H1 ASSESSMENT

Variation to Installation Permit

Eco Sustainable Solutions Limited

Parley Waste Management Facility

Chapel Lane, Parley, Christchurch, Dorset, BH23 6BG

June 2025

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Abbreviations

AEL	Associated Emissions Level
AD	Anaerobic Digester
AQIA	Air Quality Impact Assessment
AW	Ancient Woodland
BAT	Best Available Techniques
BG	Biogas
BUU	Biogas upgrading unit
CH_4	Methane
CHP	Combined heat and power (engine)
CO_2	Carbon dioxide
DWT	Dorset Wildlife Trust reserve
EA	Environment Agency
EAL	Environmental Assessment Level
ELV	Emission Limit Value
EPR	Environmental Permitting Regulations
LAC	Landair Consulting Limited
H1	Environment Agency Horizontal Guidance Note H1
H_2S	Hydrogen sulphide
HRZ	Habitat Restoration Zone
kWe	Kilowatts electrical output
kWthi	Kilowatts thermal input
LCNR	Local Community Nature Reserve
LWS	Local wildlife site
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
MWth	Megawatts thermal input
n/a	Not applicable
N	Nitrogen
NG	Natural Gas
NGR	National Grid Reference
NOx	Nitrogen oxides
O_2	Oxygen
PC	Process Contribution
PEC	Predicted environmental concentration
PVRV	Pressure and Vacuum Relief Valve
SO_2	Sulphur dioxide
SAC	Special Area of Conservation
SINC	Site of Nature Conservation Interest
tpa	Tonnes per annum
TVOC	Total gaseous and vaporous organic substances, expressed as total organic carbon
VOC	Volatile organic compounds

Executive Summary

Landair Consulting Limited (LAC) have screened the potential air quality impact on behalf of Eco Sustainable Solutions Limited to support a variation permit application to vary the existing bespoke installation permit for the anaerobic digestion (AD) plant at Parley Waste Management Facility, Chapel Lane, Parley, Christchurch, Dorset, BH23 6BG herein termed 'the Site'.

The Environment Agency's H1 Assessment Tool has been used for quantitative assessment of the proposed point source emissions to air including the 1No. combined heat and power (CHP) unit, 1No. boiler, emergency flare, emergency generator, the Biofilter for the new AD Waste Reception Building, emissions abatement system outlet for 2No. Liquid Pre-storage Tanks, and the digestate off-take point.

The process contribution of emissions to air and background concentrations have been compared with relevant environmental standards for the protection of health and ecosystems and Environment Agency (EA) significance criteria.

Emission rates of pollutants were based on Medium Combustion Plant (MCP) Emission Limit Values, Best Available Techniques (BAT) Associated Emissions Levels (AELs) and relevant guidance.

The H1 assessment has determined the pollutants which require further assessment using detailed modelling that include EALs for human health and those for ecological conservation sites:

- Nitrogen dioxide (NO_2) (annual and 1-hour mean)
- Carbon monoxide (CO) (maximum 8-hour running mean)
- Sulphur dioxide (SO_2) (15-min mean)
- Sulphur dioxide (SO_2) (24-hour mean)
- Benzene (24-hour mean)
- Nitrogen dioxide (Ecological - daily mean)
- Ammonia (NH_3) (Ecological -lichens and bryophytes), lower critical level of 1µg/m^3

1 Introduction

This H1 Assessment (H1) has been prepared by Landair Consulting Limited (LAC) on behalf of Eco Sustainable Solutions Limited, hereafter referred to as 'the Client,' in respect of a variation permit application to vary the existing bespoke installation permit for the anaerobic digestion (AD) plant at Parley Waste Management Facility, Chapel Lane, Parley, Christchurch, Dorset, BH23 6BG herein termed 'the Site'.

The plant will be operated by Eco Sustainable Solutions Limited (the Operator). The plant has been designed by Weltec who will also be responsible for construction, key equipment supplies and commissioning. Prodeval will supply and commission the biogas upgrade unit (BUU) and carbon dioxide recovery equipment.

An H1 risk assessment using the H1 tool, which is a conservative tool, is used to screen out the pollutants from the proposed emission sources that do not require further assessment. Pollutants that do not screen out would need to be considered in an Air Quality Impact Assessment (AQIA) which would use detailed dispersion modelling.

1.1 Site location

The Site is situated approximately 1.3km east of the town of Ferndown. A solar farm occupies the immediate locale to the north, west and southeast of the Site; habitat conservation areas adjoin the Site to the east and south in the intervening area between the site and Bournemouth Airport, situated approximately 160m at the nearest extent of the Bournemouth Airport Aviation Park. The Site's gradient is flat, with a slight change in slope from north to south from approximately 13m AOD to approximately 12m AOD.

The nearest residential premises, Whitemere House, is situated approximately 60m north of the Site and is owned by the Operator. Chapel Land delineates the western site boundary, beyond which the nearest workplace is approximately 10m to the west of the Site boundary.

There are several designated conservation sites within 10km of the Site, including:

- Four internationally designated Special Protection Areas (SPAs), including Dorset Heathlands, Avon Valley, Solent and Dorset Coast, New Forest, the closest of which is Dorset Heathlands situated adjacent (approximately 30m) from the Site boundary.
- Three of the identified SPAs (Dorset Heathlands SPA, Avon Valley SPA and the New Forest SPA) are coincident with Ramsar sites.
- Three Special Areas of Conservation (SACs); Dorset Heaths SAC, River Avon SAC, and The New Forest SAC, the closest of which, Dorset Heaths SAC, is situated adjacent (approximately 40m) to the Site boundary.

Within 2km of the Site there are:

- Four designated Special Sites of Scientific Interest (SSSI) including Hurn Common SSSI and Parley Common SSSI, both adjacent to the Site, in addition to the Moors River System SSSI, and St Leonards and St Ives Heaths SSSI;

- Seven Sites of Nature Conservation Interest (SNCI), one Local Nature Reserve (LNR), two Local Community Nature Reserves (LCNRs), and a Dorset Wildlife Trust reserve (DWT); and
- a Habitat Restoration Zone (HRZ) situated adjacent to the southern Site boundary.

1.2 Proposed changes

Figure 1 shows the permit boundary for the Site and the proposed locations of point source (channelled) emissions to air.

With specific regard to emissions to air, the changes proposed as part of the current permit variation application are outlined in the following sections. Further reference should be made to the supporting Non-Technical Summary[1] and the proposed Listed Activities and Directly Associated Activities, along with the relevant waste codes that are detailed within the supporting Permitted Activities document.[2]

1.2.1 Solid Recovered Fuel Plant

The permit variation application seeks to add a new listed activity for a Solid Recovered Fuel plant under Schedule 1 of the EPR under S5.4 A(1)(a)(ii). The activity is currently permitted as a waste activity (AR22). This change is to reflect the proposed tonnages of waste to be processed through the SRF Plant, up to 150,000 tonnes per annum and a treatment capacity of over 75 tonnes per day. All waste will be treated within a purpose-built building.

As detailed within the supporting Best Available Techniques (BAT) Assessment[3], in accordance with BAT 25 in order to reduce emissions to air of dust, and of particulate-bound metals, PCDD/F and dioxin-like PCBs, BAT is to apply BAT 14d for the containment, collection and treatment of diffuse emissions and to use one or a combination of the abatement techniques listed under BAT25.

The design of the SRF plant is not finalised and as such any abatement technologies have not been determined. It is proposed that this information is provided for assessment by the Environment Agency through a Pre-operational or Improvement Condition.

1.2.2 AD Plant

It is proposed to increase the maximum permitted tonnage for the AD plant in Table S2.2 from 33,000 tonnes per annum (tpa) to 70,000 tpa for the processing of substrate (prepared feedstock) or 50,000 tpa of food waste, and as detailed within the Non-Technical Summary, to amend some of the permitted waste types in Table S2.2 of the permit.

All solid feedstock will be received and processed within an enclosed Feedstock Reception Building which benefits from the continuous operation of an air extraction and emissions

[1] Non-Technical Summary Variation to Installation Permit. Document Ref: SPC0051/V019/NTS/V3/EcoPar/June25.
[2] Eco Sustainable Solutions Limited, Parley Waste Management Facility (PWMF), Change to Permitted Activities, June 25. Document Ref: SPC0051/V019/Permitted Activities/V1/EcoPar June25
[3] Best Available Techniques Assessment, Variation to Installation Permit. Document Ref: SPC0051_V019_BAT_V2_EcoPar_Mar25.

abatement via a biofilter (emission point **A2**). Abated emissions are released from the surface of the biofilter, rather than as channelled emissions from a stack. Emission point A2 is therefore represented as a point source with assumed dimensions within the H1 screening tool. In line with permit requirements, emissions from the biofilter will be monitored periodically.

There will be three digesters (two primary (BF01 and BF02) and one End Store (BE01). Each digester will have a Pressure and Vacuum Relief Valve (PVRV) (emission points **A9** to **A11**) to emit biogas or take in air if there is an over-pressure or under-pressure event respectively. PVRVs will not operate during normal operation, over-pressure is managed by operation of the flare (emission point **A5**) before the PVRVs. The operation of the digester PVRVs is therefore not considered within the H1 assessment.

Power to the AD plant will, initially, be provided through existing grid connections. Within two years of commissioning, a 1MW (1,013kWel) combined heat and power (CHP) unit will be installed to reduce this requirement. Emissions of TVOC, NOx and CO will be released from the combustion of natural gas (NG) in the CHP from a 13.5m stack (emission point **A4**). In line with permit requirements, emissions from the CHP will be monitored periodically. The CHP is required to meet the Medium Combustion Plant (MCP) Directive Emission Limit Values (ELVs) for nitrogen oxides (NOx) for new plant.[4] The emissions and monitoring standards that apply to total volatile organic compounds (TVOC) and carbon monoxide (CO) from natural gas fuelled engines are the same as those applied to landfill gas engines.[5]

- 250 mg/Nm^3 for NOx (5% O_2), MCP ELV (for natural gas)
- 1,000 mg/Nm^3 for TVOC (5% O_2), LFTGN08
- 1,400 mg/Nm^3 for CO (5% O_2), LFTGN08

Biogas may be burnt under abnormal operating conditions such as during extended periods of maintenance of the CHP and/or malfunction of the BUU by the emergency flare (emission point **A5**). The flare should operate for a limited number of hours per year (<10% or <876 hours) as it is only used under abnormal operating conditions. Guidance for monitoring enclosed landfill gas flares (LFTGN 05[6]) sets out the emission standards for enclosed gas flares:

- 150 mg/Nm^3 for NOx (3% O_2), LFTGN 05
- 50 mg/Nm^3 for CO (3% O_2), LFTGN 05
- 10 mg/Nm^3 for TVOC (3% O_2), LFTGN 05

A boiler (emission point **A7**) will be used to generate heat for the AD plant during the first two years following AD Plant commissioning. It has been conservatively assumed in this H1 assessment that the dual-fuel boiler will operate continuously during this period. Natural gas will be the primary fuel, although biogas may be used up to 10% of the time, should the gas network

[4] DIRECTIVE (EU) 2015/2193 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants
[5] Environment Agency (2010) LFTGN08 v2 2010: guidance for monitoring landfill gas engine emissions (https://assets.publishing.service.gov.uk/media/5a7d87c140f0b64fe6c24434/LFTGN08.pdf)
[6] Environment Agency (2010) Guidance for monitoring enclosed landfill gas flares LFTGN05 v2 2010 (https://www.gov.uk/government/publications/monitoring-enclosed-landfill-gas-flares-lftgn-05)

be unavailable. In this scenario, the AD operation would be adjusted accordingly (i.e. feedstock input reduced) to mitigate the requirement for power and to manage biogas production and use.

In line with permit requirements, emissions from the boiler will be monitored periodically. The boiler will primarily release emissions to air of NOx, and during biogas combustion, SO_2 from an 10m stack. The 1,600kWtho (thermal output) boiler will be capable of meeting the MCP Directive ELVs for new plant fired by biogas although it is not an MCP as its thermal input is less than 1MW. There are no BAT-AELs for TVOC and CO, emissions of which will be negligible from the boiler:

- 100mg/Nm^3 for SO_2 (3% O_2), MCP ELV (for biogas combustion)
- 200mg/Nm^3 for NOx (3% O_2), MCP ELV (for biogas combustion)
- 100mg/Nm^3 for NOx (3% O_2), MCP ELV (for natural gas combustion)
- No limit set for CO (3% O_2)

An emergency standby diesel generator (100kWe) (emission point **A8**) will provide power should it be unavailable from the grid or if the CHP is not operational. Therefore, it would be used only as an emergency backup operating typically less than 50 hours per year and operating less than 500 hours per year as a 3-year rolling average. It would be exempt from meeting MCPD ELVs and as such is not part of the H1 quantitative assessment.

Biogas produced by the process will be upgraded to biomethane and exported into the national gas distribution network. Biogas (45 - 60% CH_4 by volume) will enter the BUU where it will be treated to create biomethane (typically 99.5% CH_4 by volume) which leaves the BUU.

Biogas from the gas holders will pass through a series of gas treatment steps including drying, pressurisation, 2No. activated carbon filters installed in addition to the desulphurisation unit to remove NH_3, VOCs and H_2S, compression, followed by high pressure membrane separation that is specified as having a purification efficiency greater than 99%, with less than 1% loss of methane. The residual gas emitted from the process is (a renewable form of) CO_2 with trace amounts of water. It is the operator's intention to upgrade this plant by adding further membranes to achieve a nominal biogas flow of 1,200Nm^3/hr (input) / 719Nm^3 (output) with a max biogas flow of 1,380 Nm^3/hr (input) / 826Nm^3 (output).

To control the purification performance and ensure the adjustments comply with the Gas Grid specifications, the unit is equipped with analysers for CH_4, CO_2, and hydrogen sulphide (H_2S) at five sampling points. Further, in order for the BNEF to be compliant with the local Network operator's specification it will include a Time of Flight (ToF) skid. This additional pipework loop allows additional time for the gas to be confirmed as being of appropriate quality before entering the network/sending to the reject line. This will reduce the risk of emissions due to off specification biomethane.

CO_2 will be released from the CO_2 stack on the BUU ('CO_2 vent', emissions point **A6**), as is normal operation when CO_2 capture equipment is not installed. Biomethane will be released from the Pressure Relief Valve (PRV) on the BUU in over-pressure scenarios only (emission point **A12**). The cleaned gas that is vented must comply with Gas Safety Management Regulations for H_2S and total sulphur, and TVOC at minimal level of detection. Intermittent emissions due to the abnormal operation of the BUU PRV has therefore not been considered within the H1 assessment.

It is proposed to add a CO_2 recovery unit in the future however, the technology has not been selected for this, and it is proposed that the operation of this plant will be regulated through a pre-operational permit condition. If fitted with CO_2 recovery equipment the remaining CO_2 output stream will not be released to air but captured.

Tankers discharge liquid feedstock via sealed pipework into the 2No. Pre-storage Tanks (with a combined working capacity of approximately 788m^3). The headspace of the Pre-storage Tanks will be linked to an emissions abatement system comprising a fan, used to assist with ventilating displaced air (emission point **A3**).

