



Carbon Capture System

Home Farm Grange

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EPR Bespoke Permit Application

Home Farm Grange



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NON-TECHNICAL SUMMARY

Engie Renewable Gases UK Ltd (Engie) is making a new bespoke Installation Permit Application for the proposed operation of an agricultural Anaerobic Digestion (AD) Facility at their site in Sherburn-in-Elmet.

The proposed Installation is located at farmland at Low Farm, South Milford, Sherburn in Elmet (LS25 6FW). The proposed site covers an area of approximately 6.78ha and currently comprises undeveloped agricultural ground.

Engie have submitted a permit application to the EA on 28th November 2025, EPR/NP3829LW/A001. During biogas upgrading, a side stream of clean compressed CO₂ is produced. This document is submitted as a supporting document detailing the proposed Carbon Capture Plant (CCP) for this CO₂ stream which Engie will install, with a view to exporting offsite to an end user.

General Process Overview

The proposed process can be simplified as follows:

- Pressure Control;
- Compression;
- Drying & Purification;
- Liquefaction; and
- Storage & Export.

The proposed Carbon Capture Plant is provided by DMT, who supply a full modular capture and liquefaction system.

Initially the CO₂ gas stream is directed to the CCP via modulating gas inlet valves and a CO₂ blower to increase the inlet pressure to the CCP to ensure that connected upstream equipment is not disturbed. The CO₂ is then fed to a two-stage CO₂ compressor which increases the pressure to between 18 – 20 bars, and as such the liquefaction stage can take place at higher temperatures of -20 to -25°C. After each compression stage, cooling is achieved through after-coolers and a dedicated cooling module.

The Drying and Purification Module removes water and trace contaminants such as VOC's and H₂S from the compressed gas through filtration. This module can be continuously operated without replacement of filters by utilisation of regeneration gas. Following this conditioning process, the gas is rich in CO₂ and enters the CO₂ liquefaction module.

The CO₂ rich gas is initially cooled in a reboiler from which it is condensed into liquified CO₂ (LCO₂) in the CO₂ condenser. A refrigeration module is utilised to provide the cooling capacity needed for the condenser, the module is a closed loop system including a refrigerant compressor package and refrigerant condenser. The LCO₂ then enters a stripper column where an up-flow of boil-off gas from the reboiler optimises purification, removing CH₄, N₂ and O₂ from the CO₂ gas. It is then collected in the reboiler sump vessel prior to pumping to the storage tank. A purge gas line ensures pressure control of the liquefaction module and continuously purges part of the system volume. Control of this purge line ensures a very high CO₂ recovery rate.

The liquified CO₂ is stored within 2 x purpose built storage tanks prior to transfer offsite via dedicated road tanker. The cryogenic storage tanks are horizontal, can store 2 – 3 days worth of CO₂ assuming

uninterruptable operation and are made with carbon steel and insulation. Storage is at 20bar (industry standard). They will be located externally within 10 meters of the CO₂ liquefaction plant within a non-ATEX zone and are fully automated with accurate volume control.

Technical details of the plant are provided in *Appendix A*. The plant is designed to have a net production capacity of 1,145 kg/h.

Emissions to Air

A full Air Quality Assessment (AQA) has been completed as part of the AD plant application to demonstrate the impact that the proposed site may have on existing air quality. The AQA quantifies the impact to air from all onsite sources, both point and diffuse emission sources.

The AQA concludes that given the proposed control measures and the modelling of a worst-case scenario emitters, all potential impacts on human and ecological receptors are considered to be not significant.

Modelling of the potential emissions from the venting of concentrated or compressed CO₂ is being undertaken and will be provided to the EA imminently.

Odour Emissions

The site will be operated in accordance with its Odour Management Plan (OMP). There are not considered to be any additional risks associated with the operation of the carbon capture plant. Associated raw materials will be stored internally within the carbon capture plant building.

Noise Emissions

The site has been designed to minimise potential noise impacts during operation. An Environmental Noise Impact Assessment (NIA) has been completed in accordance with BS4142:2014 and has concluded that there will be no significant impact at the nearest sensitive receptors.

Noise impacts will be assessed upon operation of the plant, and should any mitigation measures be required these will be implemented where necessary.

Emissions to Controlled Water

There are no proposed process emissions to water associated with the carbon capture plant.

Effluent produced (up to 0.1m³/hr) will be connected to the condensate pit from where it will be recirculated into the process.

Clean, uncontaminated surface water from the site will be discharged to Mill Dike. Two main sources will form this discharge; surface water run-off from the process area, which is first held in an attenuation tank for testing prior to discharge and surface water run-off from clean areas via the detention basin.

Both discharge sources are fitted with penstock valves to prevent discharge to the water course in the event of any pollution incident.

Domestic wastewater is treated via package treatment plant and discharged to water course under consent.

Emissions to Sewer

There are no proposed emissions to sewer associated with the proposed Installation.

