinetic energy into electricity that is exported to the national grid. The hot flue gas (exhaust gas) exiting the internal combustion engine is fed into a series of heat exchangers for heat recovery before it is discharged to the atmosphere via a stack. The first heat exchanger is used to increase the temperature of the compressed air before it is injected into the internal combustion engine. The second heat exchanger is used to produce hot water which is used as a heat source for onsite users such as the AD process.

A typical PFD of an internal combustion engine facility is portrayed in Figure 3-1

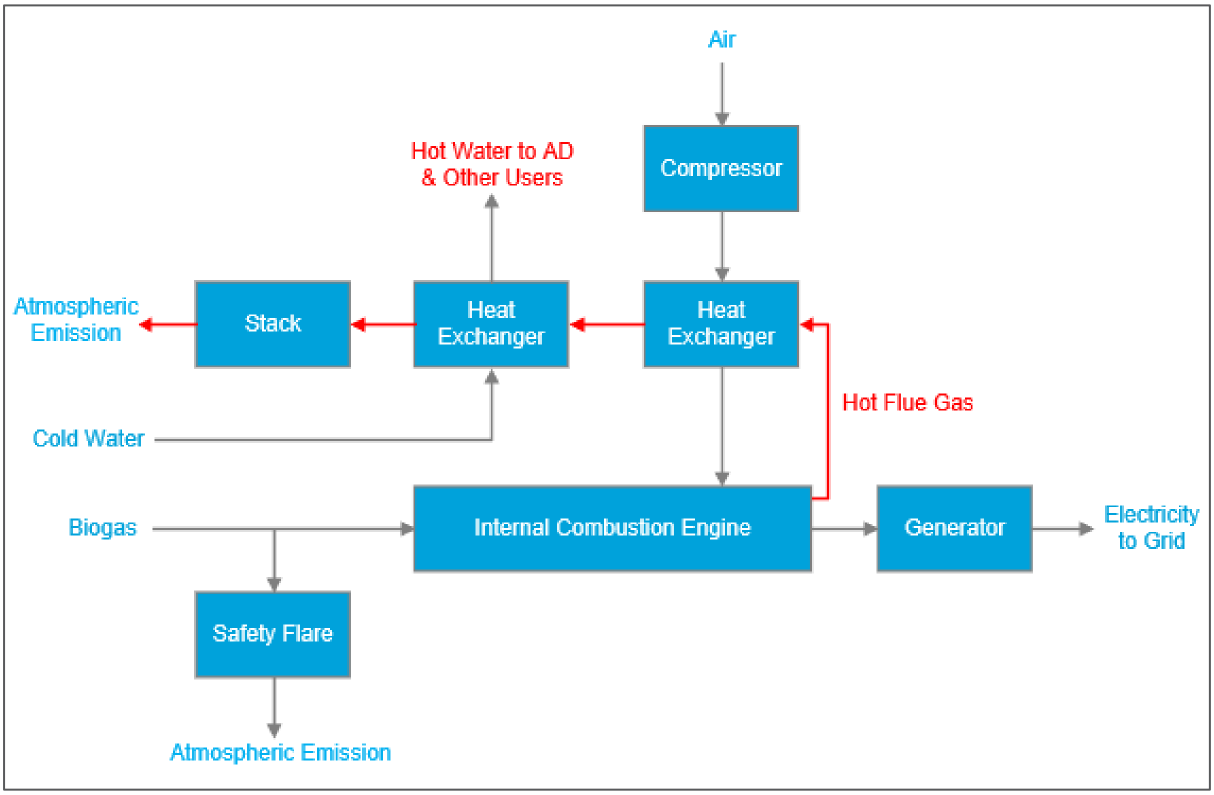

Figure 3-1 – Typical PFD of an Internal Combustion Engine CHP Facility

3.2.2. Typical Site Layout and Space Requirement

A typical site layout of an AD plant with electricity to grid can be seen in Figure 3-2.

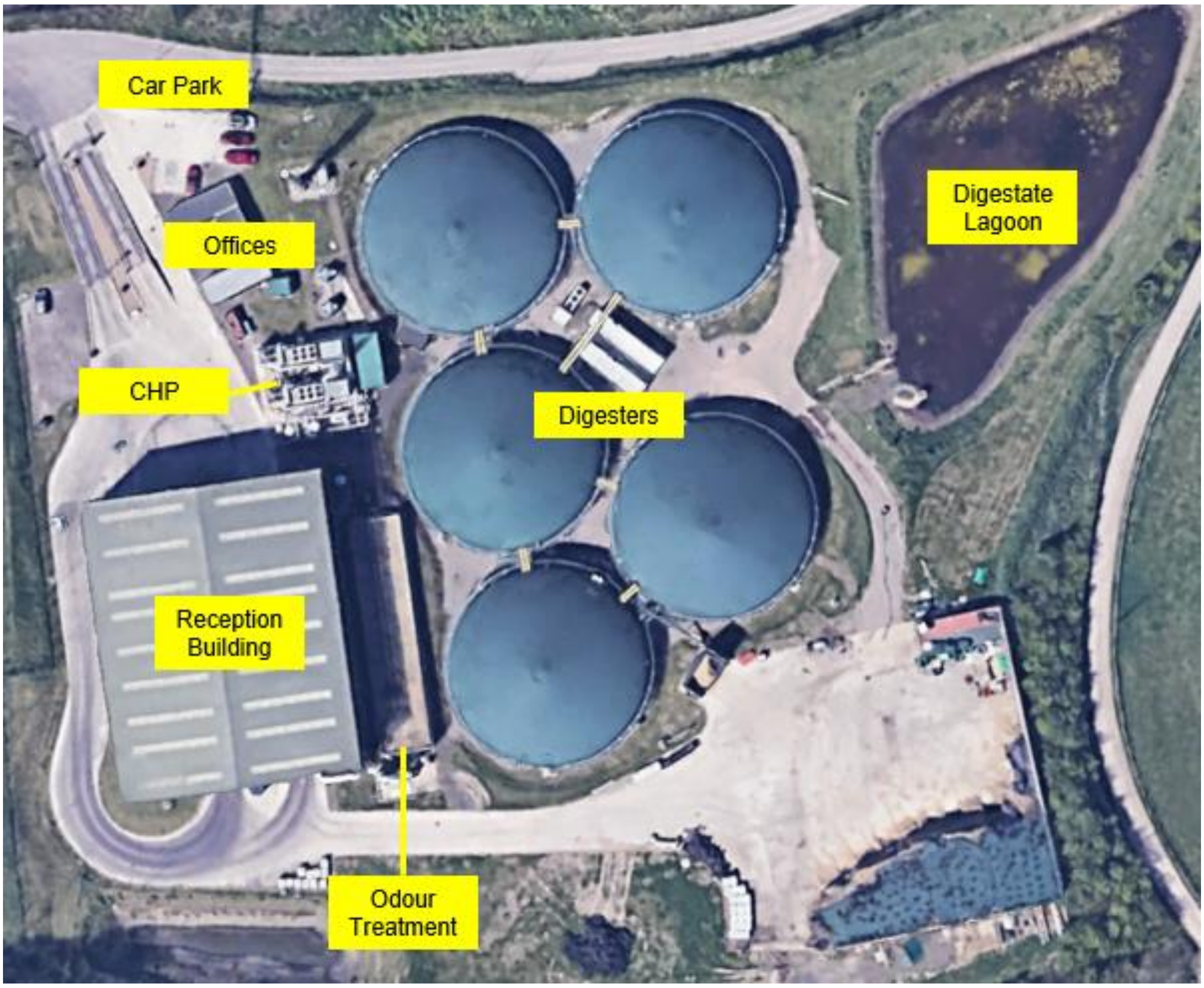

Figure 3-2 – Site Layout of an AD Plant with Electricity to Grid

To determine a high-level estimate of the space required for an AD plant with electricity to grid, an assessment was conducted which involved obtaining the footprint of a number of existing plants. Based on the assessment, it was established that the average footprint required per plant's annual capacity is approximately 0.51 m^2 per tonnes/yr. Therefore, for a plant with an annual capacity of 19,000 tonnes, the estimated footprint required is approximately 9,800 m^2 (equivalent to approx. 2.42 acres).

3.2.3. High Level CAPEX and OPEX

A report entitled "*Biomethane: The Pathway to 2030"* was published in March 2020 by the Anaerobic Digestion and Bioresources Association (ADBA), providing the average CAPEX and OPEX associated with an AD Plant that exports electricity to the grid. The information is based on the average calculated from a sample of 41 AD plants across the UK and is presented in Table 3-2.

To determine the high-level CAPEX and OPEX associated with Option 1, it was necessary to estimate the CHP capacity. Based on Atkins' high-level calculations, it was estimated that the CHP requires a capacity of approximately 850kW. Therefore, the plant's scale is considered to be 'medium' as per the categorisation guidance of Table 3-2. In accordance with the report authored by the ADBA, the average CAPEX and OPEX per installed CHP capacity is £4,300/kW and £300/kW respectively. Hence, the high level CAPEX and OPEX estimates for Option 1 are approximately £3,655,000 and £255,000 per year respectively. Given that the AD plant is required to process food cost, an additional high-level CAPEX of approximately £850,000 is required to purchase the necessary reception facility and pre-treatment equipment. This is based on a proportional scaling factor of the £1 million required for a 1MW CHP[12]. The high-level cost of land acquisition for the required 9,800 m^2 footprint was estimated to be within a range of £1,804,718 and £7,218,873, giving an average of approximately £4,511,795.

In summary, the high level OPEX estimate for Option 1 is approximately £255,000 per year. The total high level CAPEX estimate for Option 1 is approximately £9,016,795. Note that these high-level estimates should be treated as indicative values. The estimates are equivalent to an AACE class 4 estimate. AACE describes the estimate accuracy as follows:

Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks.