Whole digestate from the digesters will be screened and pasteurised before being cooled and pumped to the 1No. hybrid end store tank BE01 (5,039m^3). Any displaced air during the pasteurisation process will be directed to the Waste reception Building Biofilter (A2) to abate emissions.

Tankers will be filled with whole digestate at the tanker loading point adjacent to the hybrid End Store. There will be a brief and intermittent emission of displaced air from each tanker vent (emission point **A13**) during filling.

1.2.3 Emission points.

As summarised in Table 1 the following changes are proposed to the AD plant emission points:

- Add 1,013kWel combined CHP (natural gas)
- Add 1,600kWtho boiler (primarily natural gas)
- Add emission point for an emissions abatement system serving the 2No. pre-storage tanks (A3)
- Add emission point for offtake point on End Store tank
- 2 No. permitted biofilters are to be removed from the permit
- The following emission points are permitted but relocated:
- Biofilter for the Waste Reception Building (A2)
- Flare stack (A5)
- Biogas upgrade plant (A6)
- Pressure and Vacuum Relief Valves (PVRVs) on the digesters (A9 – A11)

The revised emission points are listed within Table 1, where numbering A2 - A13 refer to point source emissions to air, as shown on the emission point plan (Figure 1).

Table 1 AD Plant emission points to air

Emission point reference	Source	Emission parameters
A2	Biofilter for new Waste Reception Building (AD) – permitted but location changed	NH_3
A3	Emissions abatement system for 2. No Pre-storage tanks (new / replacing biofilter)	NH_3
A4	Combined heat and power engine (CHP) stack (replacing a biofilter as an emission point)	NOx, CO, TVOC (as benzene)
A5	Auxiliary / emergency flare stack (moved)	NOx, CO, TVOC (as benzene) (emergency use only)
A6	Biogas upgrading plant vent stack (moved)	CO_2
A7	Boiler stack (new)	NOx (natural gas), NOx, SO_2 (biogas)
A8	Emissions from diesel back- up generator (new)	NOx, CO, TVOC (as benzene), PM_{10} (emergency use only)
A9	PVRV on Digester 1 (BF01)	Biogas (CH_4, CO_2, VOCs) (emergency use only)
A10	PVRV on Digester 2 (BF02)	Biogas (CH_4, CO_2, VOCs) (emergency use only)
A11	PVRV on End store (BE01)	Biogas (CH_4, CO_2, VOCs) (emergency use only)
A12	PRV on BUU	CO_2
A13	Digestate offtake point on End Store tank	NH_3

1.3 About this report

This report describes: the assessment methodology and source data (section 2); the calculated impact (section 3); and concludes in section 4. Appendix A shows the H1 input and output tables.

2 Assessment methodology

2.1 H1 Emissions to Air Screening Assessment

The H1 screening evaluation has been undertaken following H1 methodology, set out in Environment Agency (EA) guidance[7] and using the EA H1 Assessment Tool spreadsheet (v9.2).[8]

2.2 Assessment Criteria

2.2.1 Air Quality Standards and Critical Levels – Human Health

Table 2 sets out those Air quality strategy (AQS) objectives, Ambient Air Directive (AAD) Limit Values and Environmental Assessment Levels (EALs) for the protection of human health that are relevant to this assessment in determining receptor exposure. In the H1 Assessment Tool these are all referred to as EALs.

Table 2 Air Quality Standards for human health

Substance	Emission period	Limit (average)	Standard	Exceedances[1]
Ammonia	1 hour	2,500 µg/m^3	EAL	None
Ammonia	Annual	180 µg/m^3	EAL	None
Benzene	24 hour	30 µg/m^3	EAL	None
Benzene	Annual	5 µg/m^3	AAD Limit Value and AQS Objective	None
Carbon monoxide	8 hour running average across a 24-hour period	10,000 µg/m^3	AAD Limit Value	None
Hydrogen sulphide	24-hour	150 µg/m^3	EAL	None
Hydrogen sulphide	Annual	140 µg/m^3	EAL	None
Nitrogen dioxide	1 hour	200 µg/m^3	AAD Limit Value	Up to 18 1-hour periods
Nitrogen dioxide	Annual	40 µg/m^3	AAD Limit Value	None
Sulphur dioxide	15 minutes	266 µg/m^3	UK AQS Objective	Up to 35 15-minute periods
Sulphur dioxide	1 hour	350 µg/m^3	AAD Limit Value	Up to 24 1-hour periods
Sulphur dioxide	24 hour	125 µg/m^3	AAD Limit Value	Up to 3 24-hour periods
Notes: from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]number of times a year that the limit may be exceeded AQS: Air quality strategy; AAD: Ambient Air Directive; EAL: Environmental Assessment Level				

[7] Environment Agency and Department for Environment, Food & Rural Affairs, Air emissions risk assessment for your environmental permit, Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Accessed January 2025]
[8] Atmospheric Dispersion Modelling Liaison Committee, H1 Risk Assessment Tool, Available at: https://admlc.com/h1-tool/ [Accessed January 2025]

2.2.2 Conversion of TVOC to benzene

Emissions are specified as TVOC for which there are no AQS. There is an AQS for benzene, one component of TVOC. An AEA Technology report on the Speciation of UK emissions of non-methane volatile organic compounds (2002)[9] reported on a series of VOC species profiles available for stationary combustion sources, covering a range of both fuel types and scale of combustion. The benzene fraction in industrial and commercial combustion of natural gas was reported to be less than 10% of NMVOC, a subset of TVOC.

For flares the NMVOC ELV is usually given as half that of TVOC, so the flare it has been assumed that 5% of the TVOC emission is benzene. For the CHP, monitoring data from another AD site has shown that NMVOC, of which benzene is a component, is less than 2% of TVOC, so benzene has been modelled as 2% of TVOC. Both assumptions are conservative as benzene is one component of NMVOC.

2.2.3 Environmental standards for protected conservation areas

The AQS objectives and AAD Limit Values for the protection of vegetation and ecosystems applicable to this assessment are presented in Table 3.

Table 3 Environmental standards for protected conservation areas

Substance	Target	Emission period
Ammonia	1 μg/m^3 where lichens or bryophytes (including mosses, landworts and hornwarts) are present. 3 μg/m^3 where they are not present.	Annual
Sulphur dioxide[1]	10 μg/m^3 where lichens or bryophytes are present 20 μg/m^3 where they are not present	Annual
Nitrogen oxides (expressed as nitrogen dioxide)[2]	30 μg/m^3	Annual
Nitrogen oxides (expressed as nitrogen dioxide)[3]	75 μg/m^3 200 μg/m^3 for detailed assessments where the ozone is below the AOT40[10] critical level and sulphur dioxide is below the lower critical level of 10 μg/m^3	Daily
Notes: from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]20 μg/m^3 is an AAD Limit Value if you have nature or conservation sites in the area; [2]30 μg/m^3 is an AAD Limit Value [3]The lower (stricter) value of 75 μg/m^3 has been used throughout this assessment.		

[9] N R Passant (2002) Speciation of UK emissions of non-methane volatile organic compounds. Reference: AEAT/ENV/R/0545 Issue 1

[10] The sum of difference between hourly ozone concentration and 40ppb for each hour when the concentration exceeds 40ppb during a relevant growing season (May to July) averaged over five years Available at: AOT40 — European Environment Agency (europa.eu) [Accessed January 2025]

2.3 Environment Agency Risk Assessment Guidance

The current evaluation is based on EA risk assessment guidance[7] to determine the significance of the predicted impact. The guidance provides screening criteria for quantifying the environmental impacts of emissions to air. The criteria include long and short-term Environmental Assessment Levels (EALs).

The guidance considers initial H1 screening and then detailed modelling. At the initial screening stage, **Test 1**, long-term and short-term concentrations due to the sources entered, referred to as the Process Contribution (PC) can be screened out from further assessment if:

- the short-term PC is less than 10% of the short-term environmental standard, and
- the long-term PC is less than 1% of the long-term environmental standard.

The second stage of screening, **Test 2**, considers the background concentration as well as the PC.

Defra provides maps of 2025 background concentrations of NOx and NO_2 on a 1km x 1km gridded basis that have been projected from a reference year of 2021;[11] and data for SO_2 and benzene for 2023, CO for 2010, also on a 1km x 1km basis.[12] Defra guidance states that the concentrations for SO_2, benzene and CO can be used, unadjusted for future years, such as 2025. The maps and factors have been used to determine 2025 background concentrations, which are shown in Table 11. Background concentrations of NH_3 are not part of the Defra mapped data and have been obtained from APIS.[13] For each pollutant, the maximum background value for human and/or ecological receptor locations have been applied in the screening assessment.

The Predicted Environmental Concentration (PEC) is the sum of the PC and background concentration. A further assessment is not needed if:

- for human receptors only, the short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration i.e., less than 20% of the 'Headroom', and
- the long-term PEC is less than 70% of the long-term environmental standards.

In accordance with the guidance, it is not necessary to calculate PEC for short-term targets. For an ecological receptor, if the short-term PC exceeds 10% of the EAL, detailed modelling is required.

If the PC cannot be screened out on that basis, the guidance outlines further steps, including detailed modelling, which may lead to a requirement to carry out a cost-benefit analysis.

[11] Defra, Background Maps, Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html (Accessed January 2025].
[12] Defra, UK AAIR, Modelled background pollution data, Available at: https://uk-air.defra.gov.uk/data/pcm-data [Accessed 17 January 2025]
[13] Air Pollution Information System, Available at www.apis.ac.uk, [Accessed January 2025]

2.4 H1 Inputs – Process Emissions

Table 4 and Table 5 detail the H1 input parameters for the point source emissions; the input data entered in the H1 Assessment Tool is shown in Appendix A, Table 7 and Table 8 and Appendix B Table 13 and Table 14. Two scenarios have been assessed;

- Scenario 1: assesses the operation of the boiler 100% of the time (adjusted for 90% of the time fuelled on natural gas, and 10% of the time on biogas) and the emergency flare for 10% of the time (during the first two years following AD Plant commissioning);
- Scenario 2: assesses the operation of the CHP 100% of the time and the emergency flare for 10% of the time.

Emissions have been assumed to meet the MCP ELVs where applicable (section 1.2). For the boiler, emissions of TVOC and CO will be negligible. The effective stack height has been calculated for each point source in accordance with EA guidance.[14,15]

[14] Gov.uk Air emissions risk assessment for your environmental permit: Effective height of release: impact of nearby buildings (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit)
[15] H1 Software Tool, Version 9.2, Available at: https://admlc.com/h1-tool/ [Accessed January 2025).

Table 4 CHP, emergency flare and boiler emission parameters (A4, A5, A7)

Parameter	Units	CHP (A4)[1]	Emergency flare (A5)[2]	Boiler (A7)[3]
Location	Easting, Northing	410297, 99042	410237, 99046	410287, 99046
Fuel	-	Natural gas	Biogas	Natural gas /biogas
Electrical output	kWel	1,013	-	-
Thermal output	kWtho	n/a	-	1,600 (NG)
Stack height	m	13.5	10	10.0
Internal diameter at exit	m	0.3	2.0	0.45
Volume flow rate (dry)	Nm^3/s	0.85	3.7	0.52
Volume flow rate (wet)	Am^3/s	1.93	48.8	0.91
Velocity	m/s	27.3	15.5	5.7
Temperature	°C	180	1,000	180
Exit concentration SO_2	mg/Nm^3	n/a	n/a	100 (ELV, 3% O_2) (biogas)
Exit concentration TVOC	mg/Nm^3	1,000 (ELV, 5% O_2) [4]	10 (ELV, 3% O_2) [5]	n/a
Exit concentration NOx	mg/Nm^3	250 (ELV, 5% O_2)	150 (ELV, 3% O_2)	100 (ELV, 3% O_2) (natural gas) 200 (ELV, 3% O_2) (biogas)
Exit concentration CO	mg/Nm^3	1,400 (ELV, 5% O_2)	50 (ELV, 3% O_2)	n/a

Notes:

[1] CHP, MTU 8V4000 GS, fuelled by natural gas (Appendix C). ELVs are the MCP Directive values for new plant (Annex II, Part 2, Table 2: Natural gas). Flue gas diameter and height were advised by the Operator. The exhaust gas volume flow rate (wet) is from the manufacturer's datasheet; the oxygen (8%) and moisture content (10%) were estimated based on monitoring data from comparable engines.

[2] Based on CDeg HTC 13.7 High Temperature Flare Stack (Appendix D) with maximum biogas flow rate of 2,100 m^3/h. Data on temperature and volume flow rate were supplied by the manufacturer, CDeg. Emission rates shown are for continuous operation; for long-term impact it has been assumed the flare will operate for a maximum of 10% of the time.

[3] Boiler parameters based on specification for a Vitomax LW Type M60A 1,600kWtho, oil/gas boiler (Appendix E). ELVs for SO_2 and NOx are the MCP Directive values for new plant (Annex II, Part 2, Table 1). The specification was used to reference volumetric flow rates; the oxygen (3%) and moisture (5.8%) content of the exhaust gas have been referenced from monitoring data from a boiler of similar specification at another AD facility (measured in August 2022). Emission rates shown are for continuous operation.

[4]Benzene emissions have been represented as 2% of TVOC emissions from the CHP (2% of TVOC ELV of 1000mg/m$^{3.}$ The release concentration of 20mg/m^3 is used as input in H1 screening).

[5]Benzene emissions have been represented as 5% of TVOC emissions from the Flare (5% of TVOC ELV of 10mg/m$^{3.}$ The release concentration of 0.5mg/m^3 is used as input in H1 screening).

Table 5 Stack and emission parameters: A2, A3, A19

Parameter	Units	(A2) Biofilter for new Waste Reception Building	(A3) Emissions abatement system for 2No. Pre-storage tanks[2]	(A19) Digestate offtake point[4]
Location	NGR (X,Y) m	410345, 99070	410321, 99009	410271, 99036
Stack height	m	3.5	2.0	2.0
Internal diameter at stack exit	m	1.0	0.125	0.10
Volume flow rate (dry)	Nm^3/s	-	-	-
Volume flow rate (wet)	Am^3/s	11.0	0.139	0.018
Velocity	m/s	14.0	11.32	2.27
Temperature	°C	Modelled as 'Ambient'	Modelled as 'Ambient'	Modelled as 'Ambient'
Exit concentration NH_3	mg/Nm^3	0.007 [1]	21 (1.0) [3]	0.96
Exit concentration H_2S	mg/Nm^3	<0.15 [1]	100 (2.0) [3]	-

Notes:

[1] Emissions abatement system designed and supplied by Eco Sustainable Solutions. Biofilter dimensions: 25m x 7m x 3.5m. Airflow rate: 39,600m^3/hr. Measured NH_3 and H_2S concentrations at biofilter outlet for operational Biofilter A1, serving the existing Food Waste/ SRF Building, used for transfer of solid food waste. The H_2S concentration was measured below the limit of detection for the method used. For assessment purposes, emission rates have been calculated based on 0.15mg/m^3.

