Department for Energy Security & Net Zero

GGSS Greenhouse Gas Calculator

User Guide

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Acknowledgements

Prepared by NNFCC Limited on behalf of the Department for Energy Security & Net Zero.

Any enquiries regarding this publication should be sent to us at:
greengassupport@energysecurity.gov.uk

Contents

Introduction

This document is the User Guide for the Biomethane Greenhouse Gas (GHG) Calculator developed by NNFCC for participants of the Green Gas Support Scheme (GGSS).

The calculator is available for reporting the greenhouse gas (GHG) emissions of biomethane injected into the grid, using the 'actual value' method. The Calculator calculates the carbon intensity of biomethane as per the requirements of the GGSS and is aligned with the REDII method for calculating GHG emissions associated with biomethane production through anaerobic digestion (AD).

The GGSS is administered by Ofgem, and Guidance on the Scheme and the GHG Calculation Methodology is available from Ofgem and the Department for Energy Security and Net Zero (DESNZ), respectively.[1 2] DESNZ has also published guidance for calculating fugitive methane emissions as part of the GHG Calculation Methodology.[3]

The GGSS supports new AD developments upgrading biogas to biomethane for grid injection only. As a result, the Calculator is designed to reflect the most common configurations of AD in Great Britain based on existing facilities commissioned under predecessor support schemes and knowledge of planned GGSS developments, with consideration of expected future change and improvement. However, as every AD site is bespoke, in terms of inputs, process and outputs, it will become evident throughout the duration of the scheme that all possible configurations are not represented from the outset. Future modifications may be made to the Calculator to better reflect the GHG impact of the biomethane resulting from less conventional systems, whilst remaining aligned with the method and rules for performing such calculations.

Any modifications should be requested through the commissioning authority, DESNZ, via e-mail to greengassupport@energysecurity.gov.uk.

[1] Green Gas Support Scheme guidance. Published February 2022. Available at: https://www.ofgem.gov.uk/publications/green-gas-support-scheme-guidance
[2] Methods of calculating greenhouse gas emissions. Updated February 2024. Available at: https://www.gov.uk/government/publications/methods-of-calculating-greenhouse-gas-emissions
[3] Guidance for calculating fugitive methane emissions as part of the greenhouse gas criteria on the Green Gas Support Scheme. Published February 2025. Available at: https://www.gov.uk/government/publications/methods-of-calculating-greenhouse-gas-emissions

Glossary

BEES – a reporting template issued by Ofgem, designed to calculate the EHO from the daily values for biomethane injected, propane blended and external heat supplied.

CHP – combined heat and power unit, providing heat and electricity from biogas or other fuels.

CH_4 – Methane, a greenhouse gas.

CO_2 – Carbon dioxide, a greenhouse gas.

CO_2eq – Carbon dioxide equivalents (relating to the global warming potential).

Consignment – collective term for feedstocks or materials with the same sustainability characteristics, as approved by Ofgem on the Fuel, Measurement and Sampling Questionnaire (FMSQ). Consignment examples include maize silage, slurry and food waste.

DM – Dry matter, typically in the context of dry matter content, the percentage of feedstock that is not moisture.

EHO – 'Eligible Heat Output' calculated by gas injected to the grid minus propane blended and any external heat supplied to the biogas production process.

g – grams, a unit of mass.

GHG – greenhouse gas; for the purposes of this calculator, this is carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

GGSS – Green Gas Support Scheme.

kWh – Kilowatt hour, a unit of energy. There are 3.6 MJ in a kWh.

Methane leak – the unintended release of methane regardless of the duration of the release.

Methane slip – in the context of biogas upgrading, slip refers to the release or loss of methane from the upgrading units, typically through the off-gas stream, resulting from inefficiencies in the separation of methane contained in biogas.

m^3 – Cubic meters, a unit of volume.

MJ – Megajoule, a unit of energy. There are 3.6 MJ in a kWh.

N_2O – Nitrous oxide, a greenhouse gas.

Products and co-products – the primary aim of a process, the production of which is deliberately optimised to increase quantity or economic value, with markets other than energy. Co-products will have comparable value to the primary output, financially or in energy.

Residues:

a) Agricultural residues - materials generated during the harvesting of the primary material being sought; they are not a primary aim of the agricultural process.

b) Processing residues - a material that is not the end product(s) that a production process directly seeks to produce; they are not the primary aim of the production process and the process has not been deliberately modified to produce it.

VS – Volatile solids, typically in the context of volatile solids content, the percentage of feedstock that is not moisture or ash/inorganic matter.

Waste – any substance or object that the holder discards or intends or is required to discard.

Calculating emissions

This calculator was developed for calculating greenhouse gas (GHG) emissions associated with biomethane production in compliance with the Green Gas Support Scheme (GGSS). The calculator follows the 'actual value' method for co-digesting biomethane plants, as laid out in the document 'Methods of calculating greenhouse gas emissions'[4]. The actual value method for co-digesting biomethane plants is:

$$E = \sum_{1}^{n} S_n \cdot \left(e_{ec,n} + e_{td,feedstock,n} + e_{l,n} - e_{esca,n}\right) + e_p + e_{td,product} + e_u - e_{ccs} - e_{ccr}$$

Provided the units of $e_{ec,n}$, $e_{td,feedstock}$, e_l and e_{sca} are calculated in gCO_2eq per MJ of biomethane, this equation can also be written as:

$$E = \sum_{1}^{n} S_n \cdot \left(e_{ec,n} + e_{td,feedstock,n} + e_{l,n} - e_{esca,n} + e_p + e_{td,product} + e_u - e_{ccs} - e_{ccr}\right)$$

Where:

E is the total emissions from the production of the biomethane;

n is a feedstock;

S_n is the share of feedstock n based on its biomethane potential;

$e_{ec,n}$ is the emissions from the extraction or cultivation of feedstock[5];

$e_{td,feedstock,n}$ is the emissions from transport of feedstock n to the digester[6];

$e_{l,n}$ is the annualised emissions from carbon-stock changes caused by land use change for feedstock n;

$e_{sca,n}$ is the emission savings from improved agricultural management of feedstock n;

e_p is the emissions from processing[7];

$e_{td,product}$ is the emissions from transport and distribution of biomethane[8];

e_u is the emissions from the fuel in use[9];

[4] DESNZ (2024) Methods of calculating greenhouse gas emissions. Available at https://www.gov.uk/government/publications/methods-of-calculating-greenhouse-gas-emissions

[5] This includes emissions from diesel use in tractors, emissions from the production of fertilisers, in-field nitrous oxide emissions from fertiliser application, emissions from transporting the crop to a silo or other processing point, and emissions (as well as losses) from ensiling or other processing of the crop. In accordance with table 1, this value is 0 for residues and wastes, including manures.

[6] From its point of generation, which may be the silo.

[7] Which includes anaerobic digestion and biogas upgrading.

[8] Which is zero in GGSS as the end distance travelled by the biomethane is not known.

[9] Which is zero in GGSS as the end use is not known.

e_{ccs} is the emission savings from carbon capture and geological storage; and

e_{ccr} is the emission savings from carbon capture and replacement.

Rewriting the equation allows GHG emissions to be calculated for biomethane from each feedstock, which must also be reported under the GGSS along with the carbon intensity of biomethane injected, expressed as gCO_2eq per MJ of biomethane.

The implementation of the equation in the tool

For each feedstock, each of these *e* factors (representing the pathway emissions) is laid out in the Summary worksheet in columns C to K.

Products - Biomethane Pathway Emissions ($gCO2eq/MJ_{biomethane}$*)										
Consignment	e_{ec}	$e_{td,feedstock}$	e_l	e_{sca}	e_p	$e_{td,product}$	e_u	e_{ccs}	e_{ccr}	Total

Figure 1: Header of a table in the Summary worksheet, showing pathway emissions for biomethane generated from feedstocks classified as products.

Each of these values is automatically calculated based on data entered in the subsequent worksheets, from Feedstocks through to Carbon Capture.

Figure 2: Worksheets in the GGSS Carbon Calculator.

The share of each feedstock, S_n (expressed as % of biogas output), is calculated in column P on the Summary worksheet. This is based on the theoretical biomethane yield of each feedstock, as well as the volumes used, as entered in the Feedstocks worksheet. The pathway emissions for each feedstock are multiplied by the share of each feedstock S_n, to generate a weighted emissions value in column W. These are summed to generate the total emissions, E, in cell W27. This total emissions value must be less than 24 gCO_2eq per MJ biomethane injected in order for biomethane generated in a given quarter to be eligible for GGSS support. Pathway emissions for each consignment, shown in column T, should also be reported; however, there is no ceiling for the GHG emissions values associated with individual feedstocks.

Data Gathering

Before using the tool, all data required for the calculations should be gathered. It is important to note that this data will be required for the annual sustainability audit and may be required for other audit purposes at a later date. Evidence (e.g. dated photos of meter readings, records of feedstock transactions, laboratory reports) for the data will also be required as part of the periodic submissions to Ofgem and should also be made available for the annual audit.

Data to be routinely gathered for the purpose of undertaking the GHG calculations includes:

- Feedstock tonnages, by consignment, per quarter
- Feedstock characteristics, by consignment, including dry matter (DM) %, volatile solids (VS) % and biomethane yield (Nm3/tonne VS)
- Biomethane injected to grid (minus propane blended), per quarter
- Quarterly meter readings for any heat and electricity generated (e.g. CHP and/or boiler outputs)
- Quarterly meter readings for any exported heat or electricity from biogas
- Quarterly meter readings for any imported electricity (e.g. grid)
- Quarterly data on imported fuel use (e.g. natural gas, imported biomethane, LNG, LPG or diesel), such as required for boilers, CHPs or emergency generators
- Digestate production tonnage, per quarter, and dry matter content (%)
- Cultivation, transport and conversion inputs – feedstock dependent (further detail below)

Although it is not needed for GHG reporting, other elements of sustainability reporting require land-use evidence for feedstocks classified as products or co-products, as well as for agricultural residues.

Note that while quarterly data is required for the reporting, it is good practice to record data on at least a monthly basis.

Using the tool – saving the GHG calculator

The Excel-based GHG calculator should be downloaded and saved locally. When the file is opened you must click ‘Enable Editing’.