Emissions to Land

There are no proposed emissions to ground or land associated with the proposed Installation. There will be soft landscaped areas on site to allow a proportion of surface water to soak away into the soil substrate. This water will be clean and uncontaminated and pose no risk to ground or land.

Waste Management

Waste feedstocks will be appropriately accepted, handled, stored and managed onsite. Minimal waste streams will be generated by the carbon capture process, primarily limited to domestic waste and spent filter materials.

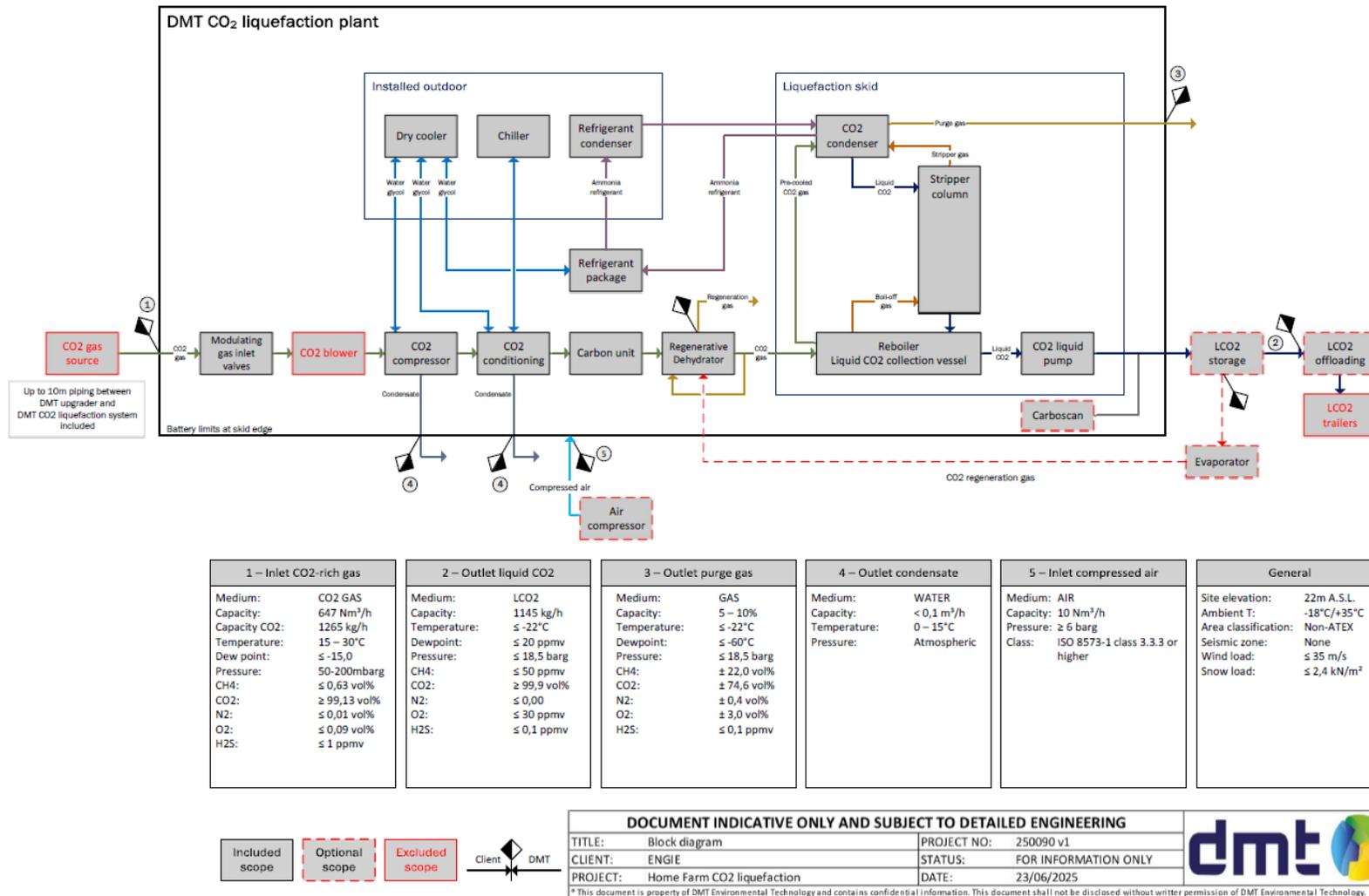


Figure 1 DMT Block Diagram

BEST AVAILABLE TECHNIQUES

The Carbon Capture Plant will be designed and constructed in accordance with BAT as outlined by *Post-combustion carbon dioxide capture: emerging techniques guidance (Environment Agency, 2021 – updated March 2024)*. A review of the plant against the relevant BAT is provided below.