Table 3-2 – Average CAPEX and OPEX of an AD Plant with Electricity to Grid[13]

Scale	CHP Capacity (kW)	Average CAPEX (£/kW)	Average OPEX (£/kW)
Micro	10-50	9,800	1,000
Small	50-500	6,300	400
Medium	500-1,000	4,300	300
Large	1,000-2,000	3,000	200
Very Large	>2,000	3,800	400

3.2.4. Revenue Potential

3.2.4.1. Contract for Difference

This government incentive is applicable to AD plants with a minimum CHP capacity of 5MWe. However, from a high-level estimate conducted by Atkins, an AD plant processing around 19,000 tonnes per year of food waste would be equivalent to a design capacity of approximately 850kW of electricity. Hence, it would not meet CfD's capacity threshold of 5MWe and would not be eligible to bid in a CfD auction.

3.2.4.2. Wholesale Electricity

According to Ofgem[14], the wholesale electricity price is approximately £70.59/MWh as of 30 July 2021. An AD plant with an installed gross capacity of 850kW is expected to generate 6,439MWh of electricity per year, based on a parasitic load and plant availability of 6% and 90% respectively. Therefore, the estimated revenue from the wholesale electricity is £454,550 per year. This estimation is based on the quoted wholesale electricity price which is subject to fluctuation.

3.2.4.3. Digestate

The liquid digestate produced from the AD plant requires pasteurisation to make it safe for use by consumers. For commercial sites, most often the digestate is provided either free of charge to off-site users such as farmers or at a cost to the operator with a minority of AD plants profiting from the sale of digestate. This generally required additional investment to process the liquid digestate into dewatered sludge cake.

[12] http://staging.adbioresources.org/docs/Biomethane_-_Pathway_to_2030_-_Full_report.pdf
[13] http://staging.adbioresources.org/docs/Biomethane_-_Pathway_to_2030_-_Full_report.pdf
[14] https://www.ofgem.gov.uk/energy-data-and-research/data-portal/wholesale-market-indicators

3.3. Option 2 – AD with Biomethane to Grid

3.3.1. Process Description

Biogas produced at an AD plant typically contains around 60% methane (CH_4) on a volume basis. The remaining volume primarily consists of water vapour (H_2O) and carbon dioxide (CO_2) with small amounts of hydrogen sulphide (H_2S) and traces of other components such as Volatile Organic Compounds (VOCs).

To make biogas suitable for use as vehicle fuel and/or direct injection into the natural gas grid, the biogas must undergo a process known as “upgrading”. Biogas upgrading is the process in which methane is separated from other constituents present in the biogas, producing a highly concentrated methane product (>97%), referred to as “biomethane”. The biomethane gas can be further processed to produce Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG) for vehicle fuel or injected with propane and subsequently fed into the natural gas grid.

There are four main technologies used for producing biomethane from biogas, these are membrane separation, pressure swing adsorption, amine scrubbing and water wash. For the purposes of this feasibility study, Atkins chose to explore membrane separation. This is due to the opportunity to recover CO_2 as a by-product in liquid form, making the facility an almost zero-emission system which aligns with BFC’s climate change strategy to be carbon neutral by 2050.

In a membrane separation facility, raw biogas from an AD plant undergoes a pre-treatment process in which it is chilled and condensed to remove water vapour and subsequently fed into activated carbon filters to remove other contaminants such as H_2S and VOCs. After pre-treatment, the biogas stream is compressed to create a driving force for the downstream process. Upon compression, the biogas is treated in a 3-stage membrane filtration system which consists of highly selective membranes that produces a concentrated biomethane stream (>97%) and a concreated carbon dioxide stream (>99%). The biomethane stream is then further processed to produce CNG or LNG for vehicle fuel or enriched with propane to increase its calorific value and subsequently supplied into the natural gas grid.

As shown in Figure 3-3 which presents a typical PFD of a membrane separation facility, the concentrated carbon dioxide stream can be further processed to produce liquefied CO_2 and sold to consumers such as carbonate drinks manufacturers to generate additional revenue.

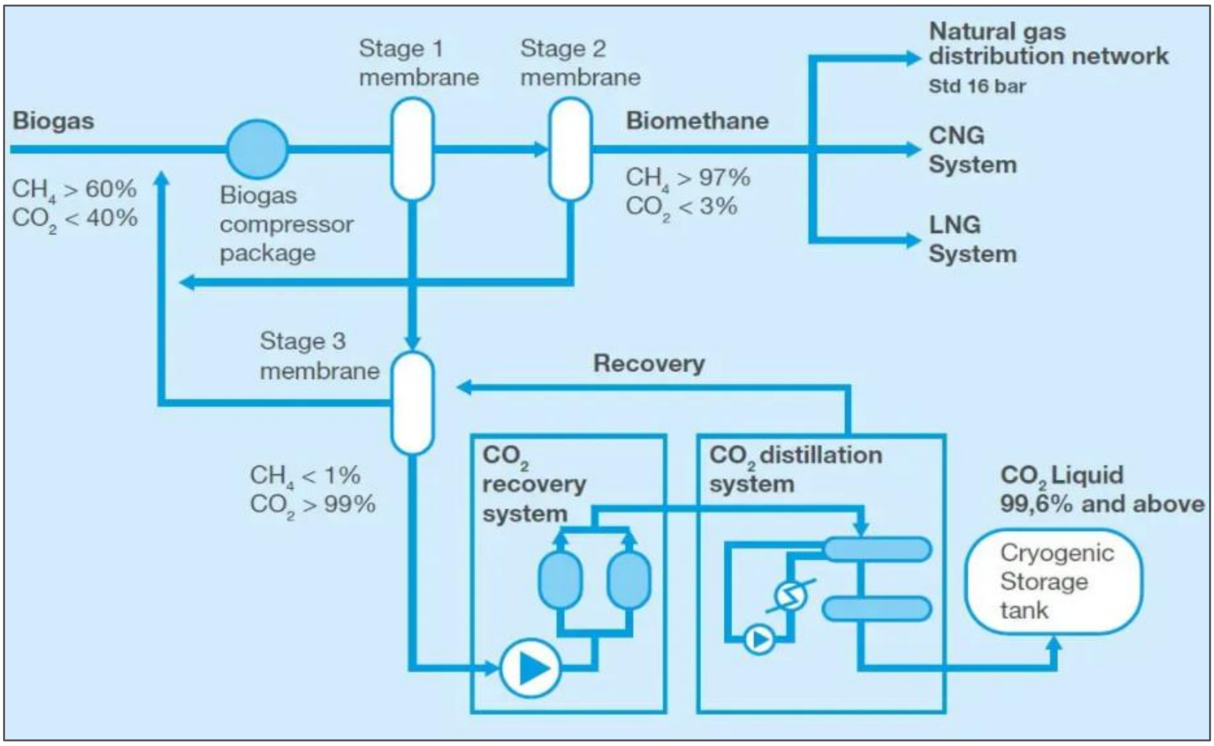

Figure 3-3 – Typical PFD of a Membrane Separation Facility for Biogas Upgrading

3.3.2. Typical Site Layout and Space Requirement

A typical site layout of an AD plant with biomethane to grid can be seen in Figure 3-4. Note that the plant shown below also has a CHP for satisfying the process heat requirement onsite and electricity export to the grid.

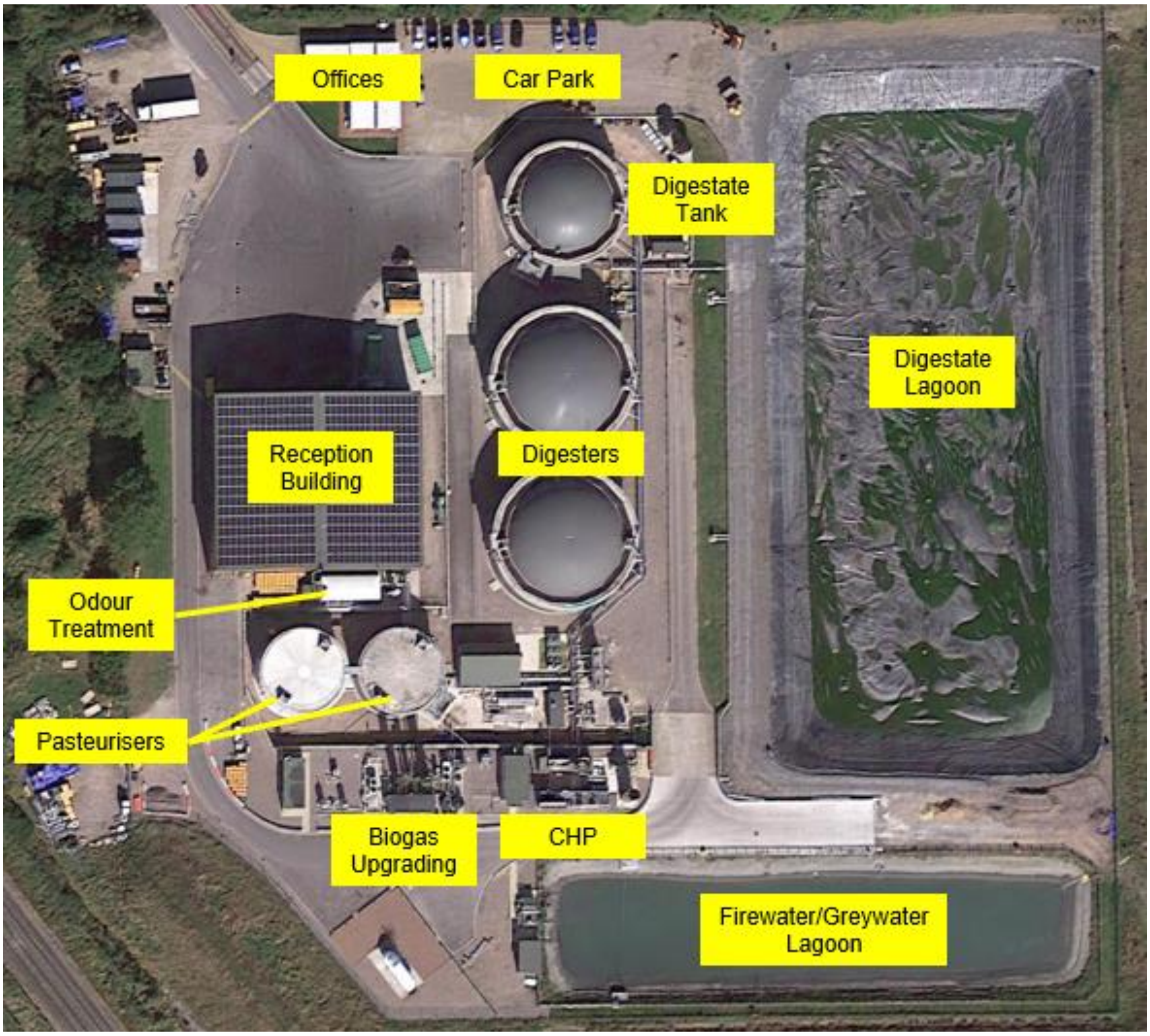

Figure 3-4 - Site Layout of an AD Plant with Biomethane to Grid

To determine a high-level estimate of the space required for an AD plant with biomethane to grid, an assessment was conducted which involved obtaining the footprint of a number of existing plants. Based on the assessment, it was established that the average footprint required per plant's annual capacity is approximately 0.42 m^2 per tonnes/yr. Therefore, for a plant with an annual capacity of 19,000 tonnes, the estimated footprint required is approx. 8000 m^2 (equivalent to 1.97 acres).