Before any data is modified in the tool, it is advised to save a copy with a new name, such as [ADsitename]_Y1Q1.xlsx.

Overview of the GHG calculator

A colour code is used in the tool, as shown in Figure 3.

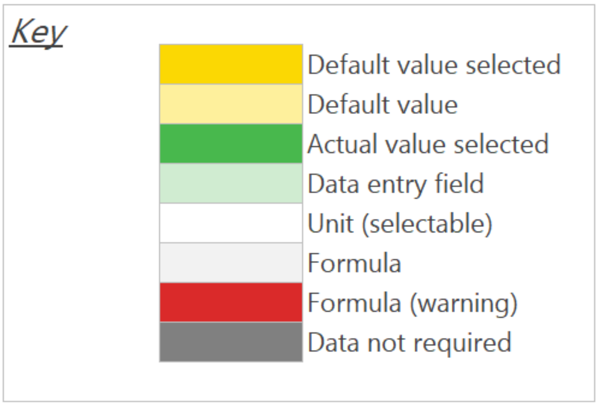
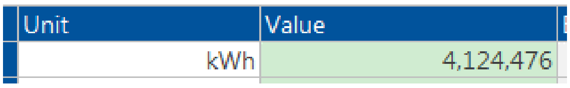


Figure 3: Colour coding used throughout the Excel tool.

In the Calculator, boxes formatted light green are where user input is required, as illustrated below in Figure 4.



Unit	Value
kWh	4,124,476

Figure 4: Example of a light green input box.

In addition, error messages may appear in some areas, asking the user to insert data, as illustrated in Figure 5. This is particularly for areas where the calculator will return an error if no data or erroneous data is entered.

Figure 5: Example of an error box.

In some areas of the calculator, answers can only be selected from a drop-down menu.

The Calculator should be used by working through the worksheets from left to right, i.e. starting at the Feedstocks worksheet and proceeding to the Cultivation and Harvesting worksheet. However, not all worksheets will be necessary for all sites or all feedstocks.

Calculating the share of feedstocks

All sites use feedstocks, so all sites should complete the *Feedstocks* worksheet with information on the feedstocks used in the relevant reporting period.

Feedstocks worksheet

The GHG reporting requirements depend on the feedstock category. As a result of these different requirements, the Calculator has five tables (see Figure 6) for data entry in the Feedstocks worksheet:

- **Products and co-products (rows 11 to 20).** When using products and co-products, GHG reporting must cover the full supply chain, from cultivation to biogas upgrading.
- **Residues (rows 24 to 38).** When using residues, it is usually not possible to determine the emissions associated with their generation, so emissions are only counted from the point of collection.
- **Wastes (excluding manures) (rows 42 to 66).** When using wastes, it is usually not possible to determine the emissions associated with their generation, so emissions are only counted from the point of collection.
- **Manures (rows 70 to 74).** Manures are wastes, but as their use is associated with a carbon credit they are handled separately in this section of the carbon calculator.
- **Ineligible for GGSS (rows 78 to 82).** Feedstocks may be ineligible for GGSS, i.e. if they fall outside the definition of sustainable biomethane listed in the GGSS Regulations (i.e. liquid non-wastes); these feedstocks should be accounted for in the GGSS-ineligible feedstocks section of the feedstock worksheet.

The category of each feedstock must be approved by Ofgem on each site’s Fuel Measurement and Sampling Questionnaire (FMSQ). See Annex A for more information. Please note that manures, although categorised as wastes in the FMSQ, should be entered in the manures section (rows 70 to 74) in order to take advantage of the manure credit.

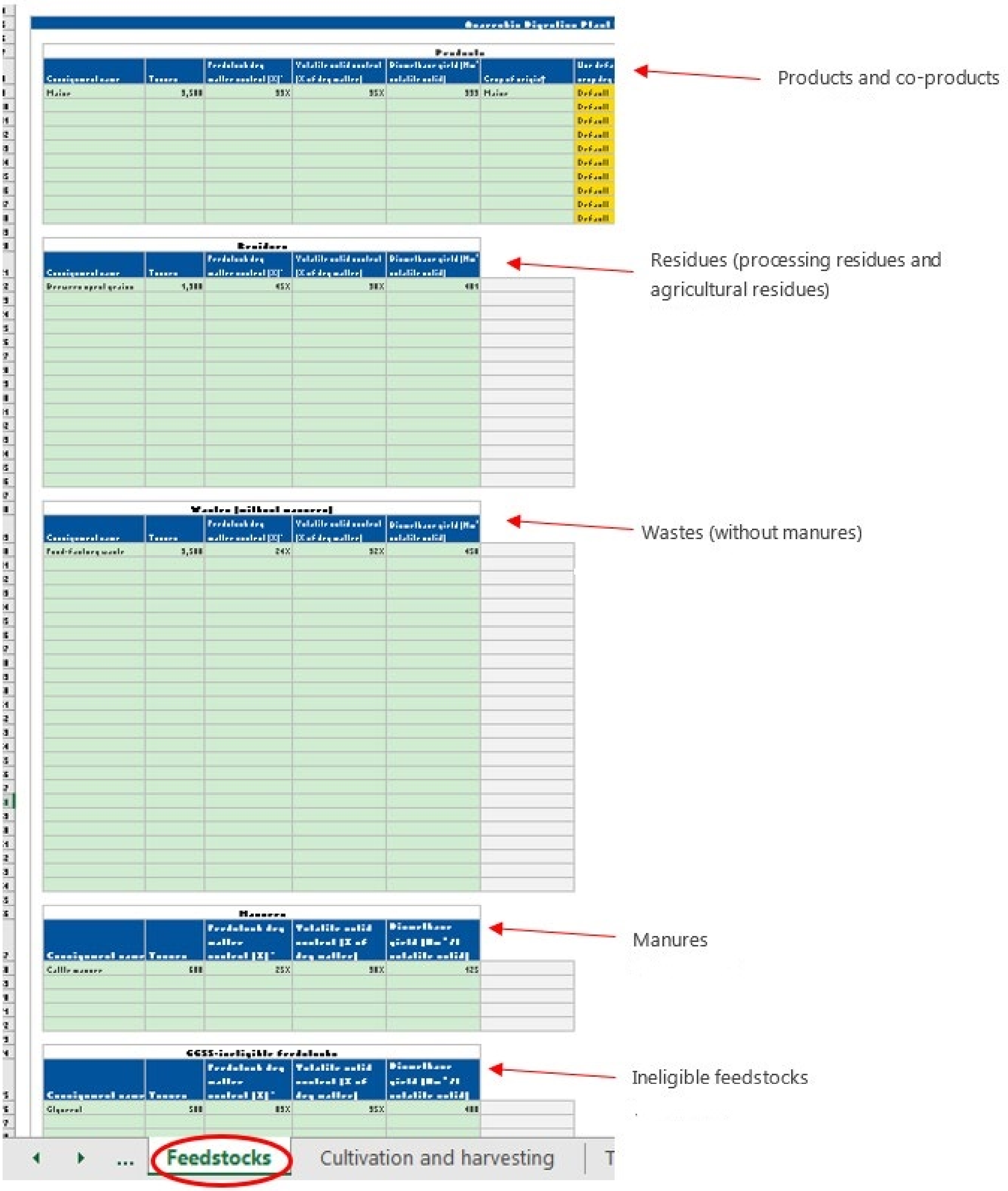


Figure 6: Zoomed out view of the Feedstocks worksheet showing the five categories of feedstock: products, residues, waste, manures and ineligible feedstocks. See Figure 7 for a closer look.

Entering feedstock data

Feedstock (i.e. ‘consignment’) names should be entered in column C in the relevant category, along with the tonnes used (in the relevant reporting period) in column D. See Figure 7.

The Feedstocks worksheet is designed to accommodate feedstocks where the following characteristics are known:

- Dry matter content (DM) as a % (to be entered in column E)
- Volatile solids content (VS) as a % of DM (to be entered in column F)
    - Please note that some laboratories and literature sources give this as a % of the fresh weight. In this case, it should be converted to % of DM
- Biomethane yield (also called biomethane potential, BMP, or specific methane yield, SMY) in Nm^3/tVS (to be entered in column G)

However, if feedstocks are used where the biomethane potential is known per tonne of fresh biomass or per tonne dry matter but not per tonne of volatile solids (VS), this can be accommodated in the tool by entering 100% for VS and, if applicable, DM. See Annex B for more information on feedstock characteristics and worked examples.

