Non-Technical Summary

GWE Biogas Permit Variation

Report produced for **GWE Biogas Ltd**

Provided by Walker Resource Management Ltd (WRM)

Document Title	Non-Technical Summary
Revision	V1.0
Date	25/08/2023
Document Reference	EPR-A01
Project Reference	PR1162WO4
Author	Gary Glover
Reviewer	James Hay

Version No.	Date	Description of change
0.1	19/10/2022	Initial Draft
0.2	26/10/2022	Internal Review
0.3	12/05/2023	Second Draft
0.4	13/06/2023	Update to include refuelling station
0.5	21/08/2023	Third Draft and Quality Review
1.0	25/08/2023	First Issue

CONTENTS

1.0 INTRODUCTION

1.1 Site Address

GWE Biogas Limited
Sandhill,
Kirkburn,
Driffield,
YO25 9DR

1.2 Operational Location

Site Grid Reference: Easting 498707, Northing 456582

1.3 Site Description

The anaerobic digestion facility is located approximately 1.25km North of the village of Kirkburn and approximately 3.1km West of the town of Driffield. The site is visually discreet, being situated on low ground and bordered by trees and hedges. The site has one main access point located off Station Road via the A614. The site, wholly owned by GWE Biogas Ltd ('GWE'), following the latest development phase will contain a weighbridge, site office, refuelling station, sileage clamp, reception hall, seven primary digesters, one secondary digester, negative aeration system, biogas cleaning system, four combined heat and power (CHPs) units and a biomethane upgrading unit with gas to grid connection and a Carbon Capture System with supportive infrastructure and ancillary plant.

1.4 Plans

Reference Drawing: GWE Site Plan

1.5 Permits and Licences

The site currently holds the following environmental permit: EPR/TP3835KE/V009. This permit allows for an Anaerobic Digestion facility including combustion of biogas.

1.6 Planning

The site has full planning permission for the operations from East Riding of Yorkshire Council under reference DC/09/00511 with Planning secured 06/05/2009. Subsequent planning permissions for developmental phases of the operational Biogas Facility have been approved by the Local Planning Authority.

1.7 Reason for Application

GWE is seeking permission to vary their current bespoke permit for the inclusion of the following:

- Construction of an Agricultural Silage Clamp
- Construction of two additional primary digesters, termed Digester 6 and Digester 7
- Installation of an additional low temperature flare and desulphurisation plant
- Installation of a Modular Carbon Capture and upgrade System (CCUS) including storage
- Installation of vehicle refuelling equipment
- An increase in capacity up to 211,000 tonnes per annum (tpa).

This variation will enable the on-site storage of up to 15,000 tonnes of whole crop silage. The installation of the two additional digesters will facilitate the increase of the processing capacity of the AD facility to

211,000 tonnes per annum. This increase in anaerobic digestion capacity necessitates the installation of an additional new low temperature flare and higher capacity desulphurisation plant to support the increased volume of biogas to be produced.

The proposed installation of the vehicle refuelling equipment enables the facility to address the issues of increasing energy prices by mitigating the reliance on external providers and have the convenience of being able to refuel onsite using its own compressed biogas.

The proposed installation of the CCUS technology enables the facility to capture the CO_2 produced as part of the anaerobic decomposition process. It is anticipated that the system will capture approximately 8,000 tonnes of CO_2 per annum from the biogas to biomethane upgrading process. The captured CO_2 will be utilised within the food and beverage industry.

2.0 PROPOSED OPERATIONS

2.1 Operational Layout

The operational layout of the facility is presented on the Proposed Site Layout (*GWE Site Plan*). Following the completion of proposed works at the site, the development will consist of the following:

- site weighbridge;
- site office;
- sileage clamp;
- two reception halls;
- seven primary digesters;
- one secondary digester;
- negative aeration system;
- four combined heat and power (CHPs) units;
- two emergency flares, biogas cleaning and upgrading plant;
- CCUS Plant;
- vehicle refuelling station;
- a gas to grid entry unit; and,
- two lagoons – a surface water storage lagoon and a digestate storage lagoon.