3.3.3. High Level CAPEX and OPEX

The methodology used to determine the high-level CAPEX and OPEX associated with Option 2 is similar to that used for Option 1.

As discussed in Section 3.2.3, the plant's scale is considered to be 'medium' as per the categorisation guidance of Table 3-2. In accordance with the report authored by the ADBA, the average CAPEX and OPEX per installed CHP capacity is £4,300/kW and £300/kW respectively. Hence, the high-level CAPEX and OPEX estimates for Option 2 are approximately £3,655,000 and £255,000 per year respectively. Since the estimated values are based on an AD plant with electricity to grid, modifications were made to account for an AD plant with biomethane to grid. The first modification was to subtract the CHP related CAPEX, which was estimated to be approximately £340,000. This is based on a proportional scaling factor of the £400,000 required for a 1MW CHP[15]. The second modification was to add the biogas upgrading facility related CAPEX, which was estimated to be approximately £900,000. This is based on requirement for 6 biogas upgrading units, each with a CAPEX of £150,000. Therefore, the CAPEX value which excludes the CHP facility and includes the biogas upgrading facility was estimated to be £4,215,000.

Given that that the AD plant is required to process food cost, an additional high-level CAPEX of approximately £850,000 is required to purchase the necessary reception facility and pre-treatment equipment. The high-level cost of land acquisition for the required 8,000 m^2 (equivalent to 1.97 acres) footprint was estimated to be within a range of £1,471,344 and £5,885,374, giving an average of approximately £3,678,359. Hence, the total high level CAPEX estimate for Option 2 is approximately £8,743,359.

The additional OPEX related to the enrichment of the biomethane with propane prior to it being supplied into the natural gas grid was estimated to be approximately £114,300. This is based a biomethane production rate of approximately 191 Nm^3/h. Therefore, the total high level OPEX estimate for Option 2 is approximately £369,300 per year

In summary, the total high level OPEX estimate for Option 2 is approximately £369,300 per year. The total high level CAPEX estimate for Option 2 is approximately £8,743,359. Note that these high-level estimates should be treated as indicative values. The estimates are equivalent to an AACE class 4 estimate. AACE describes the estimate accuracy as follows:

Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks.

3.3.4. Revenue Potential

3.3.4.1. Green Gas Support Scheme

Atkins' high-level calculations suggest that the AD with biomethane to grid plant would produce biomethane which has an annual output of approximately 18,356 MWh. This implies that the plant would be eligible for GGSS Tier 1 fixed tariff which equates to £0.0551/MWh. Therefore, the estimated high-level revenue from GGSS is £1,011,448 per year.

3.3.4.2. Wholesale Gas

According to Ofgem[16], the wholesale gas price is approximately £0.60/kWh as of 30 July 2021. The AD plant with biomethane to grid is expected to generate an equivalent annual output of 18,356 MWh. Hence, the estimated high-level revenue from wholesale gas price is £386,867 per year. This estimation is based on the quoted wholesale gas price which is subject to fluctuation.

3.3.4.3. Digestate

The liquid digestate produced from the AD plant requires pasteurisation to make it safe for use by consumers. For commercial sites, most often the digestate is provided either free of charge to off-site users such as farmers or at a cost to the operator with a minority of AD plants profiting from the sale of digestate. This generally required additional investment to process the liquid digestate into dewatered sludge cake.

[15] http://staging.adbioresources.org/docs/Biomethane_-_Pathway_to_2030_-_Full_report.pdf
[16] https://www.ofgem.gov.uk/energy-data-and-research/data-portal/wholesale-market-indicators

3.4. Option 3 – AD with Biogas Export to Third Party

3.4.1. Process Description

Refer to Section 2.1 for the process description of AD with biogas export to third party. In essence, the biogas produced at an AD plant is exported to a third party situated immediately adjacent to the site to avoid operating the considerably complex biogas upgrading facility. This option is suitable for clients that do not possess the technical expertise to operate such facility.

3.4.2. Typical Site Layout and Space Requirement

The typical site layout of Option 3 is similar to that of Option 2 with the exception of the biogas upgrading facility being owned and operated by a third party. Figure 3-5 displays the demarcation which represents the plant area that would be owned and operated by a third party.

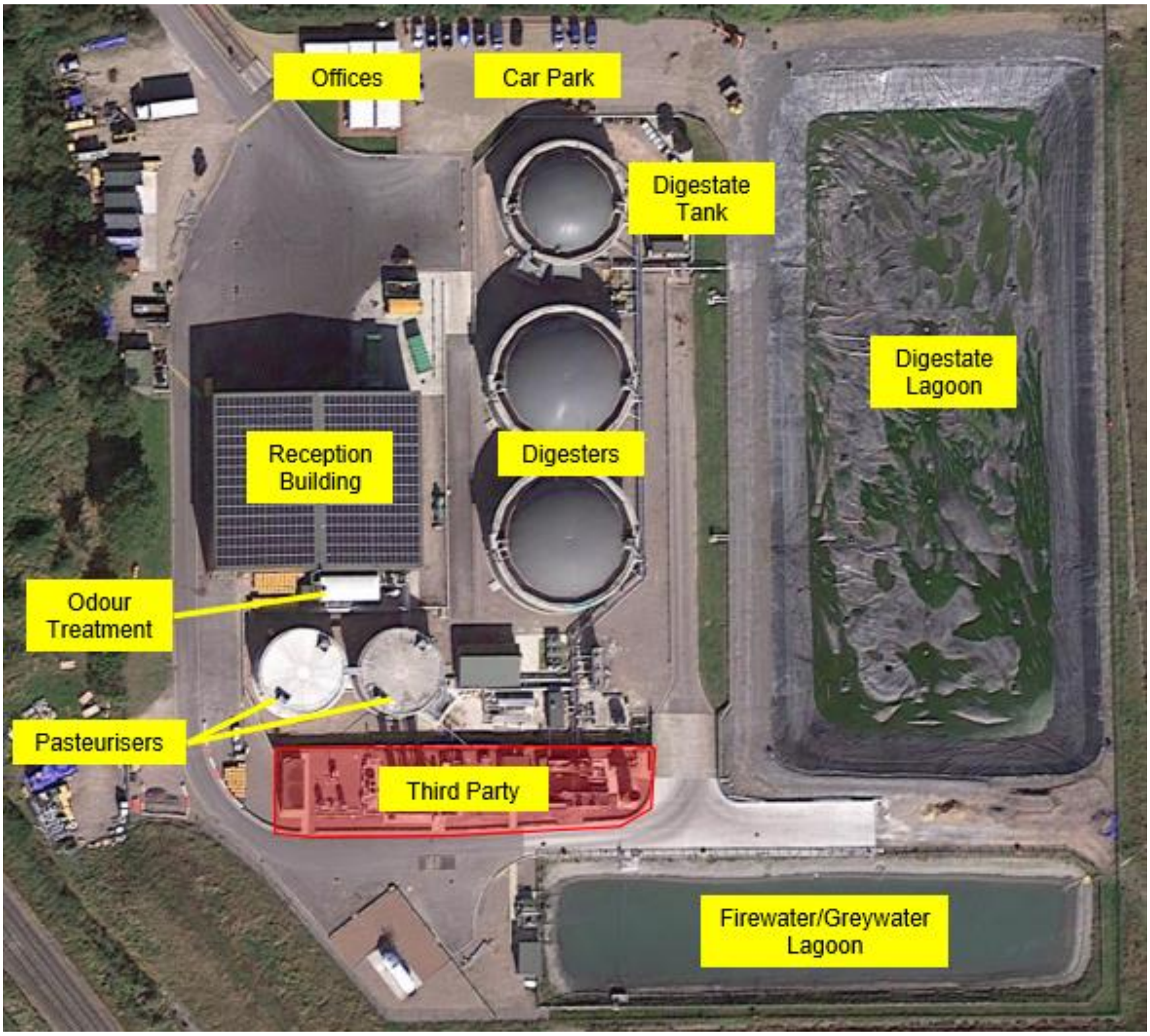

Figure 3-5 - Site Layout of an AD Plant with Biogas Export to Third Party

With regards to determining a high-level estimate of the space required for an AD plant with biogas export to third party, the average percentage of space used onsite to accommodate a biogas upgrading facility was estimated to be about 5%. Therefore, the high-level space requirement for Option 3 is 5% less than Option 2 which equates to approximately 7,600 m^2.

3.4.3. High Level CAPEX and OPEX

The methodology used to determine the high-level CAPEX and OPEX associated with Option 3 is similar to that used for Option 1.

As discussed in Section 3.2.3, the plant's scale is considered to be 'medium' as per the categorisation guidance of Table 3-2 and thus, the average CAPEX and OPEX per installed CHP capacity is £4,300/kW and £300/kW respectively. Hence, the high-level CAPEX and OPEX estimates for Option 3 are approximately £3,655,000 and £255,000 per year respectively. Since the estimated values are based on an AD plant with electricity to grid, it was necessary to subtract the CHP related CAPEX, which was estimated to be approximately £340,000. Therefore, the revised CAPEX value was estimated to be £3,315,000.