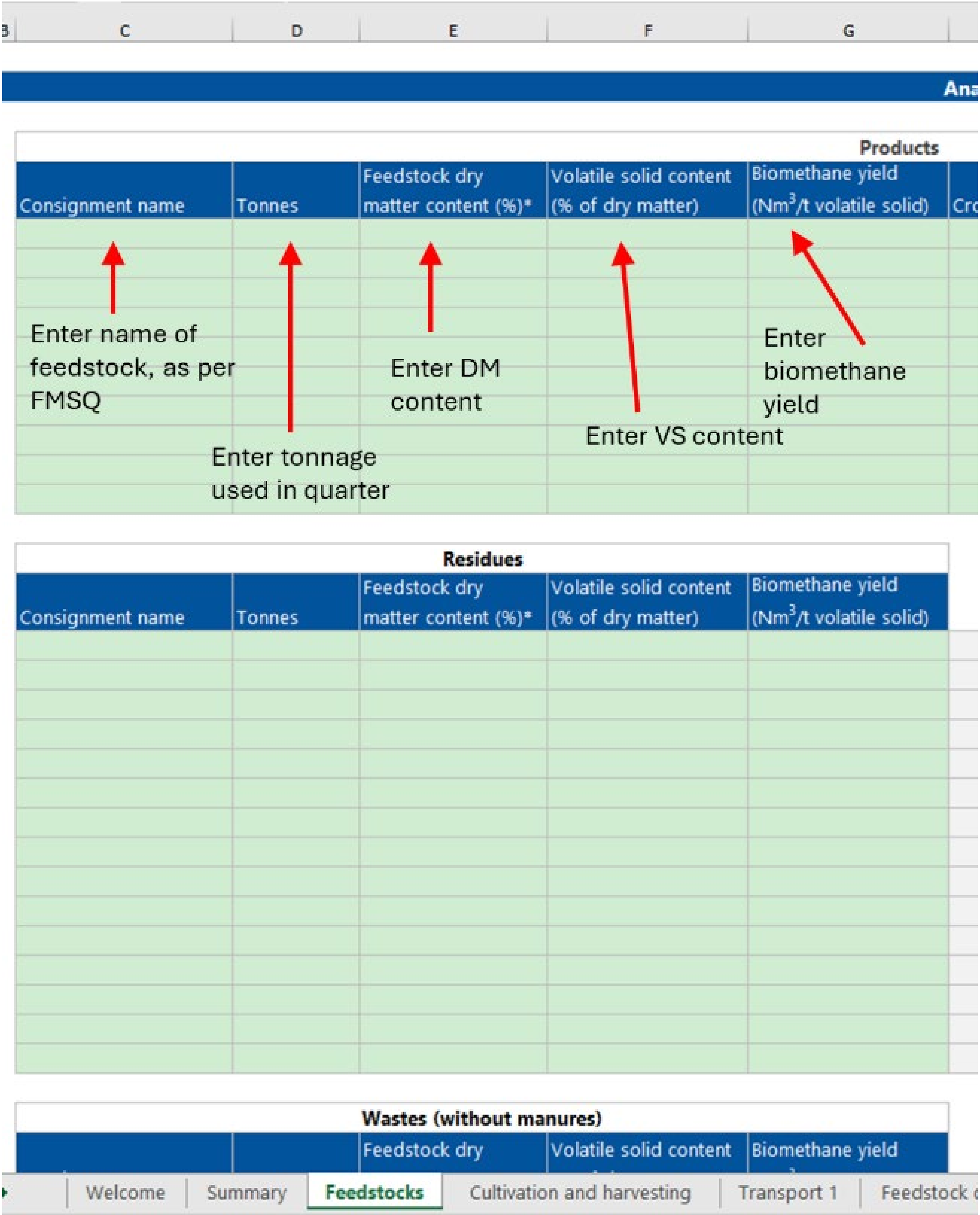


Figure 7: Closer look at the data-entry section of the Feedstocks worksheet, with arrows showing the data entry requirements in the 'Products' table. For residues, wastes, manures and ineligible feedstocks, the same information should be entered in the respective tables.

In addition, for products, the crop of origin should be selected and the crop DM % can be toggled between actual and default (Figure 8). Where the crop is not available for selection, ‘Other’ should be selected; in this case, the crop dry matter must be toggled to ‘Actual’.

The crop DM represents the DM at the time of harvest, as opposed to the DM after ensiling. This number is essential as part of the calculations for emissions from crop cultivation.

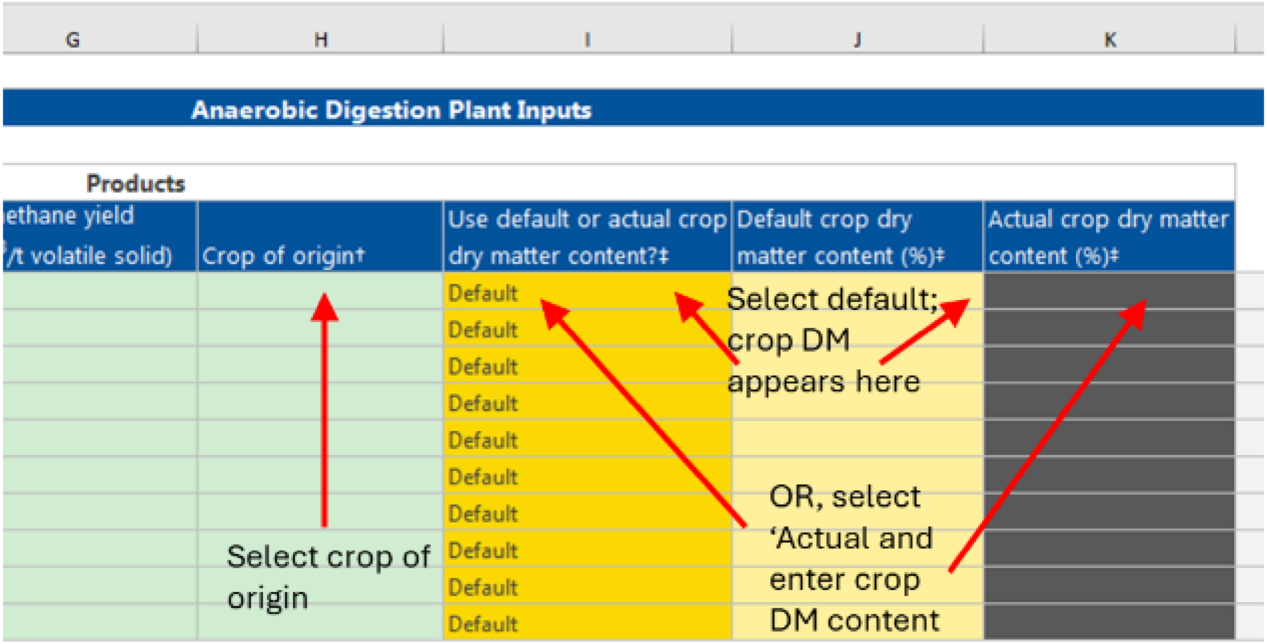


Figure 8: For products and co-products, additional information must be provided.

If laboratory data for a feedstock is unavailable, the calculator has a default look up tool (Figure 9) with a drop-down menu (for a limited number of feedstocks). Select from the list available and the default values on file for that feedstock will show and can then be copied into the correct box.

	Default value look-up			
	Feedstock	Feedstock dry matter content (%)	Volatile solid content (% of dry matter)	Biomethane yield (Nm³/t volatile solid)
Non-wastes	Maize silage	33%	95%	340
Wastes	Food waste	24%	92%	450

Figure 9: Table in the Feedstocks worksheet, allowing a limited number of feedstock default values to be looked up.

Emissions from extraction and cultivation, e_{ec}

Cultivation and harvesting worksheet

Moving along to the next worksheet, *Cultivation and harvesting*, emissions from the cultivation and harvesting step will be calculated.

This section only applies to products, as residues and wastes do not report any emissions until the point of their collection. Each of the products that has been listed on the Feedstocks worksheet will have their own data entry box. In the example below, maize has been listed as a product used, therefore data on maize cultivation should be entered.

Cultivation emissions should be given for every product feedstock.

Scroll down in the Cultivation and harvesting worksheet to see the next feedstock.

Conservative default values are available for a number of feedstocks, which can be selected from the drop-down menu.

For example, Figure 10 shows two feedstocks classified as ‘products’, maize and grass silage, made from the respective crops maize and silage grass, as seen in the Feedstock worksheet.

			Products			
Consignment name	Tonnes	Feedstock dry matter content (%)*	Volatile solid content (% of dry matter)	Biomethane yield (Nm^3/t volatile solid)	Crop of origin†	U cr
Maize silage	3,500	33%	95%	399	Maize	De
Grass silage	700	35%	90%	310	Silage grass	De
						De
						De
						De
						De
						De
						De
						De
						De

Figure 10: Two example entries (maize silage and grass silage) in the ‘Products’ table of the Feedstocks worksheet.

On the Cultivation and harvesting worksheet, the user has loaded default values for maize using cell D13 and default values for grass using D113 (Figure 11).

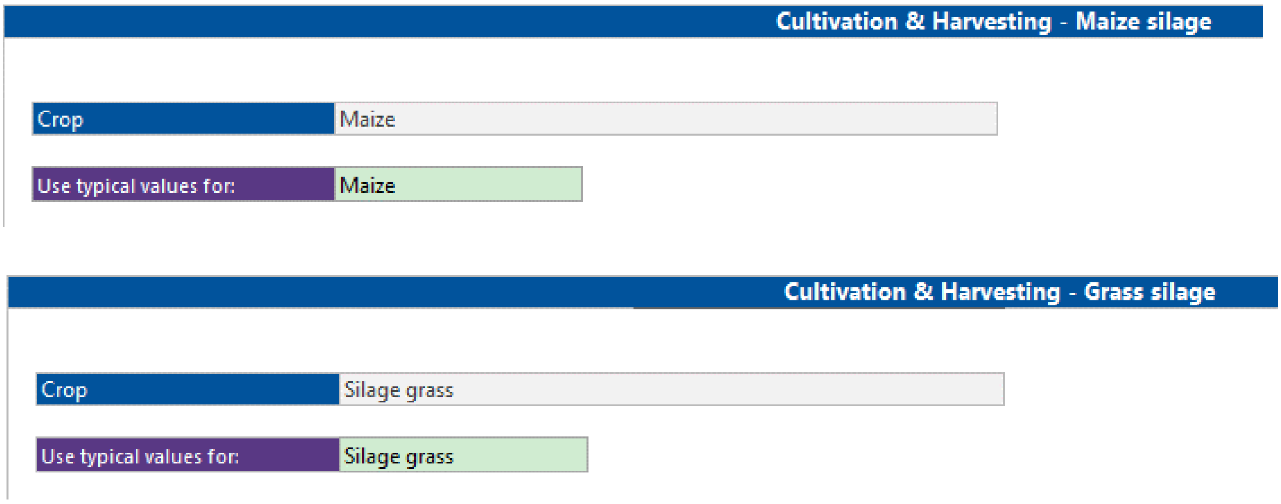


Figure 11: Two example entries (maize silage and grass silage) in the respective tables of the Cultivation and harvesting worksheet.

To enter actual harvest yield (in tonnes of fresh matter per hectare), select ‘Do not use defaults’ and toggle the yield button to ‘Actual’.

For crops where defaults are not available, and for crops where good quality cultivation data is available, actual data should be used. In this case, select ‘Do not use defaults’ from the drop-down menu next to the box ‘Use typical values for’ (see Figure 12).