GWE will be responsible for all the plant, equipment and infrastructure associated with the extended capacity Biogas Facility.

2.1.1 Construction of Feedstock Clamp

The proposed new feedstock clamp will provide engineered capacity for up to 15,000 tonnes of whole crop agricultural feedstocks to be ensiled and stored on site prior to use as digestion feedstock. The feedstock clamp will be constructed in accordance with SSAFO Regulations. The feedstock clamp will possess an impermeable base, walls and perimeter drains.

Surface runoff of rainfall and/or the leachate from the silage will drain away and be captured by a dedicated underground tank, which will have a capacity of 30m^3 or 30,000 litres. The tank will be equipped with 2 pumps – one duty and one standby. When the level in the underground tank rises, the pumps will be activated and the captured rainwater/effluent will be pumped into the lagoons, which have the following volumes:

- Storage lagoon 40,758 m3 (47,615 m3 with freeboard)
- Settlement lagoon 1,999 m3 (2,977 m3 with freeboard)

The pumps have a pump rate of 150m^3 per hour each. With an area of approximately 8,000m^3, this equates to a rainfall event of 37.5mm per hour. Any rainfall that is in excess of this drains to a low area of site, where it will be discharged to the soakaway.

2.1.2 Construction of Additional Digesters

The proposed two additional digesters, referred to as Digester 6 and Digester 7, will process materials currently permitted within the existing environmental permit and those that are currently processed by GWE. Therefore, there will be no fundamental changes to the existing anaerobic digestion processes undertaken at the facility. It is envisaged that Digester 6 will be part of the clean processing line, whilst Digester 7 will be a part of the packaged material processing line. Each digester will have a net volume of 4,839 m^3.

2.1.3 Carbon Capture and Upgrading System (CCUS)

The proposed modular Pentair CCUS will be linked to the existing Gas to Grid upgrading facility to collect and treat the Carbon Dioxide by-product otherwise released to atmosphere during the Biogas to Biomethane Upgrading process

The benefits of installing the CCUS unit are that under the current operational scenario the by-product CO_2 is an accepted material loss from the upgrading process, released as an effluent gas to the atmospheric carbon cycle. Capture, recovery and upgrading of this CO_2 to a desired specification mitigates CO_2 release into the atmosphere. The capture of the CO_2 provides a new commercial opportunity for GWE to supply 8,000 tonnes of the gas for utilisation in the food and beverage industry.

2.1.4 Low Temperature Flare and Desulphurisation Tower

The increase in the planned throughput of the site necessitates the installation of an additional temperature flare and desulphurisation unit.

Prior to the biogas-to-biomethane upgrading process, the biogas is fed through the desulphurisation system to remove hydrogen sulphide.

The desulphurisation process consists of a heat scrubber – which takes heat from the CHP engines' water jacket – which heats the gas to greater than 30° via a hot spray loop. The hot spray loop also saturates the gas to 100% humidity. The biogas is then passed into the biological reactor, where it passes up the reactor through active biological media, against a counter current of digestate slurry injected into the top of the reactor.

The active microorganisms are seeded on SESSIL media, made of polyethylene, located within the reactor tank, which has a volume of 89m^3. Microorganisms of the species Thiobacillus and Sulfolobus have been used in both commissioning and operation of the reactor. These species are highly selective in their ability to oxidise sulphur containing compounds in the presence of oxygen and at temperatures above 30° and subsequently remove them from the gas stream via conversion to an elemental sulphur solution.

The plant is monitored and controlled via a control panel mounted locally within the technical centre (Siemens HMI) and also connected to the existing SCADA system via Modbus TCP.

The site will also be equipped with an additional flare. The additional flare would only be used in emergencies (i.e in the unlikely event that the main flare is not operational).