Given that the AD plant is required to process food cost, an additional high-level CAPEX of approximately £850,000 is required to purchase the necessary reception facility and pre-treatment equipment. The high-level cost of land acquisition for the required 7,556 m^2 footprint was estimated to be within a range of £1,397,776 and £5,591,105, giving an average of approximately £3,494,441. Hence, the total high level CAPEX estimate for Option 3 is approximately £.

In summary, the total high level OPEX estimate for Option 3 is approximately £255,000 per year. The total high level CAPEX estimate for Option 2 is approximately £4,210,333. Note that these high-level estimates should be treated as indicative values. The estimates are equivalent to an AACE class 4 estimate. AACE describes the estimate accuracy as follows:

Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks.

3.4.4. Revenue Potential

3.4.4.1. Wholesale Gas

According to Ofgem[17], the wholesale gas price is approximately £0.60/kWh as of 30 July 2021. The AD plant with biogas to export to third party is expected to generate an equivalent annual output of 16,687 MWh. Hence, the estimated high-level revenue from wholesale gas price is £351,697 per year. This estimation is based on the quoted wholesale gas price which is subject to fluctuation.

It should be noted that a premium price which is higher than the quoted wholesale gas price would likely be agreed between BFC and the third party to distribute some of the revenue generated from sale of biomethane under the GGSS to BFC. The exact premium is subject to negotiation between both parties and therefore cannot be accounted during this assessment.

3.4.4.2. Digestate

The liquid digestate produced from the AD plant requires pasteurisation to make it safe for use by consumers. For commercial sites, most often the digestate is provided either free of charge to off-site users such as farmers or at a cost to the operator with a minority of AD plants profiting from the sale of digestate. This generally required additional investment to process the liquid digestate into dewatered sludge cake.

[17] https://www.ofgem.gov.uk/energy-data-and-research/data-portal/wholesale-market-indicators

3.5. Options Evaluation Results

A summary of the weighted options evaluation results is portrayed in Table 3-3. It can be seen that Option 3 has the highest total weighted score, making it the recommended process option, in a scenario where BFC decides to build their own AD plant. Brief justifications for the scoring of each process option against the key criteria is discussed to provide context.

Table 3-3 – Summary of Weighted Options Evaluation Result

Key Criteria	Weighting	Option 1	Option 2	Option 3
Capex (1-Very High to 5-Very Low)	5	5	15	25
Opex (1-Very High to 5-Very Low)	5	20	15	20
Revenue Potential (1-Low to 5-High)	5	5	25	15
Complexity of Operation (1-Difficult to 5-Easy)	3	6	6	12
Footprint (1-Large to 5-Small)	5	15	20	25
Constructability (1-Difficult to 5-Easy)	2	4	4	8
Environmental Impact (1-High to 5-Low)	5	15	25	20
Total Score		**70**	**110**	**125**

CAPEX

The high-level CAPEX estimates for each process option was used as a relative gauge to determine the preferred option in accordance with the key criteria. Based on Atkins' high-level estimations, Option 3 has the lowest CAPEX which is approximately £7,659,441. This is in comparison to Option 1 and 2 which have an estimated high-level CAPEX was £9,016,795 and £8,743,359 respectively. Therefore, Option 3 was given the best CAPEX score.

OPEX

The high level OPEX estimates for each process option was used as a relative gauge to determine the preferred option in accordance with the key criteria. Based on Atkins' high-level estimations, Option 1 and Option 3 has the same associated OPEX and were therefore given the same weighted score. Option 2 scored the lowest due the need to purchase propane to enrich the biomethane before it is supplied to the natural gas grid.

Revenue Potential

Although Atkins' high-level estimation suggests that the revenue potential of Option 3 is the lowest, it should be noted that the value is based on wholesale gas price. It was emphasised that a premium price would likely be agreed between BFC and the third party, increasing the revenue potential of Option 3, such that it is competitive with Option 1. This was the rationale used to justify giving Option 3 a better score than Option 1. It can be observed that Option 2 has the best revenue potential and thus was scored appropriately.

Complexity of Operation

Option 1 and Option 2 were considered to have the same complexity of operation due to the presence of process facilities such as CHP and membrane separation respectively. In contrast, Option 3 avoids the need for complex process facilities and was therefore given the best score, relatively speaking.

Footprint

The high-level space requirement estimates for each process option was used as a relative gauge to determine the preferred option in accordance with the key criteria. Based on Atkin's high-level estimations, Option 3 has the lowest footprint requirement.

Constructability

Option 1 and Option 2 were considered to have the same constructability due to the upstream AD process configuration which accounts for a significant proportion of the plant being identical. Option 3 was score less favourably due to the need to liaise with the third party during the construction phase.

Environmental Impact

Option 2 was given the best score due to the opportunity to recover CO_2 as a by-product in liquid form, making the facility an almost zero-emission system which aligns with BFC's climate change strategy to be carbon neutral by 2050. With that said, it should be noted that recovering the liquefied CO_2 requires additional CAPEX than the high-level value estimated in this feasibility study to purchase the necessary process equipment. Option 1 was considered to be the least favourably option due to the need to combust the biogas within the plant's boundary, producing GHG emissions which are discharged to the atmosphere.

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Member of the SNC-Lavalin Group

Bracknell AD Feasibility Study

Addendum

Bracknell Forest Council

07 December 2021

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This document has 15 pages including the cover.

Document history

Document title: Addendum

Document reference: P:\GBEMF\PDG\PC\BRACKNELL FOREST COUNCIL\Projects\5205840 - Minor Works 2021\104 - AD Plant

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for comments	TP	RL, RW	GM	SG	15/10/2021
2.0	Update for comments	TP	GM	GM	SG	25/10/2021
3.0	Final	RW				07/12/2021

Client signoff

Client	Bracknell Forest Council
Project	Bracknell AD Feasibility Study
Job number	5205840
Client signature/date	

Contents

Tables

1. Introduction

Bracknell Forest Council (BFC) is interested in the potential to use the food waste collected from BFC, Reading and Wokingham Councils and produce biogas. Atkins was commissioned by BFC to undertake a high-level Feasibility Study into the technical viability of a number of options including a potential development of its own Anaerobic Digestion (AD) plant. The intended purpose of the plant would be to treat collected food waste from approximately 47,000 households, that is currently disposed of through the re3 partnership with Wokingham and Reading Councils. 19,000 tonnes of food waste per year is the current collection expectation for 2021/22 for the combined total of the three councils. As part of phase 1, an assessment of three strategic options was investigated looking at the advantages and disadvantages of the following three options:

- Continue with current contract.
- Build own AD plant.
- Public/private partnership - collaborate with a third party

Lastly, an optioneering study assessing three different AD process configurations was performed, designed to inform BFC of the most desirable process option to employ in a scenario where the council decides to build their own AD plant. These AD process configurations were:

- Option 1: Anaerobic Digestion with Electricity to Grid
- Option 2: Anaerobic Digestion with Biomethane to Grid
- Option 3: Anaerobic Digestion with Biogas Export to Third Party

Following the completion of phase 1, BFC instructed Atkins to conduct a risks and opportunities matrix for the three process configurations with the aim to better inform BFC and its stakeholders. This report is an addendum to the original Feasibility Study.

2. Process description

Table 2-1 summarises the key characteristics of the three process configurations in question based on information acquired from phase 1 for a 19,000 tonnes per annum (tpa) Anaerobic Digestion (AD) facility. Note that the high-level estimates presented below should be treated as indicative values. The estimates are equivalent to an AACE class 4 estimate. AACE describes the estimate accuracy as follows:

Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination). Ranges could exceed those shown if there are unusual risks.

Table 2-1 - Key characteristics of process configurations for a 19,000tpa AD plant

	AD + electricity	AD + biomethane	AD + biogas
Process description	Mesophilic conditions (25-45˚C) producing biogas with a typical CH_4 content of 60% combined with a gas engine unit for the generation of electricity and heat. The electricity can be exported to the grid and the heat can be used to maintain the digester's temperature at the required levels.	Mesophilic conditions (25-45˚C) producing biogas with a typical CH_4 content of 60% combined with a gas upgrading system converting the biogas to a highly concentrated biomethane product (>97%). The produced product is then injected into the gas grid system.	Mesophilic conditions (25-45˚C) producing biogas with a typical CH_4 content of 60%. The biogas then can be exported to a third party for further treatment and conversion to a final product such as biomethane, electricity and/or heat.

Main stream of revenue	Electricity	Biomethane	Biogas
Electricity Potential	18-22 MWh_e/day 0.75-0.9 MW_e	0 MW_e – Assuming all biomethane is exported	0 MW_e – Assuming all biogas is exported
Typical site layout and space requirement	9,755m^2 (0.9755 hectares)	7,953m^2 (0.7953 hectares)	7,556m^2 (0.7556 hectares)
Typical Capex	£9m	£8.7m	£7.6m
Typical Opex	£254,000/year	£368,000/year	£254,000/year
Typical revenue potential	£453,000/year	£1.4m/year	£351,000/year

As a comparison, for a 50,000 tonnes per year anaerobic digestion plant the equivalent assumptions would be as presented in Table 2-2. It should be highlighted that no further assessment has been conducted for a 50,000 tonnes per annum AD plant. The table presented below serves purely as a comparison against a 19,000tpa AD plant. The cost estimates are equivalent to an AACE class 4 estimate.

Table 2-2 - Key characteristics of process configurations for a 50,000tpa AD plant

	AD + electricity	AD + biomethane	AD + biogas
Process description	Mesophilic conditions (25-45˚C) producing biogas with a typical CH_4 content of 60% combined with a gas engine unit for the generation of electricity and heat. The electricity can be exported to the grid and the heat can be used to maintain the digester's temperature at the required levels.	Mesophilic conditions (25-45˚C) producing biogas with a typical CH_4 content of 60% combined with a gas upgrading system converting the biogas to a highly concentrated biomethane product (>97%). The produced product is then injected into the gas grid system.	Mesophilic conditions (25-45˚C) producing biogas with a typical CH_4 content of 60%. The biogas then can be exported to a third party for further treatment and conversion to a final product such as biomethane, electricity and/or heat.
Main stream of revenue	Electricity	Biomethane	Biogas
Electricity Potential	48-57 MWh_e/day 2-2.4 MW_e	0 MW_e – Assuming all biomethane is exported	0 MW_e – Assuming all biogas is exported
Typical site layout and space requirement	25,672m^2 (25.672 hectares)	20,929m^2 (20.929 hectares)	19,883m^2 (19.883 hectares)
Typical Capex	£22.5m	£21.5m	£19m
Typical Opex	£891,000/year	£1.2m/year	£890,000/year
Typical revenue potential	£1.2m/year	£3.3m/year	£1m/year

3. Scope of work

Atkins scope is to conduct a risk and opportunities analysis of the three process configurations as presented in phase 1 with the aim to better inform BFC and its stakeholders on their decision-making process for which option is the most feasible.