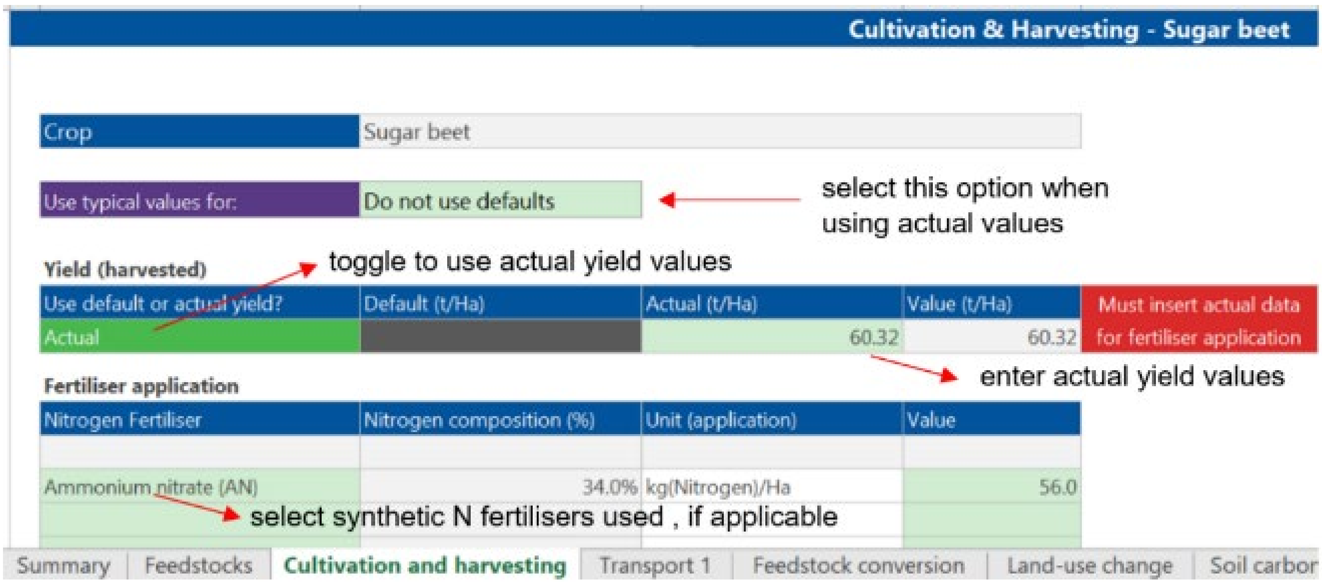


Figure 12: Example of Cultivation and harvesting worksheet where actual data has been used (as opposed to default values).

The following information should be entered manually:

- Yield
- Fertiliser inputs (whether synthetic or organic, and including digestate)
- Pesticide inputs

- Seed application rate (some crops, such as perennials are considered to have zero seed rate)
- Fuel use, for all operations from cultivation through to harvesting

Data should be listed to cover the entire period starting after the predecessor crop was harvested and ending at the point of harvest of the crop in question.

Please note that, for a particular crop, it is critical that if actual values are used for yield, actual values are also used for fertiliser application (and vice versa). This is because there is a very strong link between crop yield and fertiliser rate.

On the right hand side of the screen, the blue box shows the emissions for this stage of the process that correlate to each of these agricultural inputs.

The tool selects emissions factors for these crop inputs from the References worksheet. In particular, emissions from in-field N_2O production and emissions from the manufacture of synthetic nitrogen fertilisers have a big impact on overall emissions. If using special fertilisers with low in-field N_2O emissions, it is possible to accommodate these in the References worksheet. See below and Annex C (Section 11) for more information.

Adding new fertilisers manually

Not all fertilisers are listed, so new fertilisers can be added manually. Where a fertiliser is the same type as a listed fertiliser, but has lower manufacturing emissions than the reference, this should be treated as a new fertiliser (emissions factors are listed in the 'Reference values' worksheet).

To add a new fertiliser, two sections of the Reference values worksheet must be completed:

- under 'Conversion factors (fertiliser composition)' (cells I12 to O12 and below), the new feedstock should be named and its fertiliser composition listed. The new fertiliser can be entered as either a nitrogen fertiliser (cells I20 to O24), organic fertiliser (I43 to O47), P_2O_5 fertiliser (I60 to O64), K_2O fertiliser (I70 to O74), or other fertiliser (I84 to O88). See Figure 13.
- under 'Emission Factors' (row 257 and below) the name of the new fertiliser will appear in the relevant category (nitrogen fertiliser under row 311, organic fertiliser under row 334, P_2O_5 fertiliser under row 357, K_2O fertiliser under row 367, or other fertiliser under row 381). The emissions factor (typically available from the manufacturer) should be added in the relevant row under column D, along with the source under column E. Special attention must be taken to ensure that the units used for the emissions factor must be the same as the units listed in the column title for the input in question (e.g. $gCO_2eq/kg_{nitrogen}$ for nitrogen fertiliser). See Figure 14.

I	J	K	L	M	N	O
Conversion factors (fertiliser composition)						
Nitrogen fertiliser compositions						
ertiliser	%N	$\%P_2O_5$	$\%K_2O$	$\%SO_3$	%CaO	Source
mmonium nitrate (AN)	34%					HGCA Carbon footprinting tool June 2014
mmonium sulphate (AS)	21%			60%		HGCA Carbon footprinting tool June 2014
mmonium nitrate sulphate (ANS)	21%			60%		HGCA Carbon footprinting tool June 2014
nhydrous ammonia	82%					HGCA Carbon footprinting tool June 2014
alcium ammonium nitrate (CAN)	27%					HGCA Carbon footprinting tool June 2014
alcium nitrate (CN)	15%					HGCA Carbon footprinting tool June 2014
rea ammonium nitrate (UAN)	32%					HGCA Carbon footprinting tool June 2014
itrogen fertiliser (unspecified)	100%					Solid & Gaseous Biomass Carbon Calculator 2.0 (build 34)
ew fertiliser One	27%					NF1 fertiliser manual 2022

Organic fertiliser compositions						
ertiliser	%N	%P2O5	%K2O	%SO3	%CaO	Source
attle farmyard manure	0.60%					Nutrient Management Guide RB209

Figure 13: Here, the user has added a new synthetic nitrogen fertiliser containing 27% nitrogen, named 'New fertiliser One' under the 'Conversion factors (fertiliser composition)' section of the References worksheet, in the 'Nitrogen fertiliser composition' table.

Nitrogen Fertiliser Emission Factors		
	Emission Factor ($gCO_{2eq}/kg_{nitrogen}$)	Source
	3,522.4	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
	2,761.9	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
(ANS)	3,141.0	Biograce Additional Standard Values - Version 4d
	2,818.0	Biograce Additional Standard Values - Version 4d
(CAN)	3,652.0	Biograce Additional Standard Values - Version 4d
	4,387.0	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
N)	2,733.3	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
d)	4,571.9	BioGrace II Standard Values - Version 4a
	980.0	NF1 fertiliser manual 2022

Organic Fertiliser Emission Factors		
	Emission Factor ($gCO_{2eq}/kg_{nitrogen}$)	Source
	0	

Figure 14: Here, the same new fertiliser (New fertiliser One) has appeared in the relevant 'Emissions Factor' table (Nitrogen Fertiliser Emission Factors), and the user has manually added the emissions factor and reference.

Transport 1 worksheet

There are two worksheets where feedstock transport distances can be entered (Transport 1 and Transport 2), and most feedstocks will only require one of them to be completed.

Many feedstocks will likely require only Transport 2.

Transport 1 represents the transport of crop products (not applicable for residues, wastes and manures) from the field to another site, where they either undergo conversion or are stored. Not every product will require Transport 1. An example is pressed sugar beet pulp, where the sugar beet is transported to the sugar factory (Transport 1) and then the pulp is transported to the AD site (Transport 2).

Each of the products that has been listed on the Feedstocks worksheet will have their own data entry box. In the example below (Figure 15), maize has been listed as a product used, therefore information on mode and distance of maize transport should be entered. Scroll down within the worksheet to see the next product.

This question should be answered for every product feedstock.

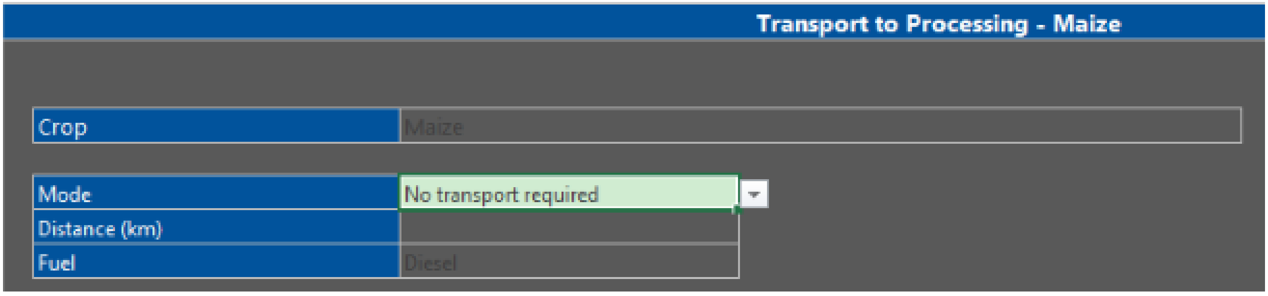


Figure 15: When the tool is first downloaded, 'No transport required' is selected under 'Mode' of Transport 1 and relevant cells are greyed out. This should be changed if Transport 1 is required. Please note that every feedstock requires some transport, but in many cases, there is only one transport step and this can be recorded under Transport 2 instead.

If Transport 1 is not needed, 'Mode' should be selected as 'No transport required', which will grey out the cells and exclude this section from subsequent calculations. This is the default position when the Calculator is first downloaded (see Figure 15).

If Transport 1 is required, the mode of transport can be selected from the 'Mode' drop-down menu (see Figure 16). For most crops, the relevant mode is Truck for dry product (40 ton) or (12 ton). The distance travelled should be entered in km, along with the fuel used (usually diesel).

The default yield is 1, which refers to the fact that losses are unlikely to take place during this transport process[10].

[10] However, if feedstocks are imported from overseas and travel by ship, it is likely that there will be some material losses (e.g. due to biodegradation). In this case, the default of 1 would not apply: 'Default' cell should be toggled to show 'Actual', and actual yield losses during transport should be entered.