2.2 On-site Vehicle Refuelling Station

The proposal for the vehicle refuelling station will include a simple set up that resembles a fuel pump equipped with adequate storage for the compressed gas (275 bar) and a compressor hut. Vehicles associated with the operation of the AD plant will be able to fill from the storage and the typical fill time is 5 minutes. The proposed equipment extends to 6.5m in height and will be located in the northern section of the site, within the vicinity of the CCUS equipment and the additional flare. The benefit of this vehicle refuelling centre will be to mitigate dependence on increasing energy prices. It should be noted that the vehicle refuelling equipment will only be used to re-fuel vehicles associated with the operation of the AD site.

2.3 Materials to be Processed

No additional waste codes are required to be added to the permit as a result of the developments detailed above.

2.4 Capacity Increase

As part of the permit variation, GWE is seeking to increase the permitted capacity of the facility from 150,000 tpa to 211,000 tpa. This is due to the increased site capacity and efficiency gains created by the addition of the new digesters.

A site capacity assessment has been undertaken (see EPR-A02 – Site Capacity Assessment). The assessment indicates the plant has sufficient capacity for the increase in throughput tonnages and the per day tonnage of processing capacity value meets the requirements as set out within the IED.

3.0 MANAGEMENT SYSTEM SUMMARY

Management of the site follows documented Management Systems, processes and procedures, adhered to by trained and competent Managers and staff. The Management Systems form the basis of the GWE Biogas Ltd. Integrated Management System and are aligned to the Management System Standards ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018.

These documents include risk assessments and method statements for all tasks undertaken on site, and consider environmental, quality, health and safety risks. All documents have a named author who is responsible for their content and regular updates. These documents form part of site inductions and are available for all staff if required.

Some of these documents also form part of externally audited Quality Assurance schemes such as the Bio-fertiliser Certification Scheme and are inspected annually as part of this certification process. For ease of reference, an overview of the operating procedures that will be affected by the permit variation is included below.

3.1 Operating Procedures for Anaerobic Digestion

The following sections provide an overview of the process undertaken at GWE Biogas Ltd.

3.1.1 Pre-Acceptance

The Site shall only accept input material permitted within the Anaerobic Digestion Quality Protocol and the Sites Environmental Permit EPR/TP3835KE. GWE have an input materials supply agreement with each of their waste suppliers. These supply agreements define the type of waste to be expected and details unacceptable material. The contracts are reviewed whenever there is a change identified by either the supplier or GWE to the constituents of the incoming waste. Appropriate records are retained electronically. Should any concerns be raised at 'pre-acceptance', the load can be rejected, or further analysis can be undertaken to confirm that the material is acceptable

3.1.2 Acceptance and Rejection

All deliveries enter the site via the weighbridge, where the paperwork is checked to confirm that the material is as described and expected. Details of the waste type, EWC code, ABP Category, client/source, quantity of waste, delivery date and delivery location on site shall be recorded on an input materials acceptance/rejection (PAS110 input) sheet and electronically generated weighbridge ticket.

Providing the supplier/hauler has a valid input supply agreement and is delivering a material as described within the agreement, the driver will be directed to the correct off-loading point within the reception areas, depending on the waste stream. Bulk packaged solid wastes are tipped within a dedicated area which is a fully enclosed reception building (existing). Palletised solid wastes are delivered into the dedicated reception area for palletised goods, which is physically separate to the reception area for bulk wastes. Clean feedstocks will be tipped into the new extension to the reception hall, ensuring these are kept separate from other feedstocks. Liquid wastes will be directed to the dedicated liquid waste reception area, with pea wash water delivered to the facility via underground pipes from a neighbouring facility and stored in an on-site lagoon.

A trained site operative inspects each delivery load, either visually in the case of solid wastes, or via sampling in the case of liquid wastes. Only wastes specified in the permit will be accepted.

Any load may be rejected prior to acceptance for the following reasons (non-exhaustive list):

i. Non-permitted, or non-conforming in relation to the permit.
ii. Waste contains excessive contaminants (e.g. metals, plastics, glass etc)
iii. Waste does not meet the EWC code definition.