[2] 1No. emissions abatement system outlet: stack height, diameter and volume flow rates based on assumptions. NH_3 concentrations have been calculated based on the nitrogen content of fresh matter in the feedstock (3.64 kg total N/tonne) contained within the Pre-storage Tanks.

[3] Brackets indicate values used for modelling, factored to account for 95% reduction in NH_3 emissions, and 98% reduction in H_2S emissions via the emissions abatement system.

[4] Digestate off-take point. Stack height, diameter and volume flow rates based on assumptions.

[5] NH_3 concentration at outlet have been calculated based on the nitrogen content of fresh matter in the feedstock (5.1kg total N/tonne) derived from the feedstocks used within the process. Emission rates have been factored to account for intermittent tanker filling, assuming constant rate Monday to Saturday, 12 hours per day (Mon- Fri), 5 hours (Sat) (3,380 hours/ year).

3 Impact assessment

Output tables from the H1 Assessment Tool for Scenario 1 (boiler operational period, excluding the CHP) are shown in Appendix A, Table 9 to Table 12.

The results for Scenario 2 (CHP operational period, excluding the boiler) are shown in Appendix B, Table 15 to Table 18. Table 10 and Table 16 show the long-term and short-term PCs and EALs for each pollutant in either scenario.

3.1 Air Impact Screening

Test 1 of the assessment compared the long-term and short-term PCs calculated by the H1 Assessment Tool with the relevant EALs for both operating scenarios.

Test 2 compared the long-term PECs are compared with the EALs and the short-term PCs with Headroom (EAL minus twice the long-term background concentration) for both operating scenarios.

The results of Air Impact Screening Test 1 and Test 2 are summarised in Table 6.

Table 6 Summary of Test 1 and Test 2 screening results

Substance	Test 1		Test 2	
	Scenario 1 (Boiler)	Scenario 2 (CHP)	Scenario 1 (Boiler)	Scenario 2 (CHP)
Benzene	Fail	Fail	Pass	Fail
Nitrogen dioxide	Fail	Fail	Fail	Fail
Nitrogen oxides (as NO_2) (ecological)	Fail	Fail	Fail	Fail
Carbon monoxide	Pass	Fail		Fail
Ammonia (ecological-lichens and bryophytes)	Fail	Fail	Fail	Fail
Ammonia (ecological-other vegetation)	Pass	Pass		
Ammonia	Pass	Pass		
Sulphur dioxide (15 min mean)	Fail	/	Fail	
Sulphur dioxide (24 hr mean)	Fail	/	Fail	
Sulphur dioxide (ecological-lichens and bryophytes)	Fail	/	Pass	
Sulphur dioxide (ecological-other vegetation)	Fail	/	Pass	
Hydrogen sulphide	Pass	Pass		
Notes: / = not applicable				

For each operating scenario, the H1 assessment has determined the pollutants which ‘fail’ both Test 1 and Test 2 and require further assessment using detailed modelling. Those requiring further assessment are those which ‘fail’ in one or both scenarios and they are as follows. EALs for human health:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (maximum 8-hour running mean)

- Sulphur dioxide (15-min mean)
- Sulphur dioxide (24-hour mean)
- Benzene (24-hour mean)

EALs for potential impacts on the local and nationally designated ecological sites:

- Nitrogen dioxide (Ecological - daily mean)
- Ammonia (Ecological -lichens and bryophytes), lower critical level of 1μg/m^3

3.3 Deposition to land

It is not possible to assess deposition to land from air using the current version of the H1 Risk Assessment Tool (version 9.2).[16] Deposition to land is therefore considered further in the supporting AQIA[17] for potential impact on ecological receptors.

3.4 Summary

Table 3 summarises which pollutant-EALs require further assessment using detailed modelling. Those requiring detailed modelling are given as:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (maximum 8-hour running mean)
- Sulphur dioxide (15-min mean)
- Sulphur dioxide (24-hour mean)
- Benzene (24-hour mean)
- Nitrogen dioxide (Ecological - daily mean)
- Ammonia (Ecological -lichens and bryophytes), lower critical level of 1μg/m^3

Deposition to land will be considered for potential impact on ecological sites within relevant screening distance criteria.

[16] Atmospheric Dispersion Modelling Liaison Committee (ADMLC) H1 Risk Assessment Tool (https://admlc.com/h1-tool/) Accessed 31/01/25).
[17] Landair Consulting Limited (June 2025) Air Quality Impact Assessment to Support a variation to installation permit for Parley Waste Management Facility, Chapel Lane, Parley, Christchurch, Dorset, BH23 6BG. Doc Ref: LAC_ESS-01_AQIA_V1.1_June 25.

4 Conclusion

This H1 Assessment has been completed support a variation permit application to vary the existing bespoke installation permit for the AD plant at Parley Waste Management Facility, Chapel Lane, Parley, Christchurch, Dorset, BH23 6BG.

The H1 Assessment Tool spreadsheet v.9.2 has been used for quantitative assessment of two operational scenarios that include combustion emissions from either the boiler (emission point A7) or CHP (A4), in addition to the operation of the emergency flare (A5). The emergency generator (A8) would be used for less than 50 hours per year and as such has not been part of the quantitative screening assessment.

Emissions were assumed to meet the MCP ELVs for NOx, and, for the CHP, EALs for CO and TVOC. The boiler will meet the MCP Directive ELVs for new plant fired by biogas although it is not an MCP as its thermal input is less than 1MW. The emergency generator will be a new MCP operating less than 500 hours per year as a 3-year rolling average and exempt from meeting MCPD ELVs.

Additional point sources to air evaluated within the screening assessment included: the already permitted but relocated Biofilter for the new AD Waste Reception Building (A2), emissions abatement system for 2No. Liquid Pre-storage Tanks (A3), and the digestate off-take point (A13).

Test 1 of the assessment compared the long-term and short-term PCs calculated by the H1 Assessment Tool with the relevant EALs for both operating scenarios; all pollutant-EAL combinations.

Test 2 compared the long-term PECs are compared with the EALs and the short-term PCs with Headroom (EAL minus twice the long-term background concentration) for both operating scenarios.

The pollutant-EALs which require further assessment using detailed modelling, within an air quality impact assessment include the following:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (maximum 8-hour running mean)
- Sulphur dioxide (15-min mean)
- Sulphur dioxide (24-hour mean)
- Benzene (24-hour mean)
- Nitrogen dioxide (Ecological - daily mean)
- Ammonia (Ecological -lichens and bryophytes), lower critical level of 1µg/m^3

Deposition to land will be considered for potential impact on these sites, and therefore the contribution of SO_2 to deposition will also be evaluated.

An air quality impact assessment has been prepared and submitted to support this application.

Figures

Figure 1 AD Plant permit boundary with emission point locations

Figure 1 Permit boundary emission points

Appendix A H1 Assessment Tool Input and Output – Scenario 1, Boiler

Table 7 Input: Air release points

Release point code	Location or grid reference	Activity/Activities	Effective height (metres)	Dispersion factor (Long term)	Dispersion factor (short term)	Dispersion factor (monthly)	Efflux velocity (m/s)	Total flow (m3/h)
A5 Flare	410237, 99045	Combustion of biogas	0	148	3900	529	15.5	13210
A3 PreStorage tanks	410321, 99009	Emissions abatement	0	148	3900	529	11.32	500
A13 Offtake	410271, 99035	Vent	0	148	3900	529	2.27	64.2
A7 Boiler NG	410287.05, 99045.528	Combustion of natural gas (90% of time)	0	148	3900	529	5.7	1866
A7 Boiler BG	410287.05, 99045.528	Combustion of biogas (10% of the time)	0	148	3900	529	5.7	1866
A2 Biofilter	410345, 99070	Emissions abatement	0	148	3900	529	14	39600

Table 8 Input: Emissions inventory

Release Point	Substance	Measurement method	Operating mode(%)	Long term conc (mg/m3)	Release rate g/s (long term)	Measurement basis (Long term)	Short term conc (mg/m3)	Release rate g/s (short term)	Measurement basis (short term)	Annual rate (t/yr)	Long term PC (ug/m3)	Short term PC (ug/m3)	Total Flow (m3/h)
A5 Flare	Benzene	Estimated	10%	0.5	0.00	5% of LFTGN 05	0.5	0.00	5% of LFTGN 05	0.01	0.03	4.22	13210.00
A5 Flare	Nitrogen dioxide	Estimated	10%	150	0.55	LFTGN 05	150	0.55	LFTGN 05	1.74	8.15	1073.31	13210.00
A5 Flare	Nitrogen oxides (as NO2) (ecological)	Estimated	10%	150	0.55	LFTGN 05	150	0.55	LFTGN 05	1.74	8.15	1266.51	13210.00
A5 Flare	Carbon monoxide	Estimated	10%	50	0.18	LFTGN 05	50	0.18	LFTGN 05	0.58	2.72	500.88	13210.00
A3 PreStorage tanks	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	1	0.00	Estimated	1	0.00	Estimated	0.00	0.02	0.54	500.00
A3 PreStorage tanks	Ammonia (ecological-other vegetation)	Estimated	100%	1	0.00	Estimated	1	0.00	Estimated	0.00	0.02	0.54	500.00
A3 PreStorage tanks	Ammonia	Estimated	100%	1	0.00	Estimated	1	0.00	Estimated	0.00	0.02	0.54	500.00
A13 Offtake	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	0.96	0.00	Estimated	0.96	0.00	Estimated	0.00	0.00	0.07	64.20
A13 Offtake	Ammonia (ecological-other vegetation)	Estimated	100%	0.96	0.00	Estimated	0.96	0.00	Estimated	0.00	0.00	0.07	64.20
A13 Offtake	Ammonia	Estimated	100%	0.96	0.00	Estimated	0.96	0.00	Estimated	0.00	0.00	0.07	64.20
A7 Boiler NG	Nitrogen dioxide	Estimated	90%	100	0.05	MCPD ELV	100	0.05	MCPD ELV	1.47	6.90	101.08	1866.00
A7 Boiler NG	Nitrogen oxides (as NO2) (ecological)	Estimated	90%	100	0.05	MCPD ELV	100	0.05	MCPD ELV	1.47	6.90	119.27	1866.00
A7 Boiler BG	Nitrogen dioxide	Estimated	10%	200	0.10	MCPD ELV	200	0.10	MCPD ELV	0.33	1.53	202.15	1866.00
A7 Boiler BG	Nitrogen oxides (as NO2) (ecological)	Estimated	10%	200	0.10	MCPD ELV	200	0.10	MCPD ELV	0.33	1.53	238.54	1866.00
A7 Boiler BG	Sulphur dioxide (15 min mean)	Estimated	10%	100	0.05	MCPD ELV	100	0.05	MCPD ELV	0.16	0.77	270.88	1866.00
A7 Boiler BG	Sulphur dioxide (24 hr mean)	Estimated	10%	100	0.05	MCPD ELV	100	0.05	MCPD ELV	0.16	0.77	119.27	1866.00
A7 Boiler BG	Sulphur dioxide (ecological-lichens and bryophytes)	Estimated	10%	100	0.05	MCPD ELV	100	0.05	MCPD ELV	0.16	0.77	202.15	1866.00

A7 Boiler BG	Sulphur dioxide (ecological-other vegetation)	Estimated	10%	100	0.05	MCPD ELV	100	0.05	MCPD ELV	0.16	0.77	202.15	1866.00
A2 Biofilter	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	0.007	0.00	Estimated	0.007	0.00	Estimated	0.00	0.01	0.30	39600.00
A2 Biofilter	Ammonia (ecological-other vegetation)	Estimated	100%	0.007	0.00	Estimated	0.007	0.00	Estimated	0.00	0.01	0.30	39600.00
A2 Biofilter	Ammonia	Estimated	100%	0.007	0.00	Estimated	0.007	0.00	Estimated	0.00	0.01	0.30	39600.00
A2 Biofilter	Hydrogen sulphide	Estimated	100%	0.15	0.00	Estimated	0.15	0.00	Estimated	0.05	0.24	3.80	39600.00
A3 PreStorage tanks	Hydrogen sulphide	Estimated	100%	2	0.00	Estimated	2	0.00	Estimated	0.01	0.04	0.64	500.00

Table 9 Output: Air impacts - pollutants

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	Long term modelled PC	Short term EAL (ug/m3)	Short term PC (ug/m3)	Short term modelled PC
1	Benzene	5	0.027153889		30	4.221695833	
2	Nitrogen dioxide	40	16.58463333		200	1376.5375	
3	Nitrogen oxides (as NO2) (ecological)	30	16.58		75	1624.31	
4	Carbon monoxide	0	2.72		10000	500.88	
5	Ammonia (ecological-lichens and bryophytes)	1	0.03		0	0.91	
6	Ammonia (ecological-other vegetation)	3	0.03		0	0.91	
7	Ammonia	180	0.03		2500	0.91	
8	Sulphur dioxide (15 min mean)	0	0.77		266	270.88	
9	Sulphur dioxide (24 hr mean)	0	0.77		125	119.27	
10	Sulphur dioxide (ecological-lichens and bryop	10	0.77		0	202.15	
11	Sulphur dioxide (ecological-other vegetation)	20	0.77		0	202.15	
12	Hydrogen sulphide	140	0.29		150	4.44	

Table 10 Output: Air impacts – Test 1

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	%PC of EAL (long term)	>1% of EAL? (long term)	Short term EAL (ug/m3)	Short term PC (ug/m3)	%PC of EAL (short term)	>10% of EAL? (short term)
1	Benzene	5	0.027153889	0.54%	pass	30	4.221695833	14.07%	fail
2	Nitrogen dioxide	40	16.58463333	41.46%	fail	200	1376.5375	688.27%	fail
3	Nitrogen oxides (as NO2) (ecological)	30	16.58463333	55.28%	fail	75	1624.31425	2165.75%	fail
4	Carbon monoxide	0	2.715388889			10000	500.8791667	5.01%	pass
5	Ammonia (ecological-lichens and bryophytes)	1	0.034485316	3.45%	fail	0	0.908734667		
6	Ammonia (ecological-other vegetation)	3	0.034485316	1.15%	fail	0	0.908734667		
7	Ammonia	180	0.034485316	0.02%	pass	2500	0.908734667	0.04%	pass
8	Sulphur dioxide (15 min mean)	0	0.767133333			266	270.881	101.83%	fail
9	Sulphur dioxide (24 hr mean)	0	0.767133333			125	119.2685	95.41%	fail
10	Sulphur dioxide (ecological-lichens and bryophytes)	10	0.767133333	7.67%	fail	0	202.15		
11	Sulphur dioxide (ecological-other vegetation)	20	0.767133333	3.84%	fail	0	202.15		
12	Hydrogen sulphide	140	0.285311111	0.20%	pass	150	4.435816667	2.96%	pass