Transport to Processing - Maize silage

Crop	Maize

Mode	Truck for dry product (40 ton)
Distance (km)	17
Fuel	Diesel

Enter transport mode, distance and fuel

Yield ($tonnes_{collected}/tonnes_{delivered}$)

Use default or actual yield?	Default ($tonnes_{collected}/tonnes_{delivered}$)	Actual ($tonnes_{collected}/tonnes_{delivered}$)	Value ($tonnes_{collected}/tonnes_{delivered}$)
Default	1.00		1.00

Figure 16: An example of Transport 1 being completed for the feedstock maize silage (where the material being transported is the maize crop before ensiling; maize after ensiling is covered by Transport 2).

The default transport efficiency is automatically loaded when the mode of transport is selected. This is the MJ of fuel needed per tonne of feedstock per km and considers the fact that the vehicle is likely to make the return journey empty. To use a value other than the default, the yellow ‘Default’ cell can be selected to show ‘Actual’. In this case, an actual fuel efficiency will be calculated based on the answers given under ‘Is a load carried for the return journey?’, ‘Fuel demand for outward journey’ and ‘Size of load’.

Note that if ‘No’ is selected for ‘Is a load carried for the return journey?’ then the calculator asks for the fuel demand for the full journey (outward and return), see Figure 17.

Is a load carried for the return journey?	No

Fuel demand for full journey (outward and return)

Unit	Value
litres	10.00

Figure 17: Example of manual transport efficiency data being entered.

On the right, the blue box shows the emissions generated at this part of the process, for each crop.

Feedstock conversion worksheet

Next, any emissions associated with the feedstock conversion step should be taken into account.

Examples of feedstock conversion include ensiling (silage making) for most crops, as well as processing of sugar beet to pressed pulp (and its co-products) in a sugar factory.

This section only applies to products, as residues and wastes do not have any emissions associated with them until the point of their collection. Each of the products that has been listed on the Feedstocks worksheet will have their own data entry box. In the screenshot below using example data, maize has been listed as a product used, therefore data on maize feedstock conversion (ensiling) should be entered, if applicable.

If feedstock conversion is not applicable, select 'No' under 'Does the feedstock require ensiling or conversion?', see Figure 18.

This question should be answered for every product feedstock. Scroll down the worksheet to see more feedstocks.

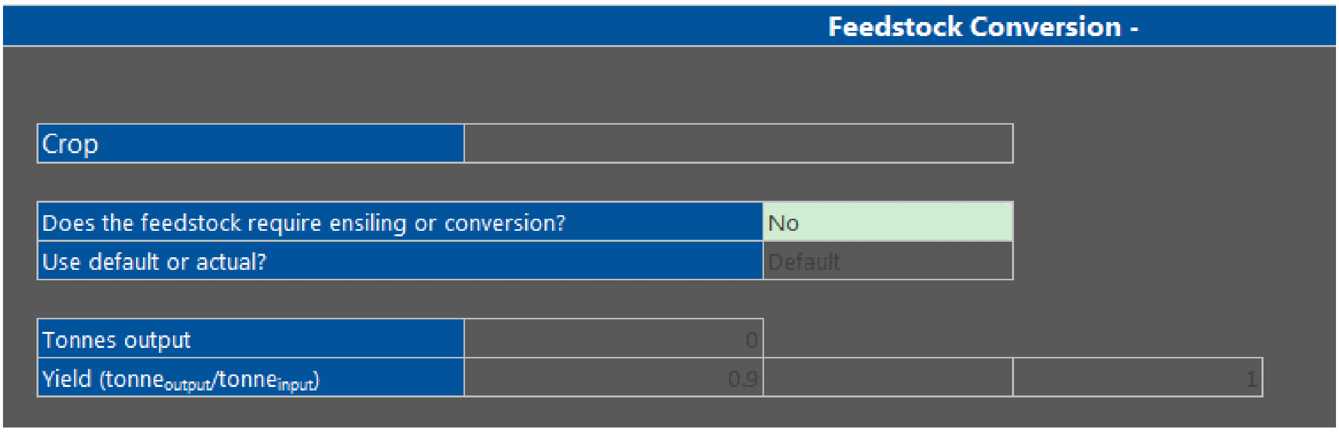


Figure 18: An example of a feedstock where ensiling or conversion is not required, and 'No' has been selected for 'Does the feedstock require ensiling or conversion?'.

If feedstock conversion is applicable (this is likely to be a requirement for all product feedstocks), select 'Yes' to 'Does feedstock require ensiling or conversion?' (Figure 19). This will also give an option to load the default values[11] for silage production by selecting 'Default' from the drop-down menu below.

If using actual values instead, enter the following:

- Yield of output per input expressed as a decimal
    - In the case of ensiling, the default is 0.9, meaning that 10% of the crop dry matter is lost during ensiling.
- Any electricity requirements
    - In the case of ensiling, the default is zero.
- Any fuel requirements

[11] Default data is obtained from the JRC Gaseous pathways document: Giuntoli J, Agostini A, Edwards R and Marelli L (2017) Solid and gaseous bioenergy pathways: input values and GHG emissions: Calculated according to methodology set in COM(2016) 767: Version 2, EUR 27215 EN, Publications Office of the European Union, Luxembourg. Available at: http://doi.org/10.2790/27486

    - In the case of ensiling, the default is diesel at 3.881 kWh/tonne(output), which accounts for the use of a tractor to fill the silage heap and compress the material. (3.881 kWh/t_{output} is derived from JRC’s 0.00375 MJ/MJ).
- Any chemical requirements
    - In the case of ensiling, the default is zero.

In some cases, the production of the feedstock will also generate a co-product. The tool has an additional section at the bottom of this worksheet to allow the allocation of emissions to this co-product, if applicable. Typically, no co-product is generated with silage.

An example where the co-product feature should be used is for pressed sugar beet pulp from a sugar factory, which is classified as a product, but the production of sugar beet pulp also produces sugar as a co-product. The co-products tool allows some emissions from the sugar factory to be allocated to co-products other than pressed sugar beet pulp. Appropriate data for the calculation of pressed sugar beet pulp should be obtained from the relevant sugar factory.

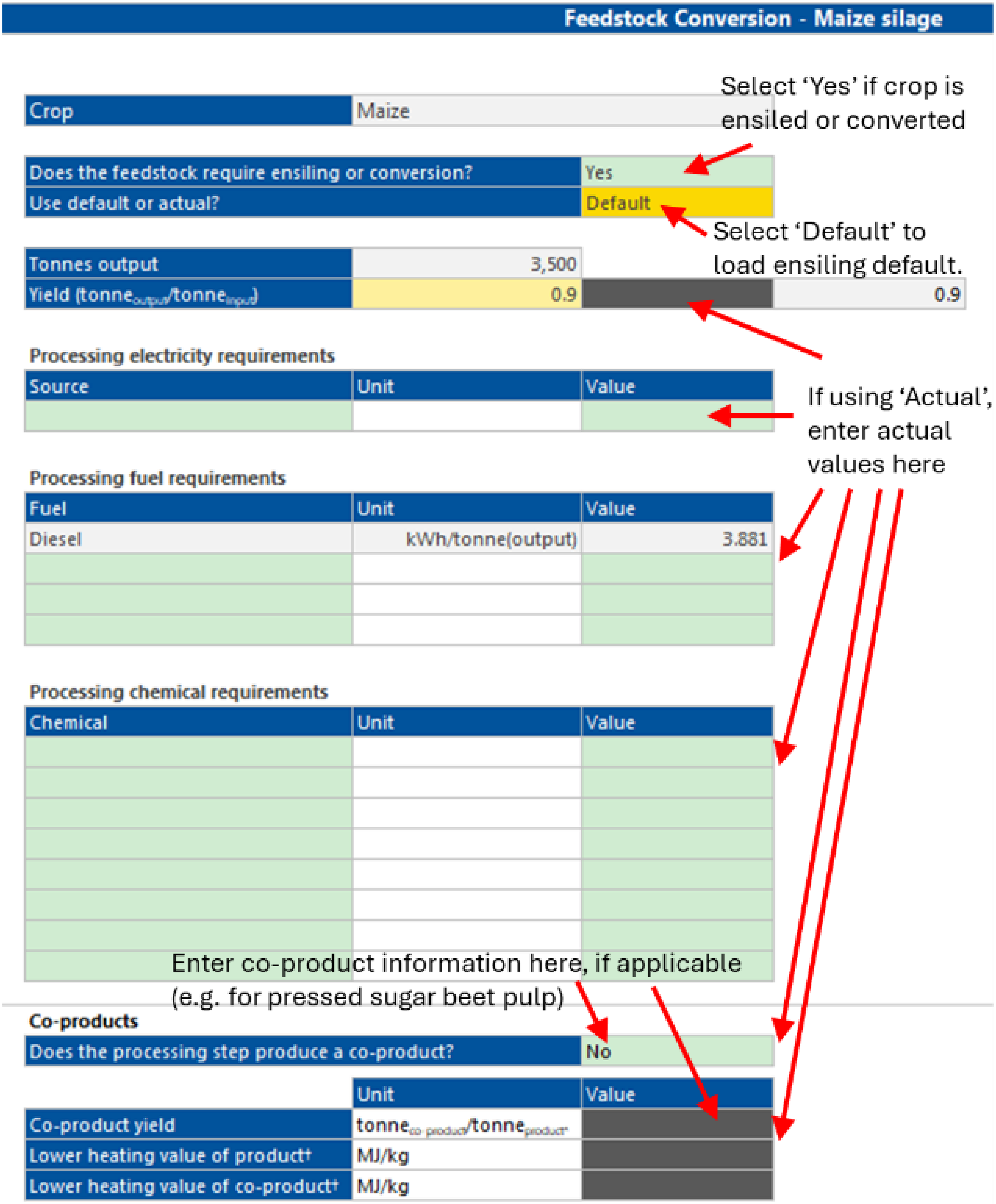


Figure 19: Example of a feedstock (maize) with default conversion selected.