The non-conforming wastes will be quarantined in a suitable area of the site reflecting its nature and the reason for it being unsuitable. They will be removed from site as soon as is practical and taken to a suitably permitted facility. The consignor of the waste will be contacted by the Site Manager and be made aware that the waste has been rejected.

3.1.3 Input Materials Pre-treatment

Packaged wastes will be loaded into the solid waste feeding system and fed into shredding and de-packaging machinery, converting the digestible fraction of the waste into a pumpable soup with particle sizes <12mm. Liquid wastes are pumped from the liquid waste reception area into a macerator unit and mixing tank. This is supplemented by 160m^3 of pea wash water from the on-site lagoon each day.

The clean materials in the reception hall extension will be placed on the floor of the building and then into a hopper, where the material will be blended via a mixing pump with re-circulated material from digesters 1 and 2. The mixing pump will have a built-in macerator to ensure all material achieves a particle size of <12mm.

3.1.4 Hydrolysis

The pumpable soup from the solid waste pre-treatment and the macerated liquid wastes is fed into a 560m^3 hydrolysis/buffer tank (existing process). This helps homogenise the soup and convert insoluble polymers to soluble organic compounds prior to pasteurisation and digestion. Temperature, substrate level and stirring are continuously monitored throughout this stage via the central computer system, with an average retention time of one day.

Clean materials from the reception hall extension feed directly into digesters 1, 2 and 6 from the mixing pump.

3.1.5 Pasteurisation

Prior to digestion, the packaged and liquid wastes from the 560m^3 hydrolysis buffer tank is transferred into one of three 14m^3 pasteurisation tanks, where it is subject to a batch pasteurisation process at >70^{o}C for one hour using heat from the CHP engines. These time and temperature parameters are in accordance with the stipulations within the ABP Directive. Temperature readings, temperature and time charts are checked and appraised from the *Pasteurisation screen* sequence on the central computer system, with each batch not being released until the critical time and temperature parameters have been reached to achieve sanitisation.

After pasteurisation, the material blend of bulk solid, palletised and liquid feedstock is fed to the remaining three primary digesters, which operate in parallel. Digesters 3 and 4 hold 4000 tonnes each, with digester 5 holding 5500 tonnes. Digester 7 will hold 4,500 tonnes.

The blended clean materials from digesters 1, 2 and 6 undergo batch pasteurisation post-digestion in 3 pasteurisation tanks, similar to the pre-digestion pasteurisation system for the other packaged food waste process flow.

3.1.6 Digestion Phase

Primary digestion of all permitted feedstocks will take place within the five existing and two newly constructed sealed digestion tanks 6 and 7. A mixed culture of micro-organisms will ferment the waste under anaerobic conditions to produce biogas, a mixed gas comprised of predominantly methane and carbon dioxide, and a whole digestate comprising a nutrient rich liquid and undigested fibre. Clean wastes from the reception hall will be digested exclusively in digesters 1, 2 and 6, with all other wastes going into digesters 3, 4, 5, 7 and the dual-purpose tank following pre-pasteurisation.

The following parameters will be monitored in each digester by the main process computer:

- Temperature;
- Pressure;
- Gas Flow Rate;
- Biogas Quality;
- Stirring;
- Foaming Level; and,
- Substrate Level.

The minimum hydraulic retention time within the digesters 3, 4, 5 and 7 will be 52 days and the temperatures are to be kept between 35°C and 45°C. After primary digestion, the substrate from these digesters will be pumped to a secondary digester named dual purpose tank. This tank is kept at a temperature between 20°C and 35°C. As the substrate is transferred for secondary digestion, it is passed through a 3.35mm screen which removes any remaining contaminants in the form of non-or slowly biodegradable material.

Digestate residing in digesters 1, 2 and 6 will not undergo secondary digestion, and once the material has achieved the stipulated digestion residence time of 59 days, it will be fed into the post-digestion pasteurisation system.