4. Risks and opportunities matrix

Sections 4.1 to 4.3 present the risks and opportunities for each of the options. The risks and opportunities have been assessed based on the following parameters:

- Footprint
- Carbon and climate impacts
- Operational complexity and staffing
- Planning and permitting requirements
- Availability of the asset
- Markets for outputs
- Plant references
- CAPEX
- OPEX
- Revenue potential
- Required tonnage of feedstock
- Water and wastewater requirements

However, it should be noted that this is not an exhaustive list of risks and opportunities for each option. The risks and opportunities are limited based on the above parameters and it is purely a qualitative analysis. In some cases the risks and opportunities were categorised on a comparative basis whereas in others they were categorised on a standalone basis.

4.1. Option 1 – AD with Electricity to Grid

Table 4-1 lists the risks and opportunities for option1 – AD with electricity to grid.

Table 4-1 – Risks and Opportunities matrix for option 1

Opportunities	Risks
Plant references: AD combined with a CHP unit is a mature and proven technology with numerous reference plants ranging from a few kW to MWe. Hence, it is expected that there will be a plethora of contractors with the expertise and experience to construct an AD plant combined with CHP.	Footprint: It would typically require the largest footprint compared to the other two options due to the CHP unit and hence lead to higher relevant risks.
OPEX: Based on a high-level assessment it was estimated that it would have the lowest OPEX (and similar to option 3) compared to option 2.	Carbon and climate impacts: From an environmental perspective, option 1 would emit GHG emissions as a consequence of the biogas combustion within the plant's boundary which are discharged to the atmosphere.
Markets for outputs: Option 1's key outputs would include electricity and digestate. Both products have a mature and well-established market.	Operational complexity and staffing: Due to the relative complexity of the operation of the AD and CHP unit, the complexity of operation and therefore staffing is expected to be slightly higher compared to option 3 and similar to option 2, incurring medium relevant risks.
	Planning and permitting requirements: Option 1 would require lengthier planning and permitting approval processes as it would include air emission limits from the combustion of biogas in the CHP engine. This means medium delay and development risks from this aspect.
	Availability of the asset: Typically, the availability of a plant is determined by the maturity and complexity of the technology used. Considering that all technologies are considered mature, the complexity is the key parameter. An AD plant tends to have an availability of 95% whereas

	the CHP unit typically has 92%. Hence, it is the CHP unit that determines the plant's overall availability. Option 1 and option 2 are considered to have similar availabilities with the limiting factor being the CHP unit.
	Required tonnage of feedstock: Based on a high-level assessment, option 1 would have the second highest CAPEX after option 2 but would be eligible only for wholesale electricity price. In our view the financial viability of this option is considered as high risk with the current assumptions as the revenues from the wholesale of electricity is not considered adequate to cover the capital expenditure and annual operational costs. However, a cost benefit analysis would be essential to confirm the above statement and determine the required tonnage necessary for making the project feasible from a financial perspective.
	Revenue potential: It would not be able to meet CfD's capacity threshold of 5MWe and would not be eligible to bid in a CfD auction which is the only financial incentive currently available for AD plants with power generation. Hence, the only stream of revenue would be the wholesale of electricity to the grid or a 3rd party. Risks to revenue security are considered as high.
	CAPEX: Based on a high-level assessment conducted by Atkins, it was estimated that it would have the highest CAPEX compared to option 2 and 3, hence incurring medium development and commercial risks

4.2. Option 2 – AD with biomethane to grid

Table 4-2 lists the risks and opportunities for option 2 – AD with biomethane to grid.

Table 4-2 – Risks and Opportunities matrix for option 2

Opportunities	Risks
Footprint: It would require the second largest footprint compared to the other two options due to the biogas upgrading system. However, its footprint can be considered almost similar to option 3 which would translate to lower capital cost for the purchase or lease of the site and likely better site availability.	Operational complexity and staffing: Due to the relative complexity of the operation of the AD and biogas upgrading unit, the complexity of operation and therefore staffing is expected to be slightly higher compared to option 1 and similar to option 2.
Carbon and climate impacts: From an environmental perspective, option 2 could be considered the most environmentally friendly as CO_2 emissions could be recovered and sold to a third party (such as a beverage producing company) making the facility to emit almost zero emissions.	Opex: Its Opex would be the highest compared to the other two options partially due to the need to purchase propane to enrich the biomethane before it is injected into the natural gas grid and partially due its complex process, leading to medium commercial risks.
Planning and permitting requirements: Option 2 is considered the second least complex technology from a planning and permitting perspective and similar to option 3. This is mainly due to the lack of any combustion process which would need air emission limits as part of the planning and permitting conditions.	Availability of the asset: Typically, the availability of a plant is determined by the maturity and complexity of the technology used. Considering that all technologies are considered mature, the complexity is the key parameter. Option 2 is considered to have similar availability with the limiting factor being the biogas upgrading unit and thus a medium risk.

Markets for outputs: Option 2's key outputs would include biomethane and digestate. Both products have a mature and well-established market.	CAPEX: Based on Atkins' high-level estimations, Option 2 has the highest CAPEX due to its complexity although the cost may be reduced as the demand is expected to be increased due to financial incentive for this type of configuration. A factor that has not been taken into account is the gas grid connection cost with the local gas grid network operator as this tends to be very site specific. The relevant commercial risk is estimated as high.
Plant references: AD combined with a biogas upgrading unit is a mature and proven technology with an increasing number of reference plants in the UK as a response to the support schemes currently available. Hence, it is expected that there will be sufficient number of contractors with the expertise and experience to construct an AD plant combined with biogas upgrading system.	
Revenue potential: The AD with biomethane to grid plant would produce biomethane which would be eligible for financial incentives such as Green Gas Support Scheme (GGSS) or Renewable Transport Fuel Obligation (RTFO). In addition, the plant would benefit from the wholesale price of gas to the grid and potentially from the export of CO_2 to the beverage industry market.	
Required tonnage of feedstock: Based on a high-level assessment, option 2 would have the highest CAPEX but also eligible for the most revenue streams (GGSS and/or RTFO and wholesale gas). In our view that would be the most financially viable option. However, a cost benefit analysis would be essential to confirm the above statement and determine the required tonnage necessary for making the project feasible from a financial perspective.	

4.3. Option 3 – AD with biogas to third party

Table 4-3 lists the risks and opportunities for option 3 – AD with biogas to third party.

Table 4-3 – Risks and Opportunities matrix for option 3

Opportunities	Risks
Footprint: It would require the smallest footprint compared to the other two options as there is no CHP or biogas upgrading unit. Option 3's small footprint would translate to lower capital cost for the purchase or lease of the site and likely better site availability.	Markets for outputs: Option 3 would produce biogas and digestate. The offtake of biogas from a third party although not novel, it is less mature and widespread compared to options 1 and 2. This risk is considered to be medium.
Carbon and climate impacts: From an environmental perspective, option 3 could be considered one of the most environmentally friendly options as there will be no CO_2 emissions from the facility. Any CO_2 emissions would be outside the plant's boundaries.	Plant references: AD plants exporting biogas to a third party is the least widespread configuration. AD plants most often are coupled with either CHP or biogas upgrading units which allow them to benefit from the sale of the final product (electricity and biomethane respectively). Although, it is expected that there will be a number of contractors with the expertise and experience to construct an AD plant, the track record is not that extensive.
Operational complexity and staffing: Due to the relatively simple operation of the AD, the complexity of operation and therefore staffing is expected to be the lowest among the three options as it avoids the need for complex processes such as CHP and biogas upgrading.	Revenue potential: Atkins' high-level estimation suggests that the revenue potential of Option 3 is the lowest. However, it should be noted that the value is based on wholesale gas price. It should be emphasised that a premium price could be agreed between BFC and the third-party sharing part of the governmental incentive,

	increasing the revenue potential of Option 3. Hence, the relevant commercial risk is considered to be high.
Planning and permitting requirements: Option 3 is considered the least complex technology from a planning and permitting perspective and similar to option 2. This is mainly due to the lack of any combustion process which would need air emission limits as part of the planning and permitting conditions.	Required tonnage of feedstock: Based on a high-level assessment, option 3 would have the lowest CAPEX but would be eligible only for wholesale gas price. In our view the financial viability of this option is considered doubtful with the current assumptions However, as mentioned above it could be argued that a premium price would likely be agreed between BFC and the third party, increasing the revenue potential of option 3. The current plans are considered to have high risks in comparison with the two other options. In any case, a cost benefit analysis would be essential to confirm the above statement and determine the required tonnage necessary for making the project feasible from a financial perspective.
Availability of the asset: Typically, the availability of a plant is determined by the maturity and complexity of the technology used. Considering that all technologies are considered mature, the complexity is the key parameter. The plant's availability for Option 3 is impacted only by the AD plant which typically ranges around 95%. From that perspective, option 3 is considered to have the highest availability.	
CAPEX: Based on Atkins' high-level estimations, option 3 has the lowest CAPEX due to the relatively simple configuration. A factor that has not been taken into account is the grid connection cost with the third party as this tends to be very site specific.	

5. Risks and Opportunities Matrix

This section presents a high-level comparative evaluation in the form of risks and opportunities analysis comparing the three options. It should be highlighted that the RAG (Red, Amber, Green) evaluation was based on qualitative data only. The results could differ substantially if a quantitative analysis is decided to be performed in due course and different weighting factors are applied or more parameters are included. For instance, if a cost benefit analysis is performed, it could reveal that only one option is financially viable and this option would automatically become the preferred option regardless of the number of opportunities the other options may have. However, this exercise is outside the scope of this study. Finally, it should be noted that the site boundaries include only those processes that BFC will build, own, and operate up to connection point and exclude any third-party processes and infrastructure which is outside the project boundaries. Table 5-1 summarises the risks and opportunities of each option per parameter.