Emissions from land-use change and soil carbon accumulation, e_l and e_{sca}

Land-use change and soil carbon worksheet

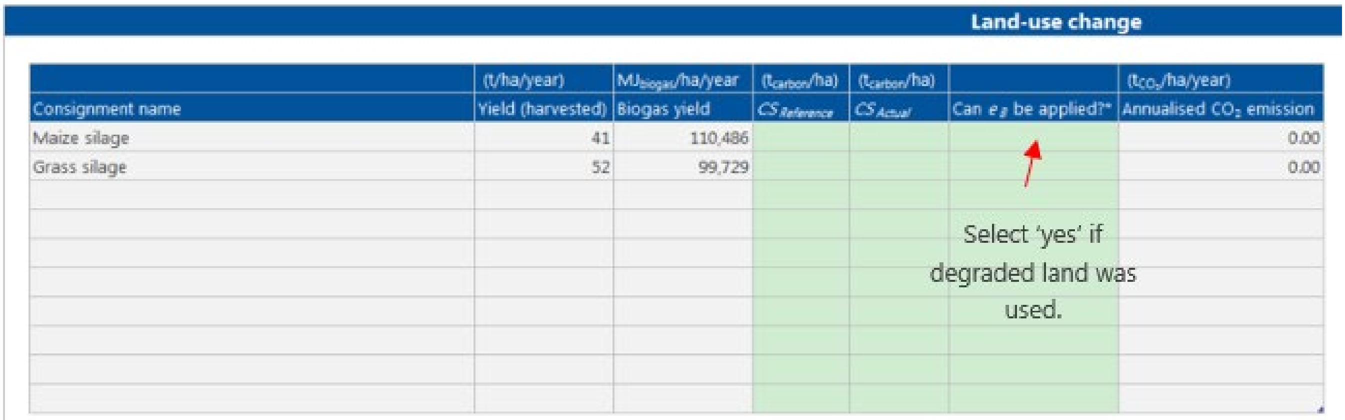
N.B. In most cases, these two worksheets should/can be left blank.

Further information, as well as the equations for calculating emissions savings from land-use change and emissions savings from soil carbon can be found in the Appendix.

Where there is evidence that the land used for feedstock cultivation has experienced an increase in soil carbon, a negative carbon emission (carbon credit) can be claimed. There are two ways that this can be reported: land-use change (e_l) and soil carbon (e_{sca}). It should be noted that the carbon saving from improved land management should only be claimed in either land-use change (e_l) or soil carbon (e_{sca}), not both.

As soil carbon increases are more commonly a result of changing agricultural practices rather than land-use change per se, we recommend reporting under soil carbon rather than land use. The exception to this is if severely degraded land has been used for crop cultivation.

In the example in Figure 20, land-use change has not taken place and the cells are left blank.


Land-use change

	(t/ha/year)	MJ_{biogas}/ha/year	(t_{carbon}/ha)	(t_{carbon}/ha)		(t_{CO_2}/ha/year)
Consignment name	Yield (harvested)	Biogas yield	$CS_{Reference}$	CS_{Actual}	Can e_B be applied?*	Annualised CO_2 emission
Maize silage	41	110,486				0.00
Grass silage	52	99,729				0.00

Figure 20: Example of the Land-use change worksheet where no land use change has occurred for cultivation of either feedstock (cells are left blank).

If severely degraded land has been used for cultivation, use the Land-use change worksheet and select 'Yes' under 'Can e_B be applied?'.

If land carbon stocks have increased with this change in land use, the reference and actual carbon stocks should be entered in columns F and G. An increase in carbon stock should give a negative number under 'annualised CO_2 emission'.

If land carbon stocks have increased but it is not (or only partially) related to land-use change, this should instead be reported under the Soil carbon worksheet.

In the example in Figure 21, the user has claimed an increase in carbon stock from 20 t_{carbon}/ha in the reference year to 22 t_{carbon}/ha in the actual year for their maize silage cultivation, and this applies to a 1-year period. This is converted to a CO_2 equivalent in column I. The user has also claimed an increase in carbon stock from 24 t_{carbon}/ha in the reference year to 30 t_{carbon}/ha over a 5-year period for their grass silage cultivation. This is converted to a CO_2 equivalent and annualised in column I.

Soil carbon accumulation

	t/ha/year	MJ_{biogas}/ha/year	t_{carbon}/ha	t_{carbon}/h	years	t_{CO_2}/ha/year
Consignment name	Yield (harvested)	Biogas yield	$CS_{Reference}$	CS_{Actual}	Time period	Annualised CO_2 emission
Maize silage	41	1,237,881.91	20	22	1	-7.33
Grass silage	52	1,295,209.99	24	30	5	-4.40

... Summary | Feedstocks | Cultivation and harvesting | Transport 1 | Feedstock conversion | Land-use change | Soil carbon | Manure credits ... +

Figure 21: Example of the Soil carbon worksheet where there has been an increase in carbon stock.

Manure credits worksheet

The GGSS allows for manure credits to be applied. This is to account for emissions avoided by the capture of methane which would otherwise have been emitted if the manures had been stored and used without treatment.

Manure credit

Consignment name	Amount of manure (t)	Manure dry matter content (%)	Equivalent amount of dry manure (t)	Energy (MJ)	Emissions (gCO_2eq)
Cattle manure	3,200	10%	320	3,840,000	172,800,000

45 gCO_2eq **per MJ manure**

Welcome | Summary | Feedstocks | Cultivation and harvesting | Transport 1 | Feedstock conversion | Land-use change | Soil carbon | Manure credits

Figure 22: Example of a feedstock (cattle manure) in the Manure credits worksheet. Note that no data entry is required here.

This worksheet shows the calculations for the manure credit (Figure 22), if any manures have been used in the process and input on the Feedstocks worksheet. No data input is required here.

Transport 2 worksheet

After any feedstock conversion, the feedstock is transported to the AD site. The data entry box is laid out in the same way as Transport 1 – with space to enter the distance and select the mode of transport.

Transport to the AD plant applies to all feedstocks, so products, residues and wastes should all have data entered at Transport 2.

Emissions from processing, e_p

Digestion and outputs worksheet

The next step is the actual AD process, where biogas is produced.

At the top of this sheet, the calculator shows the theoretical biomethane yield for each feedstock. No data needs to be entered here as these values are taken from the Feedstock worksheet, but the calculated data is used for the apportioning calculations.

Firstly, the calculator needs to know the plant set-up, see Figure 23. This takes the form of a list of questions where answers are selected from a drop-down menu. An answer must be selected for every question.[12]

Plant set-up

Is a **biogas** boiler used to generate heat?	yes
Is a **biogas** CHP used?	yes
Is a **natural gas** boiler used to generate heat?	no
Is a **natural gas** CHP used?	yes
Is a **diesel** generator used?	no
Is the digestate storage covered or open?	covered
Do you measure total crude biogas generation?	yes

Toggle these as appropriate

Figure 23: Example of answers given in the 'Plant set-up' section of the Digestion & outputs worksheet.

Then the plant outputs have to be entered (Figure 24), which are:

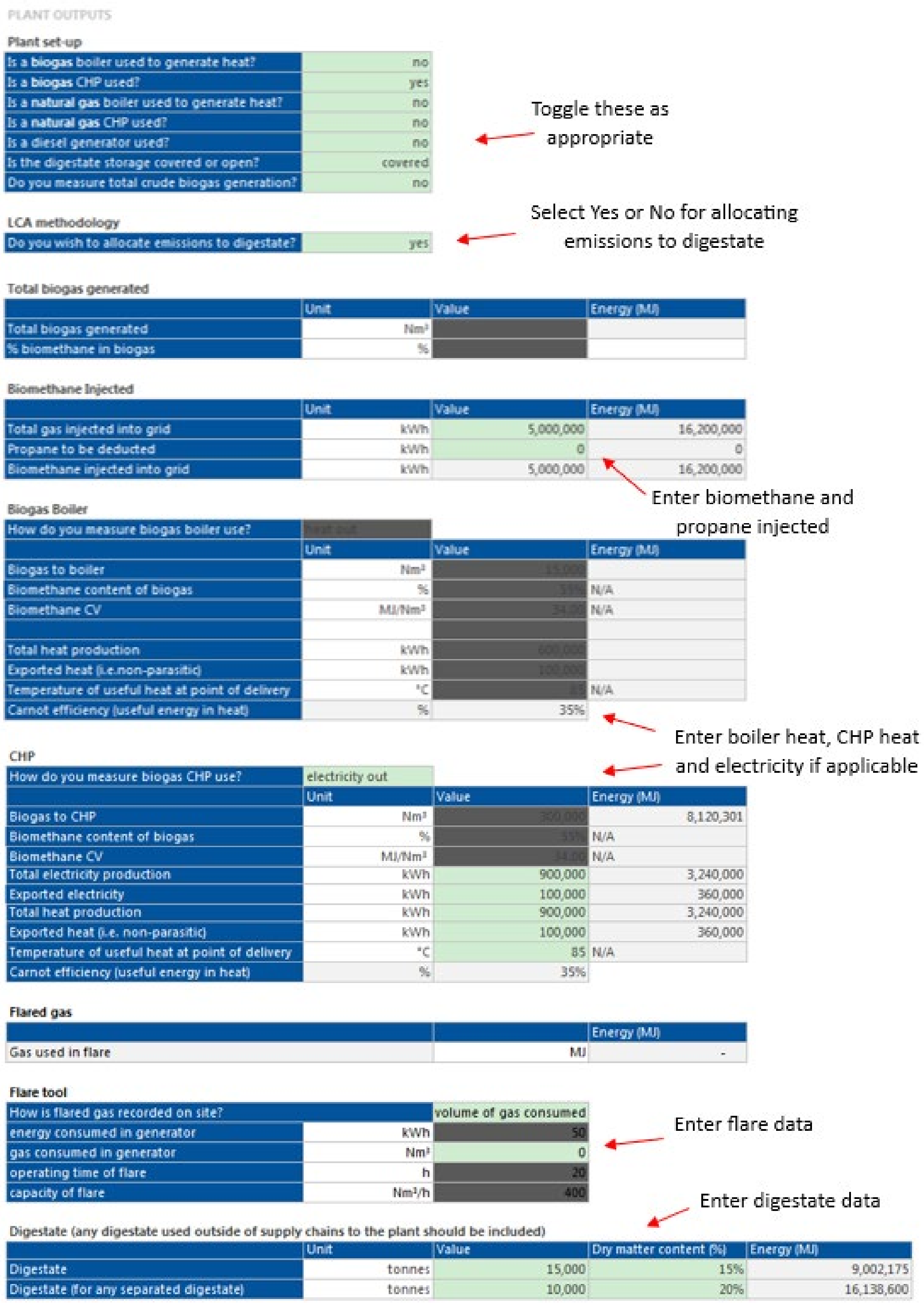
- Biomethane injected, in kWh
- Propane blended, in kWh
- Heat produced and exported by a biogas boiler, in kWh
- Heat and electricity produced and exported by a biogas CHP, in kWh
- Tonnage and DM % of digestate produced[13]
- If available, total crude biogas generation (including biogas to the upgrader, CHP and boiler, if applicable) (see also Annex H)
- If available, any biomethane rejected from the grid and flared (see also Annex H)

[12] If more than one heat or electricity source is used (e.g. one biogas CHP and one natural gas CHP), please select yes for all that apply (e.g. both biogas CHP and natural gas CHP). If more than one of each is used (e.g. two biogas CHPs), select 'yes' at the appropriate point and report the combined outputs and inputs for these, as if they were one.