3.1.7 Separation and Storage

After primary digestion, the substrate from digesters 3, 4 and 5 undergoes material separation by way of a separator to separate out the fibre fraction of the digestate from the liquid fraction. The separated liquor is pumped to the Dual-purpose tank, which has a capacity of 2,300 tonnes. The fibre fraction is conveyed to a skip to await despatch off site as a waste.

Substrate from digesters 1, 2 and 6 will undergo the pasteurisation process as described above and will then be processed through a separator, creating a solid fibre and a liquid fraction rather than a whole digestate. The fibre will be collected in a farm trailer and stored in a corner of the field it is to be spread in, with the liquid fraction being directed to the dual-purpose tank where it is recirculated into the digestion process.

3.1.8 Biogas Production & Combustion

Biogas produced in the digesters will be fed to a gas cleaning unit via storage systems on digester 3 and the dual-purpose tank. This unit comprises of a biological filter tower, which cleans the biogas using bacterial processes. The cleaned biogas is then transferred to the gas upgrading kit (see section below) as well as to the combined heat and power units (CHPs) via a compressor and cooler. In the event of a breakdown and gas storage capacity becomes full, excess gas is flared off via a stationary gas flare.

From the CHP engine, the biogas is converted to electricity and used on site. GWE still retain the option to export electricity to the National Grid as required but gas to grid will be the primary means of export.

3.1.9 Gas to Grid

In conjunction with the CHP activity above, biogas is also fed from the gas storage to the upgrading system. Once the permit is varied, the gas to grid entry process will be as follows.

Please note, when outlining the process; the term *biogas* is used to describe the raw gas from the digester, *biomethane* refers to gas that has been upgraded and *enriched biomethane* refers to biomethane that has been propanated to achieve National gas grid specification.

- Biogas passes through a desulphurisation unit to remove hydrogen sulphide in the manner described in section 2.1.4.
- The biogas is then passed through the upgrading equipment, where it is compressed, dried, cleaned and filtered with the separated Biomethane and Carbon Dioxide products routed into distinct production streams.

- Based upon automated compositional analysis of the biomethane, Propane is then proportionally injected into the biomethane flow stream to attain the required CV for grid entry.
- This enriched biogas is then re-analysed on a continuous cycle against critical grid gas specification parameters.
- Finally, specified odorant is proportionally injected into the enriched biomethane to impart a typical "Natural Gas" smell and the enriched biomethane then enters the network entry unit containing volumetric metering equipment and the remotely operated valve that is controlled by Northern Gas Networks.

The pipeline connecting the grid entry to the gas grid will extend from the site access, along the eastern edge of the driveway and forecourt and around to the western edge of the existing reception building (north of the existing 4 CHP engines).

This upgrading system is integrated into the site SCADA control system.

3.1.10 Vehicle Refuelling Station

A proportion of processed biogas will then be compressed using CNG compressors into CNG storage at 275 bar. The vehicles involved in the AD process at the GWE facility will then be able to fill from the refuelling station, which has a typical fill time of around 5 minutes. This would enable the facility to reduce dependency on external suppliers for fuel and mitigate impact of raising energy prices.

3.1.11 Carbon Capture and Upgrade System

Pentair's BioCO2Bolt-technology is utilised to create green liquid CO2 from a process of upgrading biogas. The biogas upgrading process, as described in section 3.1.9, vents a highly concentrated flow of CO2, with a limited amount of methane and other contaminants, creating the ideal source for cost-efficient production of liquid CO2. Additionally, the methane slip can be eliminated, creating a higher bio-methane yield for biogas upgrading installation. The renewable CO2 can be used for applications from CCS/CCUS to industrial applications (industrial/technical CO2) or as an ingredient for the food and beverage industry (food-grade CO2).

Exhaust CO2 from the biogas upgrading unit is fed to the bolt-on system, where CO2 compressor units increase the gas pressure to 18barg (261psig) in two stages removing condensate in the process. Next, trace impurities and moisture are removed. The purified CO2 gas is led into the cooling system where the CO2 is liquefied. The off-gas containing all non-condensable gases (CH4, 02, N2) is purged as off-gas and can be brought back to the inlet of the upgrading unit. The purified liquid CO2 end product is fed at 17.5 barg (218 psig) to the onsite storage tank.