Table 11 Output: Air impacts – Test 2

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	Air Background conc (ug/m3)	%PC of headroom (long term)	PEC Long term (µg/m3)	%PEC of EAL% (Long term)	%PEC of EAL>70%? (long	Short term EAL (ug/m3)	Short term PC (ug/m3)	%PC of the EAL-2*background	%PC of headroom >=20%? (short term)
1	Benzene	5	0.027153889	0.32	1%	0.35	6.94%	pass	30	4.221695833	14.38%	pass
2	Nitrogen dioxide	40	16.58463333	7.7	51%	24.28	60.71%	pass	200	1376.5375	745.69%	fail
3	Nitrogen oxides (as NO2) (ecological)	30	16.58463333	13.84	103%	30.42	101.42%	fail	75	1624.31425	3432.62%	fail
5	Ammonia (ecological-lichens and bryophyt	1	0.034485316	1.11	100%	1.14	114.45%	fail	0	0.908734667		
6	Ammonia (ecological-other vegetation)	3	0.034485316	1.28	2%	1.31	43.82%	pass	0	0.908734667		
8	Sulphur dioxide (15 min mean)	0	0.767133333	1.28	100%	2.05			266	270.881	102.82%	fail
9	Sulphur dioxide (24 hr mean)	0	0.767133333	1.81	100%	2.58			125	119.2685	98.26%	fail
10	Sulphur dioxide (ecological-lichens and br	10	0.767133333	1.81	9%	2.58	25.77%	pass	0	202.15		
11	Sulphur dioxide (ecological-other vegetati	20	0.767133333		4%	0.77	3.84%	pass	0	202.15		

Table 12 Results: Air Assessment

Option	Substance	Test 1	Test 2
1	Benzene	Fail	Pass
1	**Nitrogen dioxide**	**Fail**	**Fail**
1	**Nitrogen oxides (as NO2) (ecological)**	**Fail**	**Fail**
1	Carbon monoxide	Pass	
1	**Ammonia (ecological-lichens and bryophytes)**	**Fail**	**Fail**
1	Ammonia (ecological-other vegetation)	Pass	
1	Ammonia	Pass	
1	**Sulphur dioxide (15 min mean)**	**Fail**	**Fail**
1	**Sulphur dioxide (24 hr mean)**	**Fail**	**Fail**
1	Sulphur dioxide (ecological-lichens and bryophytes)	Fail	Pass
1	Sulphur dioxide (ecological-other vegetation)	Fail	Pass
1	Hydrogen sulphide	Pass	

Appendix B H1 Assessment Tool Input and Output – Scenario 2, CHP

Table 13 Input: Air release points

Release point code	Location or grid reference	Activity/Activities	Effective height (metres)	Dispersion factor (Long term)	Dispersion factor (short term)	Dispersion factor (monthly)	Efflux velocity (m/s)	Total flow (m3/h)
A4 CHP	410297, 99042	Combustion of natural gas	1.7	128.28	3335.6	444.799	27.3	3057
A5 Flare	410237, 99045	Combustion of biogas	0	148	3900	529	15.5	13210
A3 PreStorage tanks	410321, 99009	Emissions abatement	0	148	3900	529	11.32	500
A13 Offtake	410271, 99035	Vent	0	148	3900	529	2.27	64.2
A2 Biofilter	410345, 99070	Emissions abatement	0	148	3900	529	14	39600

Table 14 Input: Emissions inventory

Release Point	Substance	Measure ment method	Operating mode(%)	Long term conc (mg/m3)	Release rate g/s (long term)	Measurement basis (Long term)	Short term conc (mg/m3)	Release rate g/s (short term)	Measurement basis (short term)	Annual rate (t/yr)	Long term PC (ug/m3)	Short term PC (ug/m3)	Total Flow (m3/h)
A4 CHP	Benzene	Estimated	100%	20	0.02	2% of MCPD ELV	20	0.02	2% of MCPD ELV	0.54	2.18	33.42	3057.00
A4 CHP	Nitrogen dioxide	Estimated	100%	250	0.21	MCPD ELV	250	0.21	MCPD ELV	6.69	27.23	354.06	3057.00
A4 CHP	Nitrogen oxides (as NO2) (ecological)	Estimated	100%	250	0.21	MCPD ELV	250	0.21	MCPD ELV	6.69	27.23	417.79	3057.00
A4 CHP	Carbon monoxide	Estimated	100%	1400	1.19	LFTGN 08	1400	1.19	LFTGN 08	37.49	152.50	2775.83	3057.00
A5 Flare	Benzene	Estimated	10%	0.5	0.00	5% of LFTGN 05	0.5	0.00	5% of LFTGN 05	0.01	0.03	4.22	13210.00
A5 Flare	Nitrogen dioxide	Estimated	10%	150	0.55	LFTGN 05	150	0.55	LFTGN 05	1.74	8.15	1073.31	13210.00
A5 Flare	Nitrogen oxides (as NO2) (ecological)	Estimated	10%	150	0.55	LFTGN 05	150	0.55	LFTGN 05	1.74	8.15	1266.51	13210.00
A5 Flare	Carbon monoxide	Estimated	10%	50	0.18	LFTGN 05	50	0.18	LFTGN 05	0.58	2.72	500.88	13210.00
A3 PreStorage tanks	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	1	0.00	Estimated	1	0.00	Estimated	0.00	0.02	0.54	500.00
A3 PreStorage tanks	Ammonia (ecological-other vegetation)	Estimated	100%	1	0.00	Estimated	1	0.00	Estimated	0.00	0.02	0.54	500.00
A3 PreStorage tanks	Ammonia	Estimated	100%	1	0.00	Estimated	1	0.00	Estimated	0.00	0.02	0.54	500.00
A13 Offtake	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	0.96	0.00	Estimated	0.96	0.00	Estimated	0.00	0.00	0.07	64.20
A13 Offtake	Ammonia (ecological-other vegetation)	Estimated	100%	0.96	0.00	Estimated	0.96	0.00	Estimated	0.00	0.00	0.07	64.20
A13 Offtake	Ammonia	Estimated	100%	0.96	0.00	Estimated	0.96	0.00	Estimated	0.00	0.00	0.07	64.20
A2 Biofilter	Ammonia (ecological-lichens and bryophytes)	Estimated	100%	0.007	0.00	Estimated	0.007	0.00	Estimated	0.00	0.01	0.30	39600.00
A2 Biofilter	Ammonia (ecological-other vegetation)	Estimated	100%	0.007	0.00	Estimated	0.007	0.00	Estimated	0.00	0.01	0.30	39600.00
A2 Biofilter	Ammonia	Estimated	100%	0.007	0.00	Estimated	0.007	0.00	Estimated	0.00	0.01	0.30	39600.00
A2 Biofilter	Hydrogen sulphide	Estimated	100%	0.15	0.00	Estimated	0.15	0.00	Estimated	0.05	0.24	3.80	39600.00
A3 PreStorage tanks	Hydrogen sulphide	Estimated	100%	2	0.00	Estimated	2	0.00	Estimated	0.01	0.04	0.64	500.00

Table 15 Output: Air impacts – pollutants

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	Long term modelled PC	Short term EAL (ug/m3)	Short term PC (ug/m3)	Short term modelled PC
1	Benzene	5	2.205775889		30	37.64496377	
2	Nitrogen dioxide	40	35.37894167		200	1427.372542	
3	Nitrogen oxides (as NO2) (ecological)	30	35.38		75	1684.30	
4	Carbon monoxide	0	155.22		10000	3276.71	
5	Ammonia (ecological-lichens and bryophytes)	1	0.03		0	0.91	
6	Ammonia (ecological-other vegetation)	3	0.03		0	0.91	
7	Ammonia	180	0.03		2500	0.91	
8	Hydrogen sulphide	140	0.29		150	4.44	

Table 16 Output: Air impacts – Test 1

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	%PC of EAL (long term)	>1% of EAL? (long term)	Short term EAL (ug/m3)	Short term PC (ug/m3)	%PC of EAL (short term)	>10% of EAL? (short term)
1	Benzene	5	2.205775889	44.12%	fail	30	37.64496377	125.48%	fail
2	Nitrogen dioxide	40	35.37894167	88.45%	fail	200	1427.372542	713.69%	fail
3	Nitrogen oxides (as NO2) (ecological)	30	35.37894167	117.93%	fail	75	1684.299599	2245.73%	fail
4	Carbon monoxide	0	155.2189289			10000	3276.709893	32.77%	fail
5	Ammonia (ecological-lichens and bryophytes)	1	0.034485316	3.45%	fail	0	0.908734667		
6	Ammonia (ecological-other vegetation)	3	0.034485316	1.15%	fail	0	0.908734667		
7	Ammonia	180	0.034485316	0.02%	pass	2500	0.908734667	0.04%	pass
8	Hydrogen sulphide	140	0.285311111	0.20%	pass	150	4.435816667	2.96%	pass

Table 17 Output: Air impacts – Test 2

Number	Substance	Long term EAL (ug/m3)	Long term PC (ug/m3)	Air Background conc (ug/m3)	%PC of headroom (long term)	PEC Long term (µg/m3)	%PEC of EAL% (Long term)	%PEC of EAL>70%? (long	Short term EAL (ug/m3)	Short term PC (ug/m3)	%PC of the EAL-2*background	%PC of headroom >=20%? (short term)
1	Benzene	5	2.205775889	0.32	47%	2.53	50.52%	pass	30	37.64496377	128.22%	fail
2	Nitrogen dioxide	40	35.37894167	7.7	110%	43.08	107.70%	fail	200	1427.372542	773.22%	fail
3	Nitrogen oxides (as NO2) (ecological)	30	35.37894167	13.84	100%	49.22	164.06%	fail	75	1684.299599	3559.38%	fail
4	Carbon monoxide	0	155.2189289	165	100%	320.22			10000	3276.709893	33.89%	fail
5	Ammonia (ecological-lichens and bryophyt	1	0.034485316	1.11	100%	1.14	114.45%	fail	0	0.908734667		
6	Ammonia (ecological-other vegetation)	3	0.034485316		1%	0.03	1.15%	pass	0	0.908734667		

Table 18 Results: Air Assessment

Option	Substance	Test 1	Test 2
1	Benzene	Fail	Fail
1	Nitrogen dioxide	Fail	Fail
1	Nitrogen oxides (as NO2) (ecological)	Fail	Fail
1	Carbon monoxide	Fail	Fail
1	Ammonia (ecological-lichens and bryophytes)	Fail	Fail
1	Ammonia (ecological-other vegetation)	Pass	
1	Ammonia	Pass	
1	Hydrogen sulphide	Pass	

Appendix C Proposed CHP, technical specification

Technical Data Sheet **MTU 8V4000 GS**

93800052562_V02_en_GB **GG08V4000D1**

Voltage / Frequency	V / Hz	**400**	**/**	**50**
Cooling water temperature (in / out)	°C		**77 / 90**	
NOx emissions (dry, 5 % O_2)	mg/m³ i.N.		**< 250**	
Mixture cooler 1st stage water temperature (in)	°C			
Mixture cooler 2nd stage water temperature (in)	°C		**43**	
Exhaust gas temperature	°C		**430**	
Catalytic converter			**not included**	
Special equipment				
Elevation above sea level	m / mbar	**100**	**/**	**1000**
Combustion air temperature	°C		**25**	
Relative combustion air humidity	%		**30**	
Standard specifications and regulations			**VDE-AR-N 4110**	
Energy balance	**%**	**100**	**75**	**50**
Electrical Power [2] [3]	kW	1013	760	507
Energy input [4] [5]	kW	2356	1812	1280
Thermal output total [6]	kW	542	406	275
Thermal output engine (block, lube oil, 1st stage mixture cooler) [6]	kW	542	406	275
Thermal output mixture cooler 1st stage [6]	kW			
Thermal output mixture cooler 2nd stage [6]	kW	74	52	33
Exhaust heat (120 °C) [6]	kW	(521)	(431)	(347)
Engine power ISO 3046-1 [2]	kW	1040	783	526
Generator efficiency at power factor = 1	%	97.4	97.1	96.4
Electrical efficiency [4]	%	43.0	41.9	39.6
Total efficiency	%	88.1	88.2	88.2
Power consumption [7]	kW			
Combustion air / Exhaust gas				
Combustion air volume flow [1]	m³ i.N./h	3982	3008	2033
Combustion air mass flow	kg/h	5142	3884	2626
Exhaust gas volume flow, wet [1]	m³ i.N./h	4180	3160	2141
Exhaust gas volume flow, dry [1]	m³ i.N./h	3743	2824	1904
Exhaust gas mass flow, wet	kg/h	5315	4016	2720
Exhaust temperature after turbocharger	°C	430	459	519
Reference fuel [8]				
Natural gas			CH_4 >95 Vol.%	
Sewage gas			not applicable	
Biogas			not applicable	
Landfill gas			not applicable	
Fuel requirements [9]				
Minimum methane number	MN		72	
Range of heating value: design / operation range without power derating	kWh/m³ i.N.		10.0 - 10.5 / 8.0 - 11.0	
Exhaust gas emissions [5] [8] Compliance with emissions standards only for ≥ 507 kWel				
NOx, stated as NO_2 (dry, 5 % O_2)	mg/m³ i.N.	< 250		
CO (dry, 5 % O_2)	mg/m³ i.N.	< 800		
HCHO (dry, 5 % O_2)	mg/m³ i.N.	< 80		
VOC (dry, 5 % O_2)	mg/m³ i.N.			
Otto-gas engine, lean burn operation with turbocharging				
Number of cylinders / configuration		8	/	V
Engine type			8V4000L64FNER	
Engine speed	1/min		1500	
Bore	mm		170.0	
Stroke	mm		210.0	
Displacement	dm³		38.1	
Mean piston speed	m/s		10.5	
Compression ratio			12.5	
BMEP at nominal engine speed min-1	bar	21.8		
Lube oil consumption [10]	dm³/h	0.18		
Exhaust back pressure min. - max. after module	mbar - mbar		30 - 60	
Generator				
Rating power (temperature rise class F) [11]	kVA		1770	
Insulation class / temperature rise class			H / F	
Winding pitch			2/3	
Protection			IP 23	
Max. allowable p.f. inductive (overexcited) / capacitive (underexcited) [12]			0.8 / 0.95	
Voltage tolerance / frequency tolerance	%		± 10 / ± 5	
Engine cooling water system				
Coolant temperature (in / out), design	°C	77 / 90		
Coolant flow rate, constant [13] [14]	m³/h	38.8		
Pressure drop, design [14] Cv value [13] [15]	bar / m³/h	2.05	/	27.6
Max. operation pressure (coolant before engine)	bar		6.0	
Exhaust gas heat exchanger (EGHE)				
Exhaust gas temperature (out)	°C			
Coolant temperature (in / out), design	°C			
Coolant volumetric flow, constant [13] [14]	m³/h			
Pressure drop, design [14] Cv value [13] [15]	kPa / m³/h		/	
Min. coolant flow rate / min. operation gauge pressure	m³/h / bar		/	
Max. operation pressure (coolant water)	bar			