[13] All digestate generated should be recorded: if digestate is not further processed, the volume should be entered under 'Digestate (unseparated)' (E146); if digestate is separated, the solid and liquid fractions should be recorded (in E147 and E148); if some digestate is used without separation and some is separated before application to land, this should all be recorded.

These values are necessary so that emissions can be allocated to the other outputs produced, like heat, electricity or separated digestate, as well as the biomethane output.

There is also the option to toggle between allocating emissions to digestate, and not allocating emissions to digestate. In REDII LCA methodology, both are permissible. More information on this can be found in Annex G.



PLANT OUTPUTS

Plant set-up

Is a biogas boiler used to generate heat?	no
Is a biogas CHP used?	yes
Is a natural gas boiler used to generate heat?	no
Is a natural gas CHP used?	no
Is a diesel generator used?	no
Is the digestate storage covered or open?	covered
Do you measure total crude biogas generation?	no

LCA methodology

Do you wish to allocate emissions to digestate?	yes

Total biogas generated

	Unit	Value	Energy (MJ)
Total biogas generated	Nm³		
% biomethane in biogas	%		

Biomethane Injected

	Unit	Value	Energy (MJ)
Total gas injected into grid	kWh	5,000,000	16,200,000
Propane to be deducted	kWh	0	0
Biomethane injected into grid	kWh	5,000,000	16,200,000

Biogas Boiler

	Unit	Value	Energy (MJ)
How do you measure biogas boiler use?	heat out		
Biogas to boiler	Nm³	15,000	
Biomethane content of biogas	%	55%	N/A
Biomethane CV	MJ/Nm³	34.00	N/A
Total heat production	kWh	600,000	
Exported heat (i.e.non-parasitic)	kWh	100,000	
Temperature of useful heat at point of delivery	°C	85	N/A
Carnot efficiency (useful energy in heat)	%	35%	

CHP

	Unit	Value	Energy (MJ)
How do you measure biogas CHP use?	electricity out		
Biogas to CHP	Nm³	300,000	8,120,301
Biomethane content of biogas	%	55%	N/A
Biomethane CV	MJ/Nm³	34.00	N/A
Total electricity production	kWh	900,000	3,240,000
Exported electricity	kWh	100,000	360,000
Total heat production	kWh	900,000	3,240,000
Exported heat (i.e. non-parasitic)	kWh	100,000	360,000
Temperature of useful heat at point of delivery	°C	85	N/A
Carnot efficiency (useful energy in heat)	%	35%	

Flared gas

		Energy (MJ)
Gas used in flare	MJ	-

Flare tool

How is flared gas recorded on site?		volume of gas consumed
energy consumed in generator	kWh	50
gas consumed in generator	Nm³	0
operating time of flare	h	20
capacity of flare	Nm³/h	400

Digestate (any digestate used outside of supply chains to the plant should be included)

	Unit	Value	Dry matter content (%)	Energy (MJ)
Digestate	tonnes	15,000	15%	9,002,175
Digestate (for any separated digestate)	tonnes	10,000	20%	16,138,600

Figure 24: Example of data entered in the Digestion & outputs worksheet.

The inputs required for digestion also have to be added to this sheet, as there will be additional energy requirements which contribute to the total emissions.

The digestion requirements to be added include (Figure 25, Figure 26 & Figure 27):

- Any fuel requirements (row 169 and 170, or see also below for an alternative way to enter natural gas or diesel use)
- Any chemical requirements (row 174 to 176)
- Any grid electricity used (cell E190)
- Methane leaks (digestate and digestion) See *Guidance for calculating fugitive methane emissions as part of the greenhouse gas criteria on the Green Gas Support Scheme* for further information.

Like the other worksheets, the emissions contribution is also shown on the right in a blue box.

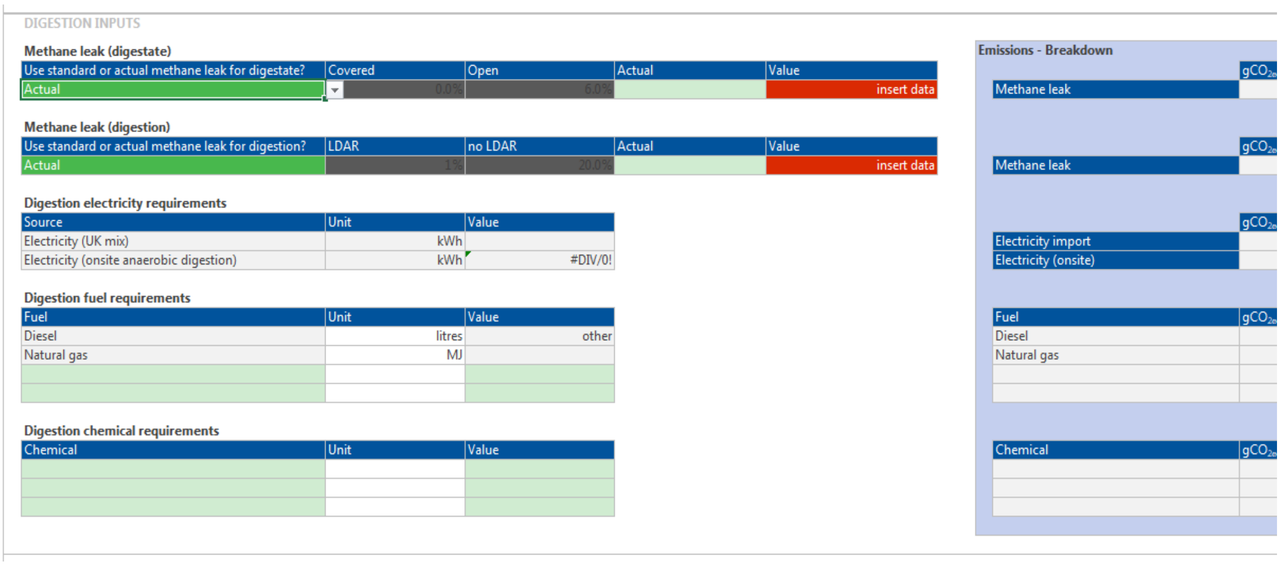


Figure 25: Example of data entered in the Digestion & outputs worksheet, continued.

For certain fuel inputs (i.e. natural gas used in a boiler or CHP, diesel used in a generator), calculation tools can be used, found further down in the Digestion & outputs worksheets.

As it is possible to account for natural gas used in a CHP in several ways, cell D200 asks “How do you measure natural gas CHP use?” (Figure 26).

- If the natural gas use is metered or billed, “natural gas in” can be selected, which is the most accurate method for recording natural gas use. Natural gas use should be entered in cell E202 in kWh (GCV (HHV), as is the billing convention) and energetic outputs (i.e. heat and electricity) should also be entered. If these values are not available, natural gas use will still be accounted for, but it will not be further apportioned between anaerobic digestion and biogas upgrading.

- If the natural gas use is not metered or billed, but electricity and heat generated are metered, “by electricity and heat out” should be selected. In this case, quarterly electricity and heat generated should be entered in cells E204 and E206, respectively.
- If the natural gas use is not metered, but only electricity or heat generated are metered, either “by electricity out” or “by heat out” should be measured, as appropriate, and entered accordingly.

Where electricity or heat from the natural gas CHP are exported, this can be taken into account by inputting the exported electricity and heat in cells E205 and E207, respectively.

Where natural gas use is measured through electricity and/or heat generation, the efficiency of the CHP must also be entered. This is typically around 40% electrical and 40% thermal efficiency.

Natural gas CHP

How do you measure natural gas CHP use?	electricity and heat out		
	Unit	Value	Energy (MJ)
Natural gas to CHP	kWh (GCV or HHV)	2,050,000	7,714,286
Natural gas LHV	MJ_{LHV}/kWh_{HHV}	3.2	N/A
Total electricity production	kWh	900,000	3,240,000
Exported electricity	kWh	500	1,800
Total heat production	kWh	900,000	3,240,000
Exported heat (i.e. non-parasitic)	kWh	600	2,160
Temperature of useful heat at point of delivery	°C	85	N/A
Carnot efficiency (useful energy in heat)	%	35%	
Electrical efficiency of CHP	%	40%	
Heat efficiency of CHP	%	44%	

Figure 26: Example data for a natural-gas CHP.

As it is also possible to account for natural gas used in a boiler in several ways, cell D225 asks “How do you measure natural gas use in the boiler?” (Figure 27).

- If the natural gas use is metered or billed, “natural gas in” can be selected, which is the most accurate method for recording natural gas use. Natural gas use should be entered in cell E227 in kWh (GCV (HHV), as is the billing convention). It is not essential to enter heat output in this case, unless exported heat should be accounted for (in which case total and exported heat must be entered).
- If the natural gas use is not metered or billed, but heat generated is metered, “by heat out” should be selected. In this case, quarterly heat generated should be entered in cells

E229 and the boiler efficiency into cell E233. If boiler heat is exported, this should be entered in cell E230.

Natural gas boiler tool

How do you measure natural gas use in the boiler?		natural gas in	
	Unit	Value	Energy (MJ)
Natural gas to boiler	kWh (GCV or HHV)	200,000	648,000
Natural gas LHV	MJ_{LHV}/kWh_{HHV}	3.2	N/A
Total heat production	kWh	80,000	288,000
Exported heat (i.e.non-parasitic)	kWh	500	1,800
Temperature of useful heat at point of delivery	°C	85	N/A
Carnot efficiency (useful energy in heat)	%	35%	
Efficiency of boiler	%	80%	

Figure 27: Example data for a natural-gas boiler.