3.2 Operational Hours

Site operational hours for the facility will typically be as identified in Table 1 below:

Table 1 - Site Operational Hours

Day(s)	Operational Hours
Monday to Friday	07:00 – 19:00
Saturday	07:00 – 19:00
Sunday Bank Holidays	Closed

3.3 Technical Standards and Control Measures

A documented list of technical standards that the site will be operating to is provided in Annex A. The critical control points governing these technical standards are to be applied to this site.

4.0 ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

All facilities have a potential impact on the environment around them. The Environmental Risk Assessment (EPR-A03) for the Facility has been reviewed for the Environmental Permit variation which covers all current and proposed permitted operational activities on site.

4.1 Odour Management

Odour is not considered a potential issue for the proposed variation due to locality of the site and the nature of the developments, however it has been addressed within a comprehensive Odour Management Plan (OMP), which is based on the Environment Agency's Guidance.

The new sileage storage clamp is considered low risk for odour emissions as ensiled feedstock will be sealed with impermeable sheeting and only exposed as required to be used.

As the anaerobic digestion process takes place in closed vessels under a positive pressure condition, with no exchange of gases between the digester and the outside air under normal operating conditions, risk of fugitive odour release is considered very low from primary digestion and secondary digestate storage operations.

The proposed carbon capture and upgrade system is a closed process flow and enclosed within a modular unit and therefore is not expected to generate odours.

4.2 Noise Management

Noise is not considered a significant issue for the proposed variation; however, it has been addressed within a comprehensive Noise and Vibration Management Plan based upon the Environment Agency's guidance.

The introduction of CCUS as a recovery activity is not anticipated to significantly increase the noise or vibration emissions associated with site activities as the technology to be used is modular and is enclosed within a container designed to provide acoustic dampening of noise emissions from the plant in operation. Furthermore, the skid enclosed housing, wherein the offered CO2 recovery system will be installed, consists of a steel structure and prefabricated components.

4.3 Air Quality Management

The gas upgrading and gas to grid systems are the only part of the proposed variation that could have an impact upon air quality at the plant. The recovered CO_2 currently released from the process via the stack will be captured by the CCUS plant further reducing greenhouse gases emissions from the site activities.

The predicted alteration to emissions from the site has been addressed with a Fugitive Emissions Management Plan based upon Environment Agency guidance.

4.4 Ecology

These phases of the variation are not anticipated to impact upon the ecology or statutory designated sites in the area surrounding the site.

4.5 Flood Risk and Drainage

The site is located within Flood Zone 1 (<1 in 1,000 annual probability of river or sea flooding) and lies outside any groundwater Source Protection Zones. Due to this and the nature of the proposed variation, changes in flood risk or drainage issues are not considered a potential issue.

ANNEX A - LIST OF TECHNICAL STANDARDS

The table below presents a list of technical documents, with reference, for the process of anaerobic digestion. These documents will continue to be in use as point of reference during the operational life of the permitted site. Documents have been sourced from both regulatory agencies and industry led organisations.

Anaerobic Digestion – Technical Standards	
Technical Guidance Note	**Document Reference**
Develop a management system: environmental permits	DEFRA and EA Guidance
Controlling and monitor emissions for your environmental permit	DEFRA and EA Guidance
Risk assessments for your environmental permit	DEFRA and EA Guidance
PAS 110 Standard Operating Procedure	BSi
H4 Odour Management Guidance	EA Pollution Prevention Guidance
Guidance for the Recovery and Disposal of Hazardous and Non-Hazardous Waste	EA SGN IPPC S5.06
How to comply with your environmental permit. Additional guidance for: Anaerobic Digestion	LIT 8737
Best Available Techniques (BAT) Reference Document for Waste Treatment	BREF Waste Treatment 2018

18 Manor Square, Otley, LS21 3AY

01943 468138
www.wrm-ltd.co.uk

A Sustainable Future. Today