Mixture cooler 1st stage, external					
Coolant temperature (in / out), design		°C			
Coolant volumetric flow, design, constant 13) 14)		m³/h			
Pressure drop, design 14)	Cv value 13) 15)	bar / m³/h		/	
Min. coolant flow rate / min. operation gauge pressure		m³/h / bar		/	
Max. operation pressure before mixture cooler		bar			
Mixture cooling 2nd stage, external					
Coolant temperature (in / out), design		°C	43 / 44.7		
Coolant volumetric flow, design, constant 13) 14)		m³/h	41.7		
Pressure drop, design 14)	Cv value 13) 15)	bar / m³/h	0.96	/	43.6
Max. operation pressure before mixture cooler		bar		6	
Heating circuit interface					
Engine coolant temperature (in / out), design		°C			
Heating water temperature (in / out), design		°C			
Heating water flow rate, design 14) 16)		m³/h			
Pressure drop, design 14)	Cv value 15) 16)	bar / m³/h		/	
Max. operation gauge pressure (heating water)		bar			
Room ventilation					
Genset ventilation heat 17)		kW		59	
Inlet air temperature: (min./design/max.)		°C		20 / 25 / 30	
Min. engine room temperature 18)		°C		15	
Max. temperature difference ventilation air (in / out)		K		20	
Min. supply air volume flow rate (combustion + ventilation) 19)		m³ i.N./h		12500	
Gearbox		**%**	**100**	**75**	**50**
Efficiency		%	-	-	-
Starter battery					
Nominal voltage / power / capacity required		V / kW / Ah		24 / 9.0 / --	
Filling quantities					
Lube oil for engine		dm³		200	
Coolant in engine		dm³		135	
Coolant in mixture cooler		dm³		15	
Heating water for plate heat exchanger 20)		dm³			
Lube oil for gearbox		dm³			
Gas regulation line					
Nominal size / gas pressure min. - max. (at gas regulation line inlet)		DN / mbar - mbar	80	/	125 - 250

Engine sound level 21) (1 meter distance, free field) +3 dB(A) for total A-weighted level tolerance; + 5 dB for single octave level					
Frequency	Hz	**63**	**125**	**250**	**500**
Sound pressure level	dB	79.3	89.1	90.0	92.6
Frequency	Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level	dB	92.2	89.2	88.8	100.0
Linear total sound pressure level	Lin dB	102.3			
A-weighted total sound pressure level	dB(A)	101.0			
A-weighted total sound power level	dB(A)	120.0			
Undampened exhaust noise 21) (1 meter distance to outlet within 90°, free field) +3 dB(A) for total A-weighted level tolerance; + 5 dB for single octave level					
Frequency	Hz	**63**	**125**	**250**	**500**
Sound pressure level	dB	102.1	118.4	110.3	106.1
Frequency	Hz	**1000**	**2000**	**4000**	**8000**
Sound pressure level	dB	101.4	99.5	93.4	84.1
Linear total sound pressure level	Lin dB	119.4			
A-weighted total sound pressure level	dB(A)	109.0			
A-weighted total sound power level	dB(A)	121.2			

Dimensions (aggregate)		
Length	mm	~ 4200
Width	mm	~ 2000
Height	mm	~ 2300
Gross weight (dry weight)	kg	~ 10350 (~ 10000)
Power derating		
Elevation		specific to the project
Combustion air temperature		specific to the project
Mixture cooler coolant temperature (in)		specific to the project
Methane number		specific to the project
Boundary conditions and consumables		
Systems and consumables have to conform to the following actual company standards:		A001072

1) Normal cubic meter at 1013 mbar and T = 273 K
2) Prime power operation will be designed specific to the project
3) Generator gross power at nominal voltage, power factor = 1 and nominal frequency
4) According to ISO 3046 (+ 5 % tolerance), using reference fuel used at nominal voltage, power factor = 1 and nominal frequency
5) Emission values during grid parallel operation
6) Thermal output at layout temperature; tolerance +/- 8 %
7) Power consumption of all electrical consumers which are mounted at the module / genset
8) Deviations from the layout parameters respectively the reference fuel can have influence on the obtained efficiency and exhaust emissions
9) Functional capability
10) Reference value at nominal load (without amount of oil exchange)
11) Generator (at nominal power) max. 1000 m height of location and max. 40 °C intake air temperature; else power derating
12) Max. allowable cos phi at nominal power (view of producer)
13) Stated values for cooling fluid composition 65% water and 35% glycol, adaption for use of other cooling fluid composition necessary
The system design must consider the tolerance.
14) Pressure loss at reference flow rate
15) The Cv value declares the volumetric flow in m³/h at a pressure drop of 1 bar. Min. and max. flow rate limits are defined.
16) Stated values for pure water, adaption for other cooling fluid composition necessary
17) Only generator- and surface losses
18) Frost-free conditions must be guaranteed
19) Amount of ventilation air must be adapted to the gas safety concept
20) Assemblies including pipe work
21) All sound pressure levels at nominal load, according to ISO 8528-10 and ISO 6798.
Resonance effects of the connected exhaust line can influence the exhaust noise sound pressure level

22) Max. admissible cos phi depending on voltage in accordance with the requirements of the valid 'Standard specifications and regulations'

Appendix D Emergency flare, technical specification

Technical Datasheet

Biogasflare

Type: HTC 13,7

Hightemperature combustion

Flow rate 1. burner stage :	min.	202 m³/h	max.	700 m³/h
At a gas flow pressure of:	min.	5 $mbar_g$	max.	80 $mbar_g$
Flow rate 2. burner stage :	min.	404 m³/h	max.	1400 m³/h
At a gas flow pressure of:	min.	5 $mbar_g$	max.	80 $mbar_g$
Flow rate 1.+2. burner stage :	min.	606 m³/h	max.	2100 m³/h
At a gas flow pressure of:	min.	5 $mbar_g$	max.	80 $mbar_g$
Heating value:	min.	4,5 kWh/m³	max.	6,5 kWh/m³
Combustion capacity:	min.	909 kW	max.	13700 kW
Safety shut down:	<	4 $mbar_g$		

Combustion conditions:

≥ 1000°C (1832°F) exhaust gas temperature in a range of control of 1:5, concealed combustion inside a thermal insulated combustion chamber with 0.3 sec. retention time and a destruction quality >>99.9%

Burner type:

C-deg-Injection burner with several, back fire protected nozzles

Dimensions:

Diameter gas connection:	DN 250
Number of burner circles (b.c.):	2
Diameter gas connection of b.c.:	DN 125 / 200
Total height ex foundation:	~ 10000 mm
Height of combustion chamber:	~ 6500 mm
Outer diameter of combustion chamber:	~ 2200 mm
Weight:	~ 5000 kg

Materials:

Combustion chamber:	☐ 321	☐ 304	☑ galvanized steel	
Insulation:	☐ cliped	☑ glued	☐ bolted	
Base console:	☐ 316TI	☐ 304	☑ galvanized steel	
Burner	☑ 321	☑ 316TI	☐ 309	☐ 310
Piping:	☑ 316TI	☐ 304	☐ galvanized steel	

Certificates:

Gasflare, complete:	CE-Conformity statement acc. to Machinery Directive 2006/42/EG
Gas fittings:	DVGW, EN 161 (for pneumatic valves on request!)
Flame arrestor:	ATEX
Pressure transmitters:	DVGW
Gas blower:	ATEX
Burner control unit:	EN 298 , EN746
Control cabinet:	Test certificate acc. DIN VDE 0100 Part 600, IEE 16th Edition
Safety engineering:	in dependence of EN, DIN, TR, ATEX, UVV and DVGW regulations

Kiel, 02.12.2024

Appendix E Boiler, technical specification

VIESSMANN

VITOMAX LW

Low temperature oil/gas boiler
700 to 1950 kW

Datasheet

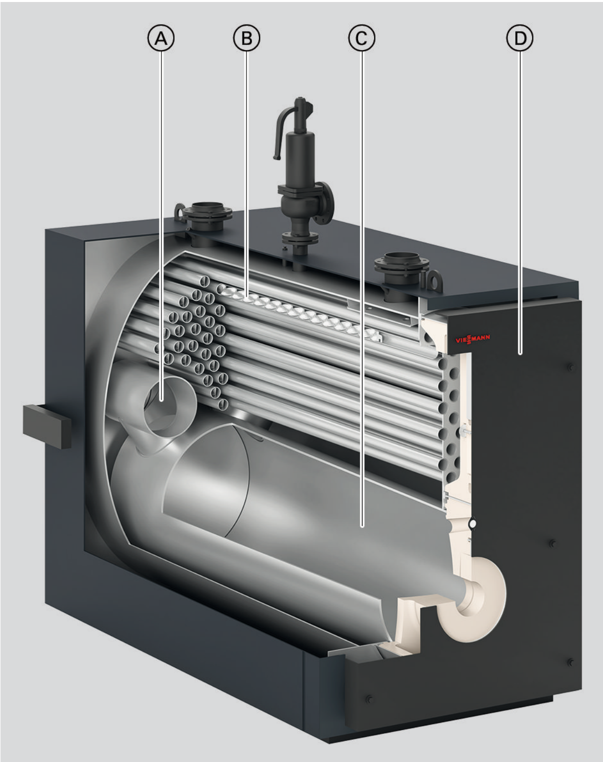
For part no. and prices: see pricelist

VITOMAX LW Type M60A

Low temperature oil/gas boiler
- **Three-pass boiler**
- **For operation with modulating boiler water temperature**

Benefits at a glance

- Economical and environmentally responsible thanks to modulating boiler water temperature
- Standard seasonal efficiency [to DIN] for operation with fuel oil: 89 % (H_s) [gross cv].
- Three-pass boiler with low combustion chamber loading, resulting in clean combustion with low emissions
- Wide water galleries and large water capacity provide excellent natural circulation and reliable heat transfer.
- Long burner runtimes and reduced cycling due to large water content protect the environment.
- Compact design for easy handling in boiler rooms
- Easy to use Vitotronic control unit with colour touchscreen
- Integral LAN interface for internet communication and integral WiFi for service interface.
- Economical and safe operation of the heating system through the Vitotronic control system with communication capability which, in conjunction with Vitogate 300 (accessories), enables integration into building management systems.
- Vitocontrol control cabinet can be supplied on request.



A Hot gas flue (second pass)
B Hot gas flue (third pass)
C Combustion chamber (first pass)
D Boiler door

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Specification

Note

All diagrams in this document are schematic, illustrative examples.

All dimensions are nominal.

Specification

Boiler size		A	B	C	D	E	F
Rated heating output	**kW**	**700**	**900**	**1100**	**1300**	**1600**	**1950**
Rated heat input	kW	761	978	1196	1413	1739	2120
CE designation complying with Gas Appliances Regulation		CE-0085					
Permiss. flow temperature (= safety temperature)	°C	110 °C					
Permiss. operating temperature	°C	95					
Permiss. operating pressure	bar	6					
	kPa	600					
Pressure drop on the hot gas side	mbar	2.7	4.6	4.0	5.7	8.2	8.5
	Pa	270	460	400	570	820	850
Boiler body dimensions							
Length (dim. k)*1	mm	2200	2500	2470	2670	3095	3095
Width (dim. c)	mm	1085	1085	1180	1180	1280	1280
Height (incl. connectors) (dim. e)	mm	1670	1670	1900	1900	2120	2120
Total dimensions							
Total length (dim. f)	mm	2280	2580	2545	2765	3195	3195
Total width							
– Incl. control unit (dim. a)	mm	1460	1460	1555	1555	1660	1660
– Excl. control unit (dim. b)	mm	1285	1285	1380	1380	1485	1485
Total height (incl. lifting eyes) (dim. h)	mm	1690	1690	1920	1920	2140	2140
Height of anti-vibration boiler supports (under load)	mm	37	37	37	37	37	37
Foundation							
Length	mm	1900	2200	2150	2300	2700	2700
Width	mm	1200	1200	1300	1300	1400	1400
Combustion chamber diameter	mm	620	620	720	720	720*2	720*2
Combustion chamber length	mm	1705	2005	1935	2155	2535	2535
Weight of boiler body	kg	1610	1830	2260	2440	3330	3470
Total weight Boiler incl. thermal insulation and boiler control unit	kg	1725	1955	2395	2585	3495	3650
Boiler water **capacity**	litres	935	1325	1525	1690	2510	2420
Boiler connections							
Boiler flow and return	PN 6 DN	100	100	125	125	150	150
Safety connection (safety valve)	PN 16 DN	50	50	65	65	65	65
Drain (male thread)	R	1¼	1¼	1¼	1¼	1¼	1¼
Flue gas parameters*3							
Temperature (at 60 °C boiler water temperature)							
– At rated heating output	°C	180					
– At partial load	°C	125					
Temperature (at 80 °C boiler water temperature)	°C	195					
Flue gas mass flow rate							
– With natural gas	kg/h	1.5225 x combustion output in kW					
– With EL fuel oil	kg/h	1.5 x combustion output in kW					
Flue gas connection	Ø mm	300	300	350	350	400	400

*1 *Boiler door removed.*

*2 *Conical combustion chamber 720/840 mm (combustion chamber diameter front/rear)*

*3 *Calculation values for sizing the flue system to EN 13384 relative to 13.2 % CO_2 for EL fuel oil and 10 % CO_2 for natural gas. Flue gas temperatures measured as gross values at 20 ºC combustion air temperature. The details for partial load refer to an output of 60 % of rated heating output. If the partial load differs (depending on operating mode), calculate the flue gas mass flow rate accordingly.*

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Specification (cont.)

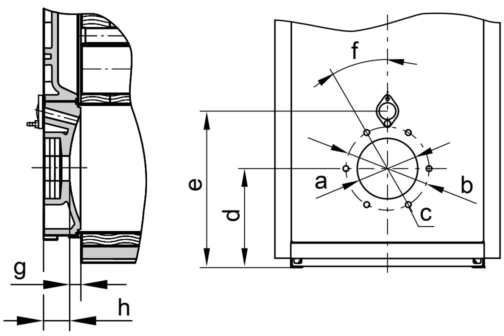
Boiler size		A	B	C	D	E	F
Rated heating output	kW	**700**	**900**	**1100**	**1300**	**1600**	**1950**
Total gas capacity Combustion chamber, hot gas flues, return pipes, reversing chamber and flue gas collector	m^3	0.90	1.00	1.35	1.45	2.50	2.50
Standard seasonal efficiency [to DIN] (for operation with fuel oil) At heating system temperature 75/60 °C	%	89 (H_s) [gross cv]					
Standby loss $q_{B,70}$	%	0.15	0.13	0.13	0.12	0.13	0.11

Design information for burner selection

Burner installation

Fit the burner plate included in the standard delivery to the hinged boiler door.
The burner must be fitted to the burner plate; mounting it directly onto the boiler door without a burner plate is not possible.
Drill the supplied burner plate on site, in accordance with the burner dimensions.
Burner plates can be prepared at the factory on request (chargeable option). If this is required, state the burner make and type when ordering.

The flame tube must protrude from the thermal insulation of the boiler door.
The burner must not exceed a total weight of 180 kg, otherwise supports will need to be provided on site.