It is possible to account for diesel use in a generator either by diesel use in litres or kWh generated by selecting the appropriate response in cell E216. The efficiency of the generator must also be entered in cell E217. Alternatively, diesel use can be entered in other units in cells E169 or E170.

Diesel generator electricity tool

How is generator use recorded on site?		by electricity generated	
Efficiency of generator	l/kWh	0.2	
	units	by fuel	by electricity
Diesel	litres		193
Electricity	kWh	-	964

Figure 28: Example data for a diesel generator.

Final conversion worksheet

The final step of the process is biomethane upgrading and injection.

Emissions that are generated at this stage that need to be taken into account are a result of methane slip, off-gas combustion (or absence of) and any fuel or chemical requirements.

A biogas upgrading technology must be selected (Figure 29). For most biogas upgrading technologies, the standard methane slip is 3% (unless there is additional technology installed that combusts the methane in the off-gas). This can send total emissions over the emissions limit of 24 gCO_2eq/MJ. However, it is possible to override the values for methane slip and yield loss, for example if compelling evidence exists from the equipment manufacturer. It is imperative that this evidence be retained for audit purposes. See *Guidance for calculating fugitive methane emissions as part of the greenhouse gas criteria on the Green Gas Support Scheme* for further information.

Default electricity requirements for the upgrading and injection are used, as most sites do not record this.

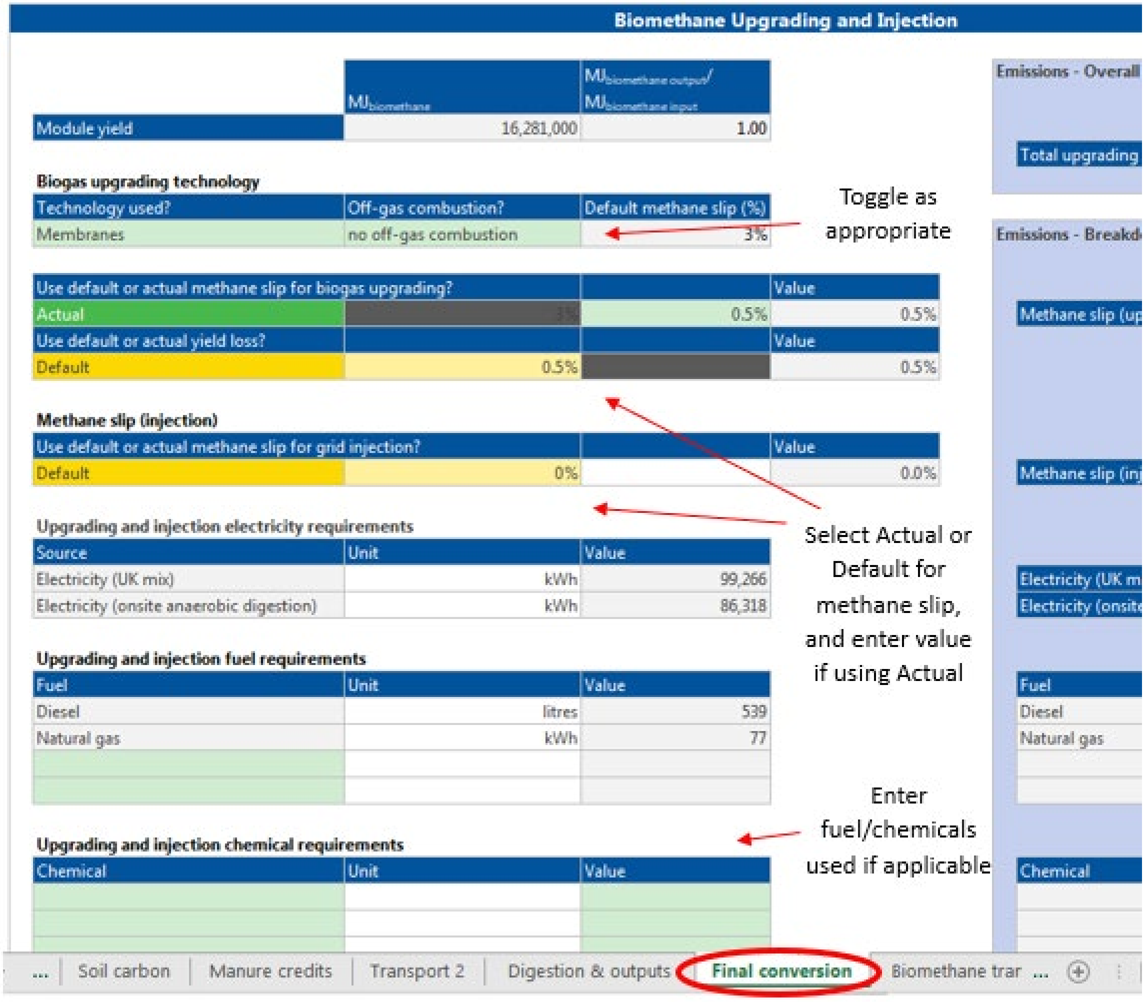


Figure 29: Example of data entered in the Final conversion worksheet.

Carbon capture

As well as biomethane, carbon dioxide is produced in the AD process. Often, the CO_2 stream is vented after biogas upgrading and cleaning. This is considered to have no effect on net emissions, as the CO_2 is assumed to be biogenic (i.e. derived from carbon that was recently taken from the atmosphere by plants)[14].

The CO_2 stream can also be captured, which can result in a negative carbon emission or carbon saving.

For this carbon saving to apply, it must fall under either:

e_{CCS} = emission savings from carbon capture and geological storage; or

[14] This is sometimes referred to as the 0/0 approach to biogenic carbon.

e_{ccr} = emission savings from carbon capture and replacement.

Geological storage is the capture and transport of CO_2 to a site where it is stored deep underground in geological formations, with the aim of it being permanently captured there.

Replacement means the CO_2 is directly offsetting any fossil derived CO_2 that would otherwise have been used for a process.

If relevant, enter the amount of CO_2 either stored (under the CCS table) or replaced (under the CCR table) in the worksheet, selecting the appropriate units (Figure 30).

Verifiable evidence should be retained for audit purposes, covering the CO_2 mass/volume, the offtake of CO_2 from the site, and the final use. If CCR is carried out, evidence of displacing fossil CO_2 is also required.

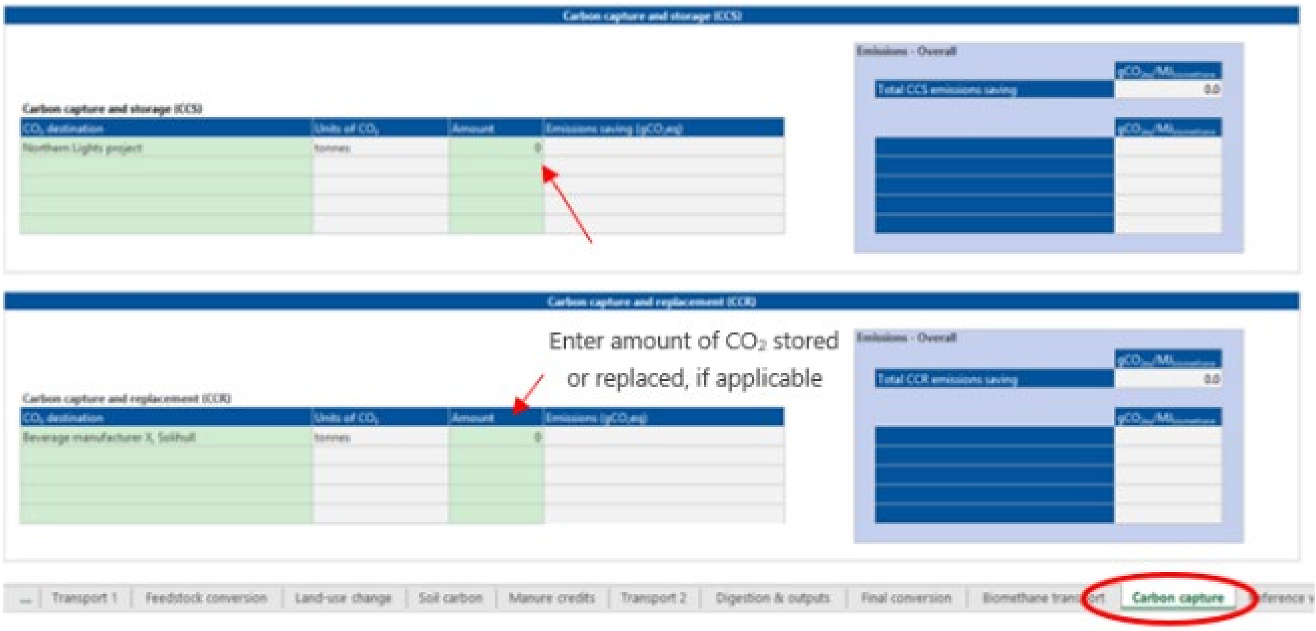


Figure 30: Example of a site carrying out some CCR and CCS.

Please note that there will be an electricity requirement for the liquefaction of the CO_2 which should be taken into account under the site's total electricity requirement, in the Digestion and Outputs worksheet.

Double counting

Please also note that if CO_2 is captured and used to generate carbon certificates or credits for use elsewhere (e.g. certificates to be sold on the voluntary carbon market), the Carbon capture worksheet cannot be used in this tool. This is because the CO_2 will be accounted for by the buyer of the carbon credit. Selling an AD site's carbon credit while simultaneously using it to reduce the carbon footprint of biomethane constitutes double counting and is not permitted.

Biomethane transport

After injection into the grid, biomethane transport is assumed, by default, to have zero emissions. This worksheet has been included for completeness.

References and notes

The final worksheets are for references and notes.

The references worksheet contains all the default values used in the calculations, for full transparency.

The notes worksheet is there for the user to input any manually added data, such as lab data for the biomethane yields of feedstocks, or other values that may require verification.

Summary worksheet

Now that all of the data has been captured, the calculator will show the results on the Summary worksheet (Figure 31). This is where the emissions and apportioning data is shown, which is required for reporting to Ofgem under GGSS.