Table 5-1 – Consolidated risks and opportunities matrix

Parameter	Impact	AD + electricity	AD + biomethane	AD + biogas
Footprint	Larger footprint will impact costs and likely site availability	High – it would have the largest footprint among the different options.	Medium – reduced footprint compared to option 1 but higher compared to option 3.	Medium – smallest footprint among the different options for Bracknell, however, there will need to be sufficient capacity available for an adjacent facility to manage the biogas within a reasonable distance.
Carbon and climate impacts	Carbon impact from deployed technology and potential to displace fossil fuel-based carbon	Medium – Option 1 is considered the least favourable option due to the need to combust the biogas within the plant's boundary emitting GHG emissions which are discharged to the atmosphere.	Low – Option 2 and 3 have the opportunity to recover CO_2 as a by-product in liquid form making the facility an almost zero-mission system which aligns with BFC's climate change strategy to be carbon neutral by 2050.	Low – As per option 2.
Operational complexity and staffing	Level of complexity impacts the operating and maintenance costs and staffing requirements of each option	Medium - Option 1 and Option 2 were considered to have the same complexity of operation due to the presence of process facilities such as CHP and membrane separation respectively.	Medium - Option 1 and Option 2 were considered to have the same complexity of operation due to the presence of process facilities such as CHP and membrane separation respectively.	Low - Option 3 avoids the need for complex process facilities and therefore has the lowest complexity and need for staffing.

Planning and permitting requirements	The more complex a technology the higher the risk of a lengthier approval process and the associated pre-construction or operation conditions attached to the planning permission or environmental permit..	Medium – Option 1 is considered to be the most complex technology as the planning and permitting process will include air emission limits from the power island and therefore lengthier approval processes for planning and permitting.	Low – Option 2 is considered the second least complex technology from a planning and permitting perspective.	Low – Option 3 is considered the least complex technology and therefore it could be argued that the planning and permitting process would have slightly less time-consuming.
Availability of the asset	The availability determines the number of hours the plant is operational in a period of time and therefore impacts opex and revenues	Medium – Typically the availability of a plant is determined by the maturity and complexity of the technology used. Considering that all technologies are considered mature, the complexity is the key parameter. Option 1 and option 2 are considered to have similar availability.	Medium – as per option 1.	Low – Option 3 is considered the least complex process and therefore its availability would be slightly higher compared to option 1 and 2.
Markets for outputs	Technologies that produce more outputs are scored higher than those that produce less due to the potential revenue streams	Low – Option 1 would produce electricity and digestate. Negligible difference between option 1 and 2 as the markets for their outputs are mature.	Low – Option 2 would produce biomethane and digestate. Negligible difference between option 1 and 2 as the markets for their outputs are mature.	Medium – Option 3 would produce biogas and digestate. The offtake of biogas from a third party although not novel, it is less mature and widespread compared to options 1 and 2.
Plant references	The number of similar plants that operate in the UK provide confidence that the technology is mature and that there are contractors with sufficient experience and expertise to build these kind of plants	Low – the majority of the AD plants currently in operation in the UK export electricity to the grid with a large range of electrical capacities ranging from a few kWe to MWe.	Medium – the latest AD plants build in the UK, export biomethane to the grid. This is a response to the change in the supportive schemes currently available in the UK for AD plants (Green Gas Support Scheme and Renewable Transport Fuel Obligation). Although currently not the	High – The number of similar plants that operate in the UK are the minority compared to the other two types of plants.

			majority, it is expected that in the upcoming years biomethane plants will become the majority for the abovementioned reason.	
CAPEX	Technologies that have a lower Capital Expenditure of investment, are scored higher than those that have a higher CAPEX.	Medium - Based on Atkins' high-level estimations, option 1 has a CAPEX that seats between option 2 and 3 as is the second most complex configuration. However, the grid connection cost with the local DNO or private offtaker has not been taken into account as this tends to be very site specific.	High - Based on Atkins' high-level estimations, option 2 has the highest CAPEX due to its complexity although the cost may be reduced as the demand is expected to be increased due to financial incentive for this type of configuration. A factor that has not been taken into account is the gas grid connection cost with the local gas grid network operator as this tends to be very site specific.	Low - Based on Atkins' high-level estimations, option 3 has the lowest CAPEX due to the relatively simple configuration. A factor that has not been taken into account is the grid connection cost with the third party as this tends to be very site specific.
OPEX	Technologies that have a lower Operational Expenditure, are scored higher than those that have a higher OPEX.	Low - Based on a high-level assessment it was estimated that it would have the lowest OPEX (and similar to option 3) compared to option 2.	Medium – based on a high-level assessment it was estimated that it would have the highest OPEX compared to the other two due to its complexity.	Low - Based on a high-level assessment it was estimated that it would have the lowest OPEX (and similar to option 1) compared to option 2.
Revenue potential	Technologies that have higher revenue potential are scored higher than those that had less	Low – Currently the size of the plant does not make it eligible to benefit from the Contracts of Difference scheme. The only stream of revenue will be wholesale electricity to the grid or a private offtaker, subject to fluctuation.	High - The AD with biomethane to grid plant would produce biomethane which would be eligible for financial incentives such as GGSS or RTFO. In addition, the plant would benefit from the wholesale price of gas to the grid and potentially from the export of CO2 to the beverage industry market.	Low - Atkins' high-level estimation suggests that the revenue potential of Option 3 is the lowest. However, it should be noted that the value is based on wholesale gas price. It should be emphasised that a premium price would likely be agreed between BFC and the third-party sharing part of the governmental incentive, increasing the revenue

				potential of Option 3, such that it is competitive with Option 1.
Required tonnage of feedstock	The required tonnage of feedstock is determined by the balance sheet when all costs and revenues have been determined.	High - Based on a high-level assessment, option 1 would have the second highest CAPEX after option 2 but would be eligible only for wholesale electricity price. In our view the financial viability of this option is considered doubtful with the current assumptions. However, a cost benefit analysis would be essential to confirm the above statement and determine the required tonnage necessary for making the project feasible from a financial perspective.	Low - Based on a high-level assessment, option 2 would have the highest CAPEX but also eligible for the most revenue streams (GGSS and/or RTFO and wholesale gas). In our view that would be the most financially viable option. However, a cost benefit analysis would be essential to confirm the above statement and determine the required tonnage necessary for making the project feasible from a financial perspective.	High - Based on a high-level assessment, option 3 would have the lowest CAPEX and eligible for wholesale gas price to the third party only. In our view the financial viability of this option is considered doubtful with the current assumptions However, as mentioned above it could be argued that a premium price would likely be agreed between BFC and the third party, increasing the revenue potential of option 3. In any case, a cost benefit analysis would be essential to confirm the above statement and determine the required tonnage necessary for making the project feasible from a financial perspective.
Water and wastewater requirements	Technologies that have lower water and wastewater requirements are scored higher than those that require more	Medium – Negligible difference in water consumption and wastewater requirements between the three options described here.	Medium – Negligible difference in water consumption and wastewater requirements between the three options described here. However, subject to the type of technology used to upgrade the biogas, water consumption could be slightly higher.	Medium – Negligible difference in water consumption and wastewater requirements between the three options described here.

6. Conclusions

Based on the high-level risks and opportunities assessment and the current available information, it is Atkins' view that the most favourable route from a risk and opportunity perspective would be for BFC to explore the development of an AD plant with biomethane export. This is due to financial incentives currently available in the UK, which constitute a significant commercial opportunity. The AD with biogas export configuration could also be an alternative option pursuant though to the negotiation with the third party and the amount of premium that the third party will be willing to pay (essentially sharing the financial incentive from the sale of biomethane or electricity and/or heat). In any case, Atkins strongly recommends that a cost benefit analysis is performed before a final decision is taken which would provide the necessary validation from a quantitative perspective on the most favourable option to be taken forward for development.

Once a decision is taken in terms of the preferred process configuration, the following stems are recommended:

- Appointment of an Owner's Engineer (OE) who will guide BFC through the tendering process for the EPC Contractor selection up to construction. Other tasks of an OE role could include the review the plant's design and specifications, assessment and evaluation of the technical assumptions in the financial model and assist BFC during the due diligence phase should Lenders are invited to support the project financially. Atkins would be happy to provide this type of services.
- Appointment of an Environmental and Planning Consultant who will guide BFC through the appropriate planning consent process and Environment Agency's regulations. This needs to be done early on to inform the design with regard to regulatory requirements including Best Available Techniques (BAT) and confirm the appropriate consenting strategy (i.e. would the facility constitute a Nationally Significant Infrastructure Project). Atkins would be happy to provide these types of services.
- Selection of the appropriate site with good access to the road network, proximity to the catchment areas for minimising transport costs and utilities such as electrical and/or gas grid networks but also a sufficient distance from sensitive receptors to minimise possible impacts from any noise and odours. Finally, the appropriate site should be in an area which adequately addresses flood risk and that it is not located in any protected or designated landscape. Atkins can support BFC in the site selection process.
- Depending on the appropriate application process to be followed, pre-application consultation with the relevant planning authority to set out intention and description of the scheme and to confirm:
    - the principle of the development/location
    - whether there is a need for EIA
    - the key issues to address in design/application
    - the appropriate assessments and supporting information to accompany the application.
- The contents of the planning application would, as a minimum, need to include:
    - Location Plan, proposed site plan and elevation drawings.
    - Design and Access Statement;
    - Landscape proposals;
    - Biodiversity Report and Net Gain Statement;
    - Flood Risk Assessment;
    - Photomontage of digester, plant buildings and stack with clear indication of building material and colour;
    - Information on grid connection works;
    - Details of emissions to air and an assessment of their impact;
    - Details of vehicular access and vehicular movement;
    - Site management measures during the construction phase;
    - Model of emissions dispersion (if applicable).

- Inform the local community early on and commence consultation for the local community’s acceptance of the project.
- Commence discussion with the Environment Agency for the type of permit necessary for the plant.

It should be noted that the above list is non-exhaustive. This is based on a preliminary assessment and are based on a high-level exercise for the typical roadmap of an AD plant.