Boiler size		A	B	C	D	E	F
a	∅mm	350	350	400	400	400	400
b	∅mm	400	400	490	490	490	490
c	Quantity/ thread	6/M12					
d	mm	525	525	580	580	640	640
e	mm	810	810	905	905	995	995
f	°	15	15	30	30	30	30
g	mm	75	75	75	75	75	75
h	mm	150	150	150	150	170	170

Installing a suitable burner

Delivery without burner.
Suitable pressure-jet oil/gas burners are available from manufacturers such as Weishaupt and ELCO and should be ordered separately (see pricelist).
The material of the burner head must be suitable for operating temperatures up to at least 500 ºC.

Pressure-jet oil burners
The burner must be tested and designated to EN 267.

Pressure-jet gas burners
The burner must be tested to EN 676 and be identified with the CE designation.

Burner adjustment
Adjust the oil or gas throughput of the burner to suit the rated boiler heating output.

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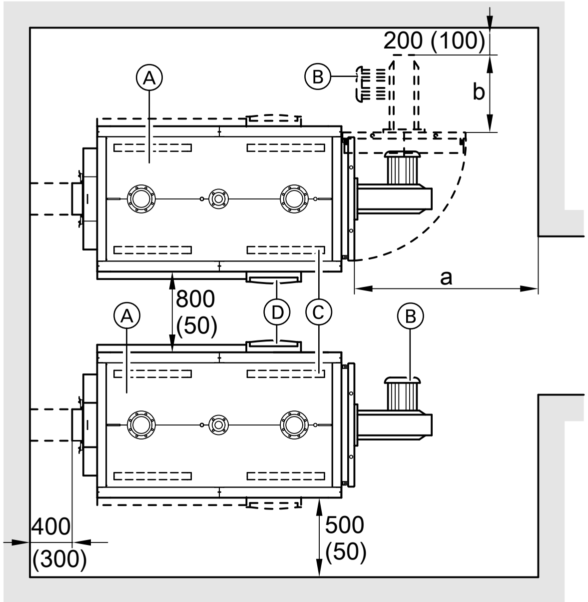
Design information for siting

Minimum clearances



Observe the stated dimensions to ensure straightforward installation and maintenance. Where space is tight, only the minimum clearances (dimensions in brackets) need to be maintained. In the delivered condition, the boiler door is fitted so it opens to the right. The hinge pins can be repositioned so that the door opens to the left.

Ⓐ Boiler
Ⓑ Burner
Ⓒ Anti-vibration boiler supports
Ⓓ Boiler control unit

Boiler size		A	B	C	D	E	F
a	mm	2050	2250	2050	2250	2700	2700
b	mm	Installed burner length					

Dim. a: Maintain this space in front of the boiler to enable the hot gas flues to be cleaned.

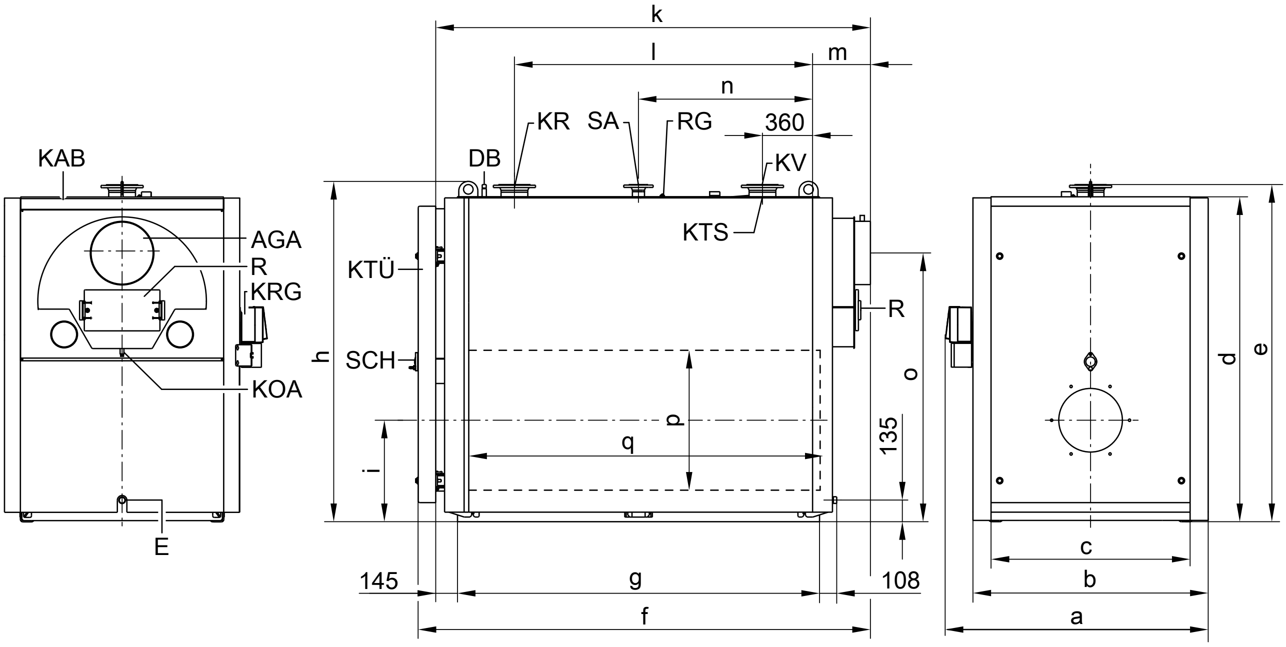
If the control units are fitted on opposite sides of the boilers, the 800 mm clearance between the individual boilers can be reduced to 50 mm.

Siting conditions

- Prevent air contamination by halogenated hydrocarbons (e.g. as contained in sprays, paints, solvents and cleaning agents)
- Prevent very dusty conditions
- Prevent high levels of humidity
- Prevent frost and ensure good ventilation

Otherwise the system may suffer faults and damage.
In rooms where air contamination through **halogenated hydrocarbons** may occur, install the boiler only if adequate measures can be taken to provide a supply of uncontaminated combustion air.

Boiler geometry



AGA Flue outlet
DB Female connection for maximum pressure limiter (R ½, male thread)
E Drain
KAB Boiler cover (walk-on)
KOA Condensate drain
KR Boiler return
KRG Boiler control unit
KTS Boiler water temperature sensor (shown offset)
KTÜ Boiler door
KV Boiler flow
R Cleaning aperture
RG Female connection for additional control equipment (R ½, male thread)
SA Safety connection (safety valve)
SCH Inspection port

Boiler size		**A**	**B**	**C**	**D**	**E**	**F**
a	mm	1460	1460	1555	1555	1660	1660
b	mm	1285	1285	1380	1380	1485	1485
c	mm	1085	1085	1180	1180	1280	1280
d	mm	1590	1590	1815	1815	2035	2035
e	mm	1670	1670	1900	1900	2120	2120
f	mm	2280	2580	2545	2765	3195	3195
g (length of base rails)	mm	1775	2075	2005	2225	2610	2610
h	mm	1690	1690	1920	1920	2140	2140
i	mm	525	525	580	580	640	640
k (handling dimension)	mm	2200	2500	2470	2670	3095	3095
l	mm	1420	1720	1650	1870	2250	2250
m	mm	280	280	320	320	340	340
n	mm	890	1040	1005	1115	1305	1305
o	mm	1270	1270	1375	1375	1498	1498
p	∅ mm	620	620	720	720	720*4	720*4
q	mm	1705	2005	1935	2155	2535	2535

Dim. k: With boiler door removed

Efficiency

Boiler efficiency as a function of boiler load (values averaged across the series)

*4 *Conical combustion chamber 720/840 mm (combustion chamber diameter front/rear)*

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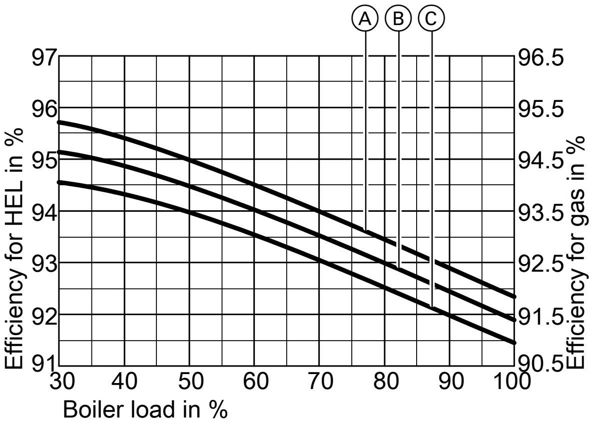
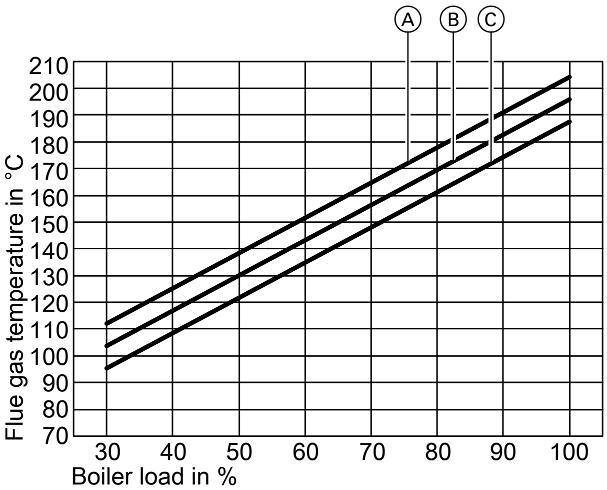


Ⓐ 70/53 °C flow/return
Ⓑ 80/60 °C flow/return
Ⓒ 90/70 °C flow/return

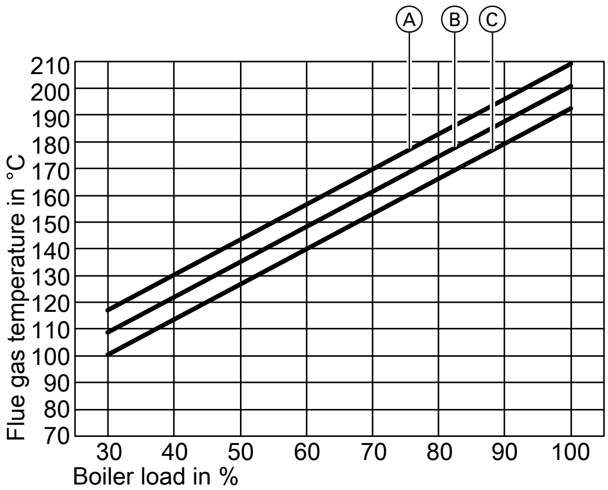
Flue gas temperature

Flue gas temperature as a function of boiler load (values averaged across the series)



Flue gas temperature for EL fuel oil

Ⓐ 90/70 °C flow/return
Ⓑ 80/60 °C flow/return
Ⓒ 70/53 °C flow/return

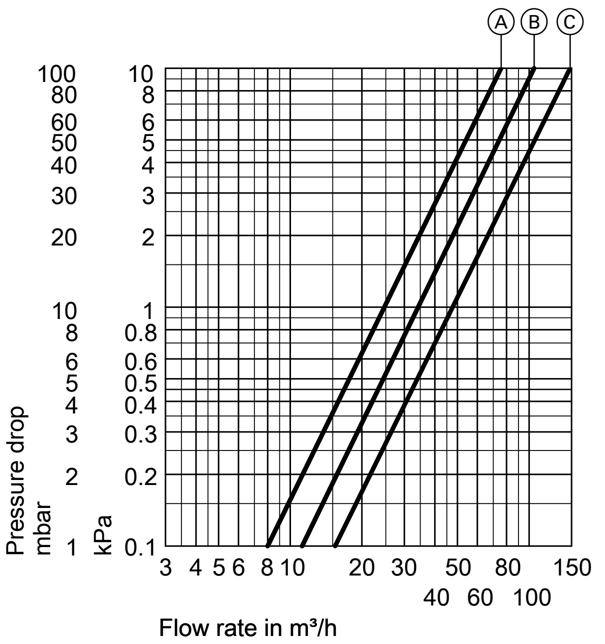


Flue gas temperature for natural gas

Ⓐ 90/70 °C flow/return
Ⓑ 80/60 °C flow/return
Ⓒ 70/53 °C flow/return

Boiler geometry (cont.)

Pressure drop on the heating water side



Ⓐ Rated heating output 700 and 900 kW
Ⓑ Rated heating output 1100 and 1300 kW
Ⓒ Rated heating output 1600 and 1950 kW

The Vitomax LW is only suitable for fully pumped hot water heating systems.

Delivered condition of the boiler

Boiler shell with fitted boiler door, fitted cleaning cover and permanently fitted boiler cover.
Mating flanges are fitted to all connectors.
The adjusting screws and burner plate can be found inside the combustion chamber.

2 Boxes with thermal insulation and 1 cleaning brush
1 Box with boiler control unit and 1 bag with technical documentation
1 Coding card and technical documentation

Control unit versions

For a single boiler system

- **Vitotronic 100, type CC1E**
  For the control unit with a constant boiler water temperature.
  For weather-compensated or room temperature-dependent operation in conjunction with an external control unit.
- **Vitotronic 200, type CO1E**
  For weather-compensated operation and mixer control for up to 2 heating circuits with mixer. For the 2 heating circuits with mixer, the accessory "Extension for heating circuits 2 and 3" is required.

For a multi boiler system (up to 8 boilers)

- **Vitotronic 300, type CM1E**
  For weather-compensated operation of a multi boiler system. This Vitotronic control unit also handles control of the boiler water temperature of a boiler within this multi boiler system.
  Vitotronic 100, type CC1E and LON communication module
  To control the boiler water temperature for each additional boiler in the multi boiler system.
- **Vitocontrol 100-M/200-M multi mode system controller**
  For weather-compensated cascade control of boilers with Vitotronic 100 control unit and a Vitobloc CHP unit or other heat generators.

Multi mode system controller in the control panel

For single and multi boiler systems

Vitocontrol 100-M
- For operation of multi mode heating systems with up to 4 heat generators, with various combinations of oil/gas boilers, heat pumps, CHP units and solid fuel boilers. The Vitocontrol 100-M can operate a range of defined standard schemes. The schemes are available via the Viessmann Schematic Browser. For the compatibility of the Vitocontrol 100-M in conjunction with Viessmann control units, see the compatibility list. Connection to ViScada for web-based system visualisation is available as an option. This requires an internet connection.
  Viessmann Schematic Browser: **www.viessmann-schemes.com**
  Compatibility list: **www.vitocontrol.info**

Vitocontrol 200-M
- For the operation of customer-specific multi mode energy systems with any number of heat generators in various combinations, as well as cooling, solar, ventilation and electricity components. Solutions are based on a modular system and can be flexibly extended with new functions and process applications. Connection to ViScada for web-based system visualisation is available as an option. This requires an internet connection.

Boiler accessories

See pricelist and "Boiler accessories" datasheet.