Table 1 Review against Post-Combustion Carbon Capture: BAT Guidance, EA 2021

BAT	Site Compliance
2. Power Plant Selection & integration with PCC	
2.1 Energy Efficiency in plants with PCC	N/A – carbon capture is following anaerobic digestion and biogas upgrading rather than post-combustion, as such this section of the guidance does not apply.
2.2 Dispatchable operation	
2.3 Supplying heat and power for PCC operation	<p>The PCC plant proposed requires approximately 520Kw of power, this will be supplied by the onsite natural gas generation sets.</p> <p>There is no requirement for steam for the PCC plant.</p> <p>Relevant BAT relating to power supply is met.</p>
3. PCC Plant Design and Operation	
3.1 Purpose	<p>The purpose of the carbon capture system is to maximise capture of CO₂ for export and use by an end user.</p> <p>The plant will have a carbon capture rate of 95% during normal operating conditions (as an annual average).</p> <p>CO₂ will be produced with levels of water, oxygen and other impurities as required for transport and storage – this will be based upon EIGA Code: 70/17 CARBON DIOXIDE FOOD AND BEVERAGE GRADE, SOURCE QUALIFICATION, QUALITY STANDARDS AND VERIFICATION; Revision of Doc 70/08.</p> <p>Liquid carbon dioxide gas will be at pressure.</p> <p>The carbon capture plant has been assessed within the Environmental Risk Assessment for the site provided with the permit application.</p> <p>There is no continual emission to atmosphere from the carbon capture process. Modelling of potential abnormal emissions, including potential CO₂ venting scenarios is currently being undertaken and will be provided to the EA imminently.</p>
3.2 Solvent Selection	<p>N/A – no amine solvents are being used in the process.</p> <p>Regenerative gas is utilised removing the requirement for filter replacement.</p> <p>There is no continual emission to atmosphere from the carbon capture process.</p>
3.3 Features to control and minimise atmospheric and other emissions	3.3.1 Flue gas cleaning – N/A there is no flue gas stream arising from the carbon capture process.
	3.3.2 PCC System Operation – operating temperatures will be optimised for stripping and purifying.
	3.3.3 Absorber emissions abatement – N/A there is no absorber as part of the plant.
3.4 Process and emissions monitoring	<p>3.4.1 Role of monitoring – Monitoring will be undertaken in accordance with the guidance. This includes:</p> <ul style="list-style-type: none"> ▪ Energy and resource efficiency; ▪ CO₂ capture rate; ▪ Verification that the CO₂ product is suitable for safe transport and storage. <p>The plant is fully automated and controlled by Seimens PLC.</p>

	<p>A monitoring plan will be developed and implemented prior to operation and included in the sites EMS system.</p>
	<p>3.4.2 Point source emissions to air – there is no continuous emission point to air from the PCC. All other emission points to atmosphere from the AD plant will be in line with the ELV’s stipulated within the permit.</p>
	<p>3.4.3 Process Control Monitoring – all relevant process controls stipulated by the guidance will be monitored.</p>
	<p>3.4.4 Monitoring of CO₂ – all relevant parameters stipulated by the guidance will be monitored including:</p> <ul style="list-style-type: none"> ▪ CO₂ mass balance; ▪ CO₂ capture rate; ▪ CO₂ released to environment; and ▪ CO₂ quality.
	<p>3.4.5 Monitoring Standards – all monitoring will be undertaken by MCERTS (or equivalent) qualified persons with any laboratory analysis undertaken at a UKAS accredited laboratory.</p>
3.5 Unplanned emissions to the environment	<p>The Engie AD facility is subject to a Leak Detection and Repair Program (LDAR) which includes the carbon capture plant. Additionally, the CCP is included in the sites HAZOP and DSEAR assessments and Accident Management Plan.</p>
3.6 Capture level, including during flexible operation, start up and shutdown	<p>The facility will develop and implement an OTNOC management plan for the carbon capture plant prior to commissioning.</p>
3.7 Compression	<p>The system will include 2 x CO₂ compressors. These are of two stage reciprocating oil free design and are highly efficient and flexible to accommodate process changes.</p>
3.8 Noise & Odour	<p>An Environmental Noise Impact Assessment has been undertaken for the full AD plant facility, including equipment for the carbon capture plant namely compressors. The NIA concluded that there will be no significant impact at nearby sensitive receptors.</p> <p>There are no additional odour sources associated with the carbon capture plant – storage of all associated raw materials will be taken internally. The AD plant facility will be operated in accordance with the sites Odour Management Plan.</p>
3.9 Hot potassium carbonate post combustion capture plant	<p>N/A</p>
<p>4. Cooling</p>	
Temperature	<p>BAT is to use the lowest temperature cooling available. The proposed carbon capture plant utilises a dry cooler for efficiency and a refrigerant module. This is considered BAT for the facility.</p>
<p>5. Discharge to Water</p>	
Discharge to water	<p>There is no proposed discharge to water as part of the carbon capture process. Small volumes of effluent produced will be collected and tankered offsite for disposal.</p>

Please refer to *Appendix A* for the technical specification of the Carbon Capture Plant.

APPENDIX A

TECHNICAL SPECIFICATION OF CARBON CAPTURE PLANT