END

Tryfon Papalexandrou
Atkins Limited
Woodcote Grove
Ashley Road
Epsom
KT18 5BW

Tel: +44 (0)1372 726140
Fax: +44 (0)1372 740055

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Local Renewable Power Generation: Anaerobic Digestion Plant High Level Feasibility

Climate Change Advisory Panel

27th January 2022

Bracknell Forest Council

Anaerobic Digestion Plant High Level Feasibility

Kevin Gibbs
Executive Director: Delivery
Bracknell Forest Council

Bracknell Forest Council

Types of Renewable Energy Power

- Solar
- Anaerobic Digestion plant
- Wind turbines
- Hydroelectric
- Micro-nuclear
- Micro combined heat and power
- Hydrogen fuel cell

Bracknell Forest Council

Anaerobic Digestion (AD)

- AD is the breakdown of organic material by micro-organisms in the absence of oxygen
- AD produces biogas - methane-rich gas that can be used as fuel
- AD produces digestate - source of nutrients that can be used as a fertiliser
- AD is being used to make the most of waste by turning it into renewable energy

Bracknell
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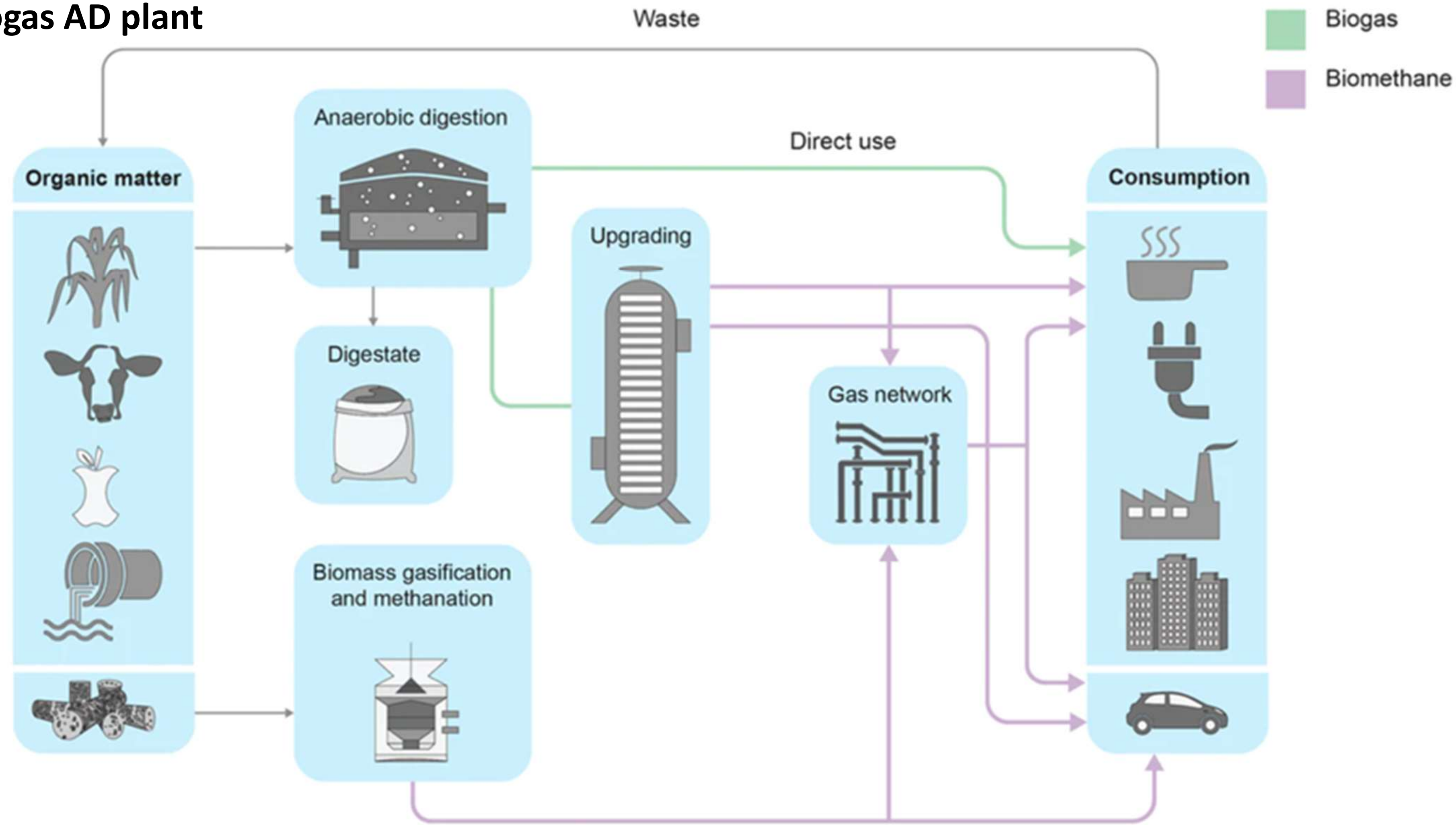
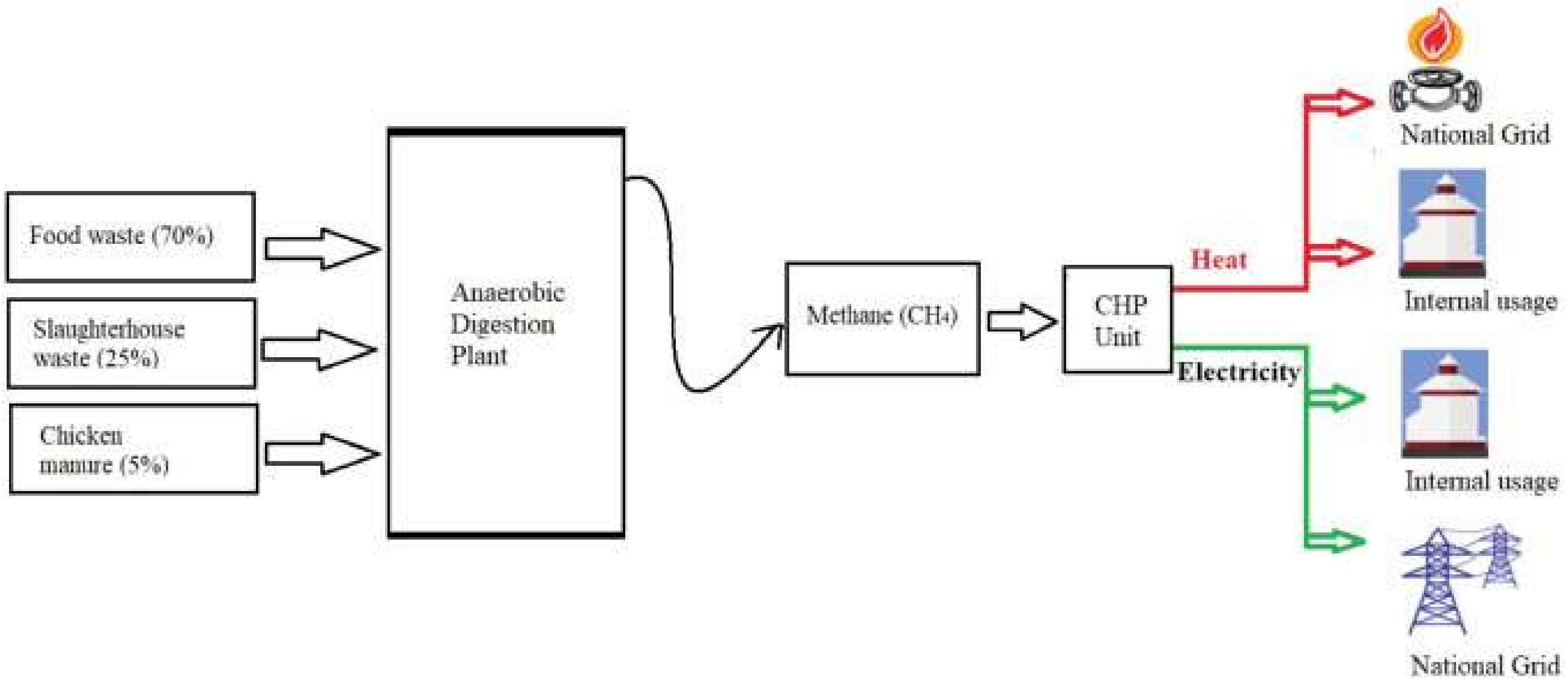
Council

Biogas AD plant



Combined Heat & Power (CHP) AD plant



re3 Food Waste

- re3 food waste contracted to Wallingford
- Contract locked in place until 2031
- Processed in an Anaerobic Digestor
- Produces biomethane which is used to create electricity
- Circa 20,000 tonnes p/a from 3 Councils

Bracknell Forest Council

Power Generation

- 1 home uses circa 12,000 KWh electricity p/a
- 2,000 homes use 24,000,000 KWh or 24,000 MWh
- The average village is 2,000 homes & would need around 17,000 tonnes p/a of food waste to electrically power it
- Cira £9m to build an electricity to grid AD plant
- Circa £8.7 for a biomethane AD plant
- Opex costs of circa £245k - £378k p/a

Bracknell Forest Council

Land Space Requirements

- 19,000 tonnes of feedstock would require a land space of circa 0.8 hectares
- 50,000 tones would be circa 2.1 hectares
- A 50,000 tonne plant would generate 3 MWh which could electrically power up to 6,000 homes

Bracknell Forest Council

Vehicle Movements

- 780 re3 vehicle movements p/a to Wallingford
- An AD plant powering 6,000 homes would require circa 700 trips p/a (14 per week)

Bracknell Forest Council

Conclusion

- Business case for an AD plant appears viable
- Significant investment – at least £18m (including land)
- Not for Council to lead as not a core service nor do we have the expertise
- Initial feasibility work available for a developer to take forward