Operating conditions with Vitotronic boiler control units

For water quality requirements, see the technical guide to this boiler

		Requirements	
Operation with burner load		**≥ 60 %**	**< 60 %**
1.	Heating water flow rate	None	
2.	Boiler return temperature (minimum value)	– Oil operation 40 ºC – Gas operation 53 ºC	– Oil operation 53 ºC – Gas operation 58 ºC
3.	Lower boiler water temperature	– Oil operation 50 ºC – Gas operation 60 ºC	– Oil operation 60 ºC – Gas operation 65 ºC
4.	2-stage burner operation	Stage 1: 60 % of rated heating output	No minimum load required
5.	Modulating burner operation	Between 60 and 100 % of rated heating output	No minimum load required
6.	Reduced mode	Single boiler systems and lead boiler in multi boiler systems – Operation with lower boiler water temperature Lag boilers in multi boiler systems – Can be shut down	
7.	Weekend setback	As per reduced mode	

System examples
Available system examples: See ***www.viessmann-schemes.com****.*

Notes

Permissible flow temperatures

Hot water boiler for permiss. flow temperatures (= safety temperatures)

- Up to 110 °C
  CE designation:
  CE-0085 complying with the Gas Appliances Regulation

Notes (cont.)

Further planning information

See the technical guide to this boiler.

Tested quality

CE designation according to current EC Directives

Subject to technical modifications.

Represented by

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Hortonwood 30
TF1 7YP Telford
Telephone: +441952 675000
Telefax: +441952 675040
www.viessmann.co.uk

Manufacturer

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15749 Mittenwalde / Germany
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www.viessmann.com

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Appendix F Extract from BUU technical offer

I. YOUR PROJECT

A. INPUT DATA

Proposed Equipment and services are designed on the base of the following data:

- Project and Installation site data
- Inlet gas characteristics
- Outlet gas specifications

PRODEVAL will use the data indicated in the paragraph below as a basis for designing the Equipment. In this framework, the Client acknowledges that the data and information provided are of utmost importance for PRODEVAL to enable the latter to duly perform its tasks, as described therein.

1. Project data

Description	
Project Name	Request for quotation - UK - 906 Nm^3/h Rawbiogas dry
Project Type	/
Localisation du site	UK
Injection pressure on the network (Network Manager)	8 to 14 barg
Biomethane in the offgas	< 1 %
Implementation constraints	No particular space constraints
Environmental conditions	The environmental conditions of the installation site, considered for the design, are the following: § Ambient temperature: -10°C to 40 ° C § Humidity (average): 70%

2. Biogas characteristics

	Min	Nom	Max
Dry Flow Phase 1 (Nm3/h)	400	906	1030
Dry Flow Phase 2(Nm3/h)	400	1200	1380

Bio raw gas	Unit	Value		
		min.	Average	max.
Source	-	Food Waste Soup (EcoSus)		
CH_4	Vol.%	50	59	65
CO_2	Vol.%	35	46	49
H_2O	Vol.%		100 % water vapour saturated at the respective temperature	
O_2	Vol.%	0,0		0,2
N_2	Vol.%	0	0,4	0,8
H_2S	Vppm	10	100	500
NH_3	Vppm			<1
Pressure[a]	mbar(g)	-15 [b]	2	5
Temperature	°C	10	35	40

3. Biomethane specifications

The biomethane at the outlet of the Equipment must meet the following technical specifications equivalent to :

Appendix A: Network Entry Specification from Gas Network Operator

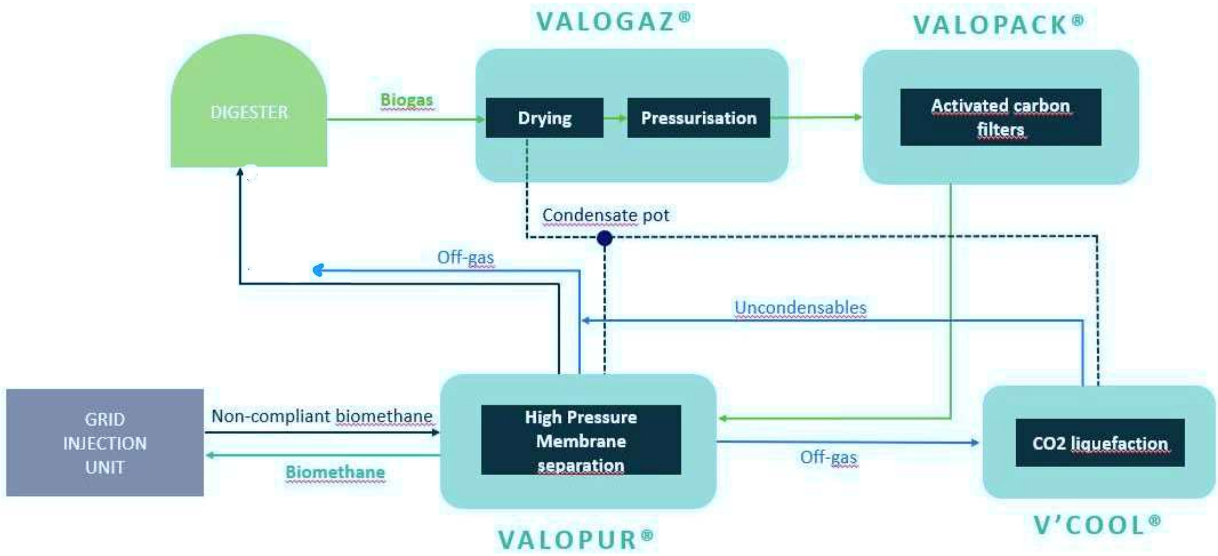
Description	Units	Acceptable Range	Uncertainty	Limit	Determined /derived by:
Calorific Value	MJ/m^3	35 to 44	+/- 0.2	CV Target	NEA
Wobbe index	MJ/m^3	45 to 54	+/- 0.1	47.2 to 51.41	GSMR
Soot index	-	0 to 1	+/- 0.02	0.6 max	GSMR
Incomplete combustion factor	-	-3 to 2	+/- 0.02	0.48 max	GSMR
H_2S	mg/m^3	0 to 10	+/- 0.1	5	GSMR
Water dewpoint 7bar or below	°C	20 to -100	+/- 2.0	-10 @ 7 Bar	LRS/GL equation of state
Water dewpoint above 7bar	°C	20 to -100	+/- 2.0	-10 @ MOP	LRS/GL equation of state
Hydrocarbon dewpoint	°C	20 to -100	+/- 2.0	Not more than -2 at any pressure up to 85 bar g'	GSMR
O2	mol%	0 to 2.5	+/- 0.01	1.0	GSMR
Total sulphur content	mg/m^3	0 to 60	+/-	50	GSMR
Hydrogen (H2)	mol %	TBA	+/-	0.1	GSMR
Pressure	Bar	Site dependent	+/- 1%		NEA
Temperature	°C	0 to 20 Deg C	+/- 1.0	TBA	NEA
Flow	sm^3/hr	Site dependent	+/- 1%		NEA
Carbon dioxide	mol %	0 to 7	+/- 0.1	2.5	NEA
Methane	mol%	78 to 100	+/- 0.1	TBA	NEA
Propane	mol%	0 to 7	+/- 0.1	TBA	NEA
Odorant concentration	mg/m^3	2 to 18 7.0 (operating)	+/- 0.1	TBA	NEA

B. PROPOSED SOLUTION

The process developed by PRODEVAL involves different stages of treatment and recovery of biogas to arrive at the production of biomethane. This solution has been designed to maximize the efficiency of the installation, both in terms of capacity (installation availability) and recovery efficiency.

The solution is composed of the following Equipment:

- VALOGAZ
- VALOPACK
- VALOPUR®
- Biogenic CO_2 liquefaction (not included)



3.

TECHNICAL PROPOSAL

III. TECHNICAL PROPOSAL

A. TECHNICAL DATA

1. Mass balance

The operating data of the equipment depends on the flow rate and composition of the raw biogas. The performance of the Equipment is given for the biogas conditions specified in the *Section 1 Paragraph A Project data.*

	MASS BALANCE			
	Basic offer		Upgrade	
	NOM	MAX	NOM	MAX
BIOGAS				
Nominal dry biogas flow rate	906 Nm3/h	1 030 Nm3/h	1 200 Nm3/h	1 380 Nm3/h
Nominal flow of wet biogas	945 Nm3/h	1 074 Nm3/h	1 251 Nm3/h	1 439 Nm3/h
% CH4 biogas dryer outlet	59,0%	59,0%	59,0%	59,0%
% CO2 biogas dryer outlet	40,5%	40,5%	40,5%	40,5%
% O2 biogas dryer outlet	0,1%	0,1%	0,1%	0,1%
% N2 biogas dryer outlet	0,4%	0,4%	0,4%	0,4%
BIOMETHANE				
% CH4 biomethane	97,95%	98,00%	98,03%	98,03%
Biomethane flow rate	543 Nm3/h	617 Nm3/h	719 Nm3/h	826 Nm3/h
OFFGAZ				
% CH4 off-gas	0,74%	0,73%	0,73%	0,73%
Off-gas flow rate	364 Nm3/h	414 Nm3/h	482 Nm3/h	554 Nm3/h
Purification efficiency	99,5%	99,5%	99,5%	99,5%

2. Installed power supply.

ITEMS	RANGE	Installed power	EQUIPMENTS ELECTRICAL CONSUMPTION Basic offer	
			NOM	**MAX**
VALOGAZ®: Drying and over-pressurization	VGAZ_08	113 kW	28,5 kW	31,2 kW
VALOPUR®: Membrane biogas upgrading unit	VPUR_06	10 kW	1,9 kW	1,9 kW
BIOGAS COMPRESSION	2xUVG200	605 kW	217,6 kW	269,8 kW
	TOTAL	728 kW	**248 kW**	**303 kW**
		TOTAL in Kwh/Nm³ of wet biogas	0,268 kWh/ Nm³	0,288 kWh/ Nm³

3. Expected Performances

a) Pretreatment and upgrading

	Expected value(s)
Expected specific electrical consumption (*)	0,28 kWh/ Nm3 of processed raw biogas
Expected activated carbon consumption (nominal pollutant composition)	7,19 T/year
Change of one tank every…	3,29 month(s)

(*) Calculated at:

- compressor nominal flow rate
- Biogas inlet temperature: 30 °C
- Ambient medium annual temperature: 15°C

The specific electrical consumption does not include the electrical consumption of the frost protection or cooling devices following meteorological conditions.

4. Noise emission

	Noise emission
2xUVG200	83 dB @ 1m *(excluding silencer option)*

5. Product certification

The Equipment is CE certified.

Appendix G Biofilter (A1) monitoring results

REPORT

Biofilter, odour and trace gas testing at Eco Sustainable Solutions, Parley

Client:
Eco Sustainable Solutions

Report Number:
ECSS24A_01_Draft

Project Code:
ECSS24A

title:	Biofilter, odour and trace gas testing at Eco Sustainable Solutions, Parley
report number:	ECSS24A_03_Draft
project code:	ECSS24A
client:	Eco Sustainable Solutions Chaple Lane, Parley, Christchurch Dorset, BH23 6BG 01202 597355 jamie.williams@thisiseco.co.uk
contact:	Jamie Williams
contractor:	Olfasense UK Ltd Unit 6 & 7 Anglo Office Park Bristol BS15 1NT 01225 868869 phone Companies House Cardiff 2900894 uk@olfasense.com
authors:	J Gardner-Medwin
approved:	on behalf of Olfasense UK Ltd by Louise Warren, Principal Consultant
date:	September 02, 2024
copyright:	©2024, Olfasense UK Ltd

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1 Introduction and Scope

1.1 Introduction

Eco Sustainable Solutions Ltd commissioned Olfasense UK Ltd to undertake emissions monitoring of the A2 biofilter which serves the waste reception barn at their waste management facility in Parley, Dorset. The unit comprises 2 No. separate inlet streams which combine in the plenum of the open woodchip biofilter prior to treatment and release. The testing is required under a permit variation for the site (EPR/GP3793FY).

Monitoring is required every 6 months. This report summarises the results of Visit 1 of the 2024 emissions monitoring campaign, undertaken in August 2024. An MCERTS monitoring report, in the format prescribed by the Environment Agency, is provided separately for the data collected under MCERTS certified sampling procedures.

This report also presents the findings of the biofilter media health and airflow assessment.

1.2 Scope

The full scope of testing required within the permit is summarised in Tables 1 and 2 below.

Table 1: Emission monitoring as specified in Table 3.1 of the permit

Emission point	Parameter	Limit	Monitoring frequency	Monitoring standard or method
OUTLET of A2 (biofilter serving waste reception barn)	Hydrogen sulphide	No limit set	6 months	CEN TS 13649 for sampling NIOSH 6013 for analysis
	Ammonia	No limit set	6 months	EN ISO 21877
	Odour	1,000 ou_E/Nm^3	6 months	BS EN 13725

Table 2: Process monitoring as specified in table 3.7 of the permit

Emission point	Parameter	Monitoring frequency	Monitoring standard or method
A2 (biofilter serving waste reception barn)	Odour (inlet)	6 months or as agreed in writing by the EA	BS EN 13725
	Hydrogen sulphide (inlet and outlet)	6 months	Outlet CEN TS 13649/NIOSH 6013 Inlet as agreed in the OMP
	Ammonia (inlet and outlet)	6 months	Outlet EN ISO 21877 Inlet as agreed in the OMP
	Media health, airflow distribution and emission removal efficiency	Annual	BS EN 13725 for odour removal

1.3 Sampling schedule

The sampling schedule for Visit 1 of the 2024 monitoring campaign is summarised in Table 3 below. A number of deviations from the methods specified in the permit were required, due to operational conditions, and these are summarised in Section 1.4 below.

Table 3: Sampling schedule – Visit 1, 2024

Odour control unit	Sampling location	Measurement parameter and No. of samples				
		Odour	Hydrogen sulphide (H_2S)	Ammonia (NH_3)	Volumetric flow & temperature	Media health
A2 Biofilter (serving waste reception hall)	Biofilter inlet 1	3	3	3	✓	✓
	Biofilter inlet 2	3	3	3	✓	
	Biofilter outlet	3	3	3	✓	
Total		9	9	9	-	-

1.4 Sampling and analysis techniques

The monitoring methods used for each measurement parameter and the respective accreditation status held by Olfasense UK Ltd are summarised in Table 4 below.