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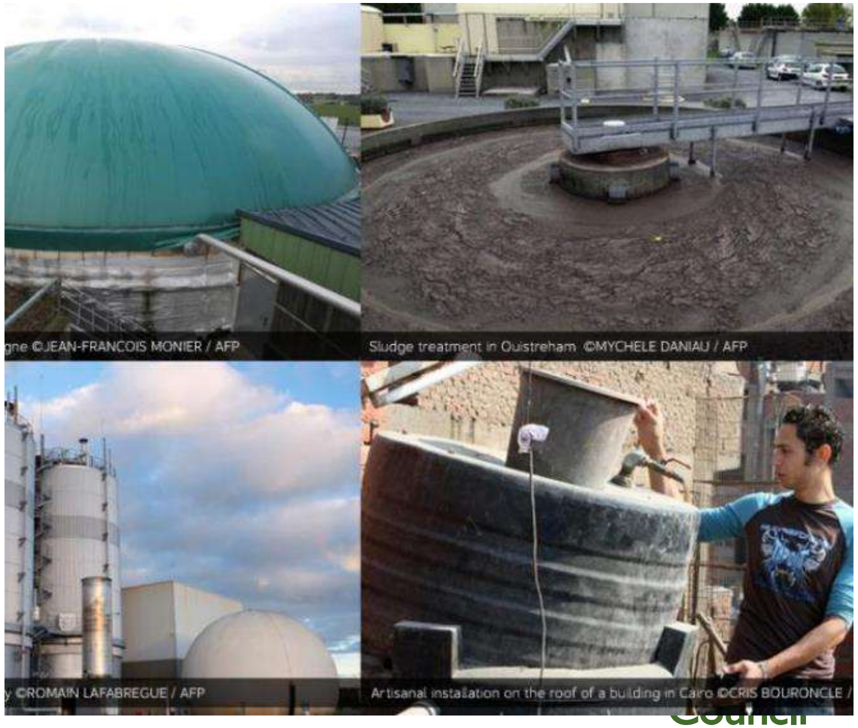
Local Renewable Power Generation: Member visits

Climate Change Advisory Panel

27th January 2022

Report from Cllr Ingham (June ‘21)

Re the anaerobic digester, the National Farmers Union (NFU) is looking into this for farming and describe it like this (less techie than science sites) …..”the controlled breakdown of organic matter in a closed ‘digester’ vessel. The air supply is restricted to stimulate ‘anaerobic’ decomposition (as opposed to composting, which takes place in the presence of air). After 20 to 60 days, depending on the configuration and internal temperature of the digester, a methane-rich ‘biogas’ is produced. This gas is commonly used for electricity and heat generation, and may also be upgraded for other applications. The residual co-product is an odour-free ‘digestate’, which is rich in plant-available N, P and K and may be directly spread on the land as a fertiliser.”



Basingstoke Anaerobic Digestor plant – 3rd September '21

Bracknell Forest Council

Basingstoke Anaerobic Digestor plant – 3rd September '21

- The tonnages of feedstock the plant takes in on an annual basis? 29,000tpa
- What is this made up from (e.g. Food waste or other waste types)? Food Waste Only
- Which local councils supply you with food waste, if any? Isle of White
- Which process does the plant use - Anaerobic Digestion with Electricity to Grid or Anaerobic Digestion with Biomethane to Grid Electrical Grid
- What is the size of the plant footprint? 1.46 hectares
- How did they engage with the public when the site was first proposed and also through its build and what issues arose – and have been raised whilst the site has been operational. Biogen only acquired the site in 2018 well after its commissioning in 2015. Since 2018 Biogen have spent considerable monies rectifying many of the inherent design faults and as a result have eased many resident concerns. The site has had a full audit from the EA and passed with flying colours. We hold a regular liaison committee to address any concerns from residents. These have largely been eliminated…..

Bracknell Forest Council

Basingstoke Anaerobic Digestor plant – 3rd September ‘21

“…Shropshire Unitary who had their own plant from 2008 but ceased production in 2012 over many difficulties. Of course, technology has moved on since then and they built it with funding from Defra …Today they would use a commercial partner to operate the plant given the complexities.”

Report to Climate Change Panel on the members visit to the Biogen facility in Dummer Hampshire 20th September 2021

Wallingford Anaerobic Digestor plant – 1st December ‘21

Wallingford Anaerobic Digestor plant – 1st December ‘21

- The tonnages of feedstock the plant takes in on an annual basis? 50,000tpa
- What is this made up from (e.g. Food waste or other waste types)? Food Waste
- Which local councils supply you with food waste, if any? re3, RBWM, Vale of White Horse, South Oxfordshire
- Which process does the plant use - Anaerobic Digestion with Electricity to Grid or Anaerobic Digestion with Biomethane to Grid Electrical Grid
- What is the size of the plant footprint? 2.7 hectares
- How did they engage with the public when the site was first proposed and also through its build and what issues arose – and have been raised whilst the site has been operational. Unknown. No issues raised whilst re3 has been engaging with this site.

Bracknell Forest Council

Wallingford Anaerobic Digestor plant – 1st December ‘21

Wallingford Anaerobic Digestor plant – 1st December ‘21

Lakeside Energy from Waste plant – 30th November

Lakeside Energy from Waste plant – 30th November

Lakeside Energy from Waste plant – 30th November

Lakeside Energy from Waste plant – 30th November

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Report to Climate Change Advisory Panel on the members visit to the Biogen facility in Dummer Hampshire.

Reason for Visit:

The Climate Change Advisory Panel was asked to consider a proposal for BFC to construct a local Anaerobic Convertor to service the Borough and other local authorities and commercial contractors. Members wanted to obtain more information and understanding of the facility before they could make comment.

The Visit:

Simon Musther (Commercial Director on behalf of **Biogen** – (who were awarded Recycling business of the year) arranged for us to visit (Cllr Ingham, Mossom and Virgo) on Friday 3rd September 2021.

The Facts:

All Councils will be expected to recycle their food waste by **2023**! Simon also explained in his opinion the present number of AD's could not cope with extra demand. We also learnt that the Government subsidy for building renewables had been withdrawn and as a consequence there had been no new facilities constructed for some time. We were told that it cost around **6 to 8 Million Pounds** to construct a reasonable sized AD. The whole process of turning organic material with the aid of microorganisms, in the absence of Oxygen, is highly technical and needs considerable expertise to make the facility both efficient and cost effective. By turning organic matter into biogas, the product is combusted to generate electricity or heat via a generator which can be processed into renewable natural gas and transportation fuels (ethanol). Most of the AD plants produce electricity which can be fed directly to the grid but there are some producing just Biogas – Methane CH4 (50/70%) and Carbon dioxide C02 30/40%.
Methane is a much more potent greenhouse gas which during natural decay would have entered the atmosphere, by capturing the methane and converting it to CO2 to generate electricity **prevents** it from escaping in the atmosphere.

/2

The plant:
Annual food waste capacity: 29,000T
Generation to grid: 1.5MW/h
Homes powered: 2,000
Digestate: 1,600 acres

<u>The Tour</u>

Members were first taken to the control centre and given a health and safety briefing as well as an overview of the process. Most of the food waste for this site comes from hospitality and supermarkets with some food waste from Local Authorities. They had also processed some arable crops, but Simon stressed that the contents must be closely scrutinised for the microorganisms to work properly. In the control centre they constantly monitored the output of the digester in order to check its quality of output. The total staff employed at this facility including engineers and operatives were 6.

<u>Discharge Area</u>

Members watched as the Biffa company discharged a full lorry of food waste (from Waitrose in Bracknell) on the yard. It considered of considerable plastic materials and containers. We were informed that it was important that the food was not too wet or stale as this harmed the biological process and they only accepted waste from reliable sources.

The waste was then lifted by means of a JCB machine into a hopper which removed all the plastic and non - organic materials. Constant attention was given to cleaning down the yard and vehicle after the load was emptied. **The planning consent only allowed 19 lorry movements per day.**

/3

The Digestor

We followed the process to the digestor which resembled that of a chemical plant. The tank or reactor converted food waste using bacteria to break down organic solids without the use of oxygen. The dome at the top of the plant collected and stored the biogas.
A large and very expensive generator fuelled on biogas worked constantly (24/7) to complete the process of converting the product into electricity with a direct link to the National Grid.

Planning and the Community

Biogen put considerable effort into working with the local community into the running of the site when it bought the plant in 2018. There was much hostility to its existence before the company purchased it but through careful adjustments to lorry movements and reducing the emission of unsavoury odours, the plant now works without objection, but Simon stressed it took a lot of careful handling and compliance and this need to be monitored daily. He went on to say, ‘It is essential to bring the community with you regarding planning matters.

Recommendations

I spoke with Mark Foxall at Shropshire Unitary who had their own plant from 2008 but ceased production in 2012 over many difficulties. Of course, technology has moved on since then and they built it with funding from Defra and are considering a restart. Today they would use a commercial partner to operate the plant given the complexities. It also helps that there is arable land around to use the bi product. He suggested we should consult **Anaerobic Digestion & Bioresources Association ADDBA** who will give advice on methods and commercial arrangements for our region. Close attention should also be given to the price of tariff offered to make the operation viable and commercially productive given the type of waste we would use.

Notes from Cllr Ingham – 20th September 2021
Comparison of 2 AD plants using questions asked:

QUESTION	OXFORDSHIRE	BASINGSTOKE
Tonnage of feedstock the pant takes in on an annual basis	50,000 tonnes/pa	29,000 tonnes/pa
What is the tonnage made up from	Food waste	Food waste and arable crops
Which local councils supply you with food waste	re3, RBWM, Vale of White Hors, South Oxfordshire	Isle of Wight, Hants, Eastleigh, Portsmouth and commercial businesses inc. Waitrose Bracknell
Which process does the plant use - Anaerobic Digestion with Electricity to Grid or Anaerobic Digestion with Biomethane to Grid	Electrical Grid	Anaerobic digestion and Biomethane to grid (they harvest methane gas)
What is the size of the plant foodprint?	2.7 hectares	1.6 acres (0.647 hectares)
How did they engage with the public when the site was first proposed and also through its build and what issues arose – and have been raised whilst the site has been operational?	Unknown, no issues raised whilst re3 has been engaging with this site	Biogen put considerable effort into working with the local community into the running of the site when it bought the plant in 2018. There was much hostility to its existence before the company purchased it but through careful adjustments to lorry movements and reducing the emission of unsavoury odours, the plant now works without objection, but Simon stressed it took a lot of careful handling and compliance and this need to be monitored daily. He went on to say, 'It is essential to bring the community with you regarding planning matters.

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