Table 4: Sampling techniques, reference methods and accreditations

Analyte	Reference method	Accreditation status	Replicates per location
Odour sample collection	BS EN 13725: 2022	MCERTS – ducts UKAS – open biofilter	3 per inlet (two inlets) 3 at biofilter outlet
Odour sample analysis	BS EN 13725: 2022	UKAS	3 per inlet (two inlets) 3 at biofilter outlet
Volumetric flow & temperature	BS EN 16911-1: 2013	MCERTS – ducts	1 per inlet (two inlets)
H_2S sampling	PD CEN TS 13649: 2014	MCERTS – ducts UKAS – open biofilter	1 per inlet (two inlets) 1 at biofilter outlet
H_2S analysis	NIOSH 6013: 1994	Accreditation not available[1]	
Ammonia sampling	NIOSH 6016: 1996	UKAS - ducts UKAS – open biofilter	1 per inlet (two inlets) 1 on biofilter outlet
Ammonia analysis	NIOSH 6016:1996	UKAS	
Microbial health (biofilter media/chemical analysis[2])	EA TGN M9 / AFOR EA TGN M8 & M17	Accreditation not available	1
Biofilter airflow distribution	BS EN 13725: 2022 & BS EN ISO 16911-1: 2013	UKAS	10 locations on biofilter surface

[1] Hydrogen sulphide analysis was conducted by a non-UKAS accredited laboratory as UKAS accreditation is not currently available for this analyte. Accreditation cannot therefore be claimed for the overall Hydrogen sulphide result.
[2] Includes Total viable count of aerobic and anaerobic bacteria (cfu/g), Nitrate expressed as NO_3-N (mg/l), Dry matter (%), Ammonium as NH_4 N (mg/l), pH, Electrical conductivity (µs/cm)

Sampling and analysis was conducted in-house by Olfasense UK Ltd with the exception of the following:

- Hydrogen sulphide analysis was undertaken by RPS Laboratories.
- Biofilter media analysis was undertaken by Eurofins/Eurofins Agro Testing UK Ltd.

The following deviations from the methods specified in the permit were required:

- Monitoring methods for open biofilters are not included within the MCERTS scheme. Sampling of the emissions from the biofilter outlet was therefore undertaken using UKAS accredited methods (rather than MCERTS). As such, ammonia monitoring will be conducted to NIOSH 6016 (rather than EN ISO 21877).
- Hydrogen sulphide analysis was conducted to NIOSH 6013 by a non UKAS accredited laboratory because UKAS accreditation is not currently available for this analyte.

1.5 Quality Control and Assurance

Olfasense's odour measurement, assessment and consultancy services are conducted to the highest possible quality criteria by highly trained and experienced specialist staff. All activities are conducted in accordance with quality management procedures that are certified to ISO 9001 (Certificate No. A13725).

All sensory odour analysis and odour sampling services are undertaken using UKAS accredited procedures (UKAS Testing Laboratory No. 2430) which comply fully with the requirements of the international quality standard ISO 17025:2017[3] and the European standard for olfactometry BS EN 13725:2022[4]. Olfasense is the only company in the UK to have secured UKAS accreditation for all elements of the odour measurement and analysis procedure. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The Olfasense laboratory is recognised as one of the foremost laboratories in Europe, consistently out performing the requirements of the British Standard for Olfactometry in terms of accuracy and repeatability of analysis results.

[3] ISO 17025:2017 – *General requirements for the competence of testing and calibration laboratories.*
[4] BS EN 13725:2022 – *Stationary source emissions. Determination of odour concentration by dynamic olfactometry and odour emission rate.*

2 Monitoring results and discussion

2.1 Emissions monitoring results

The results of the monitoring undertaken on the 6th of August 2024 are summarised in Table 5 below. MCERTS monitoring reports, in the prescribed format required by the Environment Agency, are provided separately for those elements of the monitoring which fall under the MCERTS scheme. Process conditions during testing were normal.

Table 5: Measurement results

Monitoring location	Odour conc. [ou_E/m^3]	Airflow [Nm^3/s] 293K[5]	Temperature [°C]	Odour emission [ou_E/s]	H_2S conc. [mg/m^3]	NH_3 conc. [mg/m^3]
Biofilter inlet 1	1,003	2.9	29.1	2,909	<0.15	0.05
Biofilter inlet 2	511	2.5	24.1	1,278	<0.15	0.046
Combined inlet	775*	5.4**	-	4185	<0.15*	0.048*
Biofilter outlet	809	5.4**	22.4	4369	<0.15	0.007

*The combined inlet odour and trace gas concentrations have been calculated using the the respective inlet 1 and inlet 2 emission rates and airflow values.
**The combined inlet and biofilter outlet airflow has been calculated by combining the inlet 1 and inlet 2 volume flow rates. The outlet airflow is assumed to be the same as the inlet airflow, assuming that all incoming air passes through the biofilter media.

2.2 Abatement efficiency

The abatement efficiencies for odour, hydrogen sulphide and ammonia are presented in Table 6 below.

Table 6: Abatement efficiencies

Monitoring location	Odour		Hydrogen sulphide		Ammonia	
	Odour conc. [ou_E/m^3]	Abatement [%]	H_2S conc. [mg/m^3]	Abatement [%]	NH_3 conc. [mg/m^3]	Abatement [%]
Combined biofilter inlet	775	-4%	<0.15	-%*	0.048	85%
Biofilter outlet	809		<0.15		0.007	

*No abatement efficiency could be calculated for hydrogen sulphide as the measured values were <LLOD in all measured locations.

2.3 Discussion of emissions monitoring results

At the time of testing, the odour concentration results indicate that the A2 biofilter was not achieving any abatement of odour, as the odour concentration measured at the inlet and outlet of the biofilter was comparable. However, the character of the odour at the outlet of the biofilter was described as 'woody' and 'earthy', rather than 'waste' which indicates that the biofilter is

[5] Volumetric airflow standardised, for odour, to 293K & 101.3kPa, wet basis.

successfully abating at least some of the waste processing odours. Odours emitted from the biofilter outlet are likely to be, at least in part, due to the wood-based biofilter media.

The odour concentration at the outlet of the biofilter (809 ou_E/m^3) was below the limit value specified in the permit variation (1,000 ou_E/m^3). It should be borne in mind that this is likely to be in part due to the low odour load presented to the biofilter at the time of testing, and under higher loading conditions the biofilter outlet may exceed the emission limit value.

The hydrogen sulphide concentration was below the limit of detection of the analytical technique in both the inlet and outlet airstreams. Ammonia was detectable, but at a low concentration in the inlet airstream, and showed good abatement by the biofilter (85%).

2.4 Biofilter media analysis results

The criteria used during this study for assessing biofilter media health are summarised in the table below.[6]

Table 7: Criteria for assessing biofilter media health

Parameter	Optimal operation	Intermediate operation	Poor operation
Electrical conductivity (µs/cm)	<1000	1000-3000	>3000
Dry matter (%)	25-40	20-25 and 40-50	<20 and >50
pH	6-8	5-6 and 8-9	<5 and >9
$NH_4^+ + NO_2 + NO_3$ (mg/l)	250 - 3500	3500 – 5000 and 150 – 250	>5000 and <150

The results of the biofilter media analysis are summarised in Table 8 below.

Table 8: Criteria for assessing biofilter media health

Parameter	A2 biofilter media result
Total viable count of aerobic bacteria (cfu/g)	1,030,000
Total viable count of anaerobic bacteria (cfu/g)	630,000
Nitrate expressed as NO_3 (mg/l)	63.9
Nitrite as NO_2 (mg/l)	<0.1
Ammonium as NH_4 (mg/l)	<0.05
Total ammonium, nitrite and nitrate ($NH_4^+ + NO_2 + NO_3$) (mg/l)	64.05
Dry matter (%)	26.7
pH	6.6
Electrical conductivity (µs/cm)	68.0

2.5 Biofilter airflow survey and visual inspection results

The results of the biofilter airflow monitoring are summarised in the table below. Additional airflow information is presented in the Annex for reference.

[6] Criteria for assessing biofilter media health taken from Sniffer Report – Project Number ER36: Understanding biofilter performance and determining emission concentrations under operational conditions, LA Fletcher, N Jones, L Warren, EI Stentiford, June 2014

Table 9: Biofilter airflow monitoring

Parameter	Biofilter media result
Average airflow velocity across biofilter surface (m/s)	0.727
Velocity range across biofilter surface (m/s)	0.54 – 1.06
Average airflow temperature (ºC)	20.0
Average humidity (%)	92.4

Table 10 below presents the minimum, maximum and average airflow rate based on the flow survey undertaken at 10 No. equally spaced points across the biofilter surface.

Table 10: Biofilter airflow survey results

Number of measurement points	Minimum airflow [m/s]	Maximum airflow [m/s]	Average airflow [m/s]
10	0.539	1.057	0.727

Figure 1 below presents the schematic representation of the 10 No. individual measurement points and their respective location on the biofilter surface.

Figure 1: Biofilter airflow survey results [m/s]

0.539	0.710	0.541	1.057	0.963
0.541	0.587	0.568	1.054	0.715
Building				

A visual inspection of the surface of the biofilter was made and the following specific observations were made:

- The biofilter was comrpised of shredded wood material, and had minor undulations in height across the surface.
- There was no moss or vegetation present on the surface of the biofilter.
- There were no obvious signs of cracking or channelling, and the media surface appeared moist.

2.6 Discussion of biofilter media analysis and airflow results

Review of the data prompts the following observations:

- The biofilter microbial analysis results indicate a healthy bacterial colony is present, with a good concentration of both aerobic and anaerobic bacteria present.
- The biofilter chemical analysis results indicate that the elctrical conductivity, pH and dry matter within the media are within the range expected for optimal operation of a biofilter, indicating that the mechanisms by which bacteria break down odorous compounds are able to operate effectively.

- The total ammonium, nitrite and nitrate levels are below the expected range for optimal operation of a biofilter, the reason for this is unclear. However, the nitrate concentration is higher than the ammonium indicating that the bacteria are processing the ammonium into nitrate so the ammonia cycle is functioning as expected.
- The biofilter airflow survey results indicate that the velocity rate was broadly homogenous across the biofilter surface as the difference between the minimum and maximum airflow recorded was less than a factor of 2. This suggests an even distribution of the media, with no particular areas of compaction or cracking.

3 Summary of findings

The findings of the study can be summarised as follows:

- The odour concentration measured at the inlet and outlet of the biofilter was comparable. However, the character of the odour at the outlet of the biofilter was described as 'woody' and 'earthy', rather than 'waste' which indicates that the biofilter is successfully abating at least some of the waste processing odours presented to it.
- The odour concentration at the outlet of the biofilter (809 ou_E/m^3) was below the limit value specified in the permit variation (1,000 ou_E/m^3). It should be borne in mind that this is likely to be in part due to the low odour load presented to the biofilter at the time of testing, and under higher loading conditions the biofilter outlet may exceed the emission limit value.
- Microbial analysis results indicate a healthy bacterial colony is present in the biofilter. Chemical analysis indicates that the elctrical conductivity, pH and dry matter are within the range expected for optimal operation of a biofilter, indicating that the mechanisms by which bacteria break down odorous compounds are able to operate effectively.
- Overall, the total ammonium, nitrite and nitrate levels are below the expected range for optimal operation of a biofilter. However, review of the individual results indicates that the nitrate concentration is higher than the ammonium, indicating that the bacteria are processing the ammonium into nitrate and that the ammonia cycle is functioning as expected.
- The biofilter airflow survey results indicate that the velocity rate was broadly homogenous across the biofilter surface, suggesting an even distribution of the media, with no particular areas of compaction or cracking.

Annex A: Sampling and analysis techniques

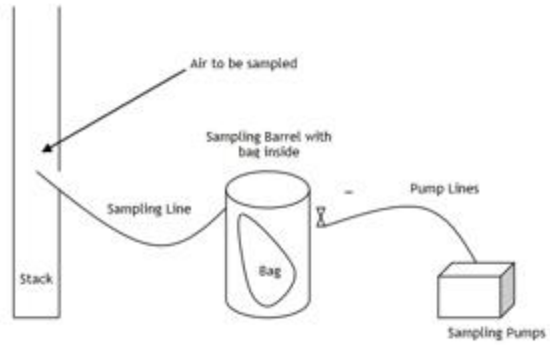
A.1 Sampling techniques

A.1.1 Sample collection for odour analysis

Air samples from each source were collected using standardised techniques based on the European Standard for Olfactometry EN13725[7].

For duct sources, samples were collected using the ‘lung principal’ as illustrated in Figure 2 below.

Figure 2: Sampling from ductwork and enclosed tanks/buildings



A.1.2 Airflow measurement

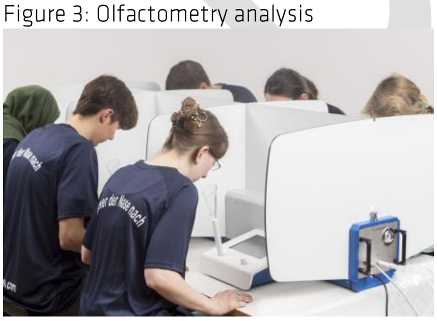
Air flow measurements were conducted using anemometers/pitot tubes in accordance with the standard BS EN ISO 16911[8].

A.2 Analysis Techniques

A.2.1 Odour concentration analysis

Odour analysis was conducted by olfactometry using a state of the art TO-Evolution™ olfactometer in full accordance with the procedures defined in EN13725[9], using 4 to 6 no. qualified and trained odour panellists.

Figure 3: Olfactometry analysis



[7] EN13725: Air Quality: Determination of odour concentration by olfactometry analysis
[8] BS EN ISO 16911:2013. Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts. Part 1: Manual reference method
[9] Analysis will be conducted within 30 hours of sample collection.

A.2.2 Trace gas analysis

Hydrogen sulphide was sampled in accordance with Olfasense's UKAS accredited procedures based on BS EN 13649 PD CEN/TS 13649, subsequent analysis was undertaken by an appropriate external laboratory by ion chromatography conductivity.

Ammonia was sampled in accordance with Olfasense's UKAS accredited procedures based on NIOSH 6016, subsequent analysis was undertaken by an appropriate UKAS accredited laboratory by ion chromatography conductivity.

The following deviations from standard requirements were necessary:

- Hydrogen sulphide analysis was conducted by non-UKAS accredited analysis at an appropriate laboratory, as UKAS accredited analysis is not currently available for this analyte.

Annex B: Airflow measurement non-compliance

Table 7: BS EN 16911 non-compliant points for each measurement location

Measurement point	BS EN 16911 non-compliance points
Biofilter inlet 1	Gas velocity was > 5 m/s.
Biofilter inlet 2	Gas velocity was > 5 m/s.
	Ratio of highest to lowest gas velocities > 3:1.

Annex C: Biofilter airflow data

The figure below summarises the airflow measurements made across the surface of the biofilter. Average velocity (V), average temperature (T), relative humidity (RH) and oxygen (O) measurements were recorded at 10 points across the biofilter surface.

Figure 4: Biofilter airflow measurements

V: 0.54 m/s T: 19.4 °C RH: 81.6 % O: 21.1 %	V: 0.71 m/s T: 19.0 °C RH: 95.8 % O: 21.0 %	V: 0.54 m/s T: 19.7 °C RH: 99.9 % O: 21.0 %	V: 1.06 m/s T: 19.8 °C RH: 99.9 % O: 21.0 %	V: 0.96 m/s T: 19.9 °C RH: 98.6 % O: 21.0 %
V: 0.54 m/s T: 21.0 °C RH: 83.4 % O: 21.0 %	V: 0.59 m/s T: 19.5 °C RH: 73.8 % O: 21.1 %	V: 0.57 m/s T: 20.5 °C RH: 93.2 % O: 21.0 %	V: 1.05 m/s T: 21.2 °C RH: 98.7 % O: 21.0 %	V: 0.72 m/s T: 20.3 °C RH: 98.5 % O: 21.0 %
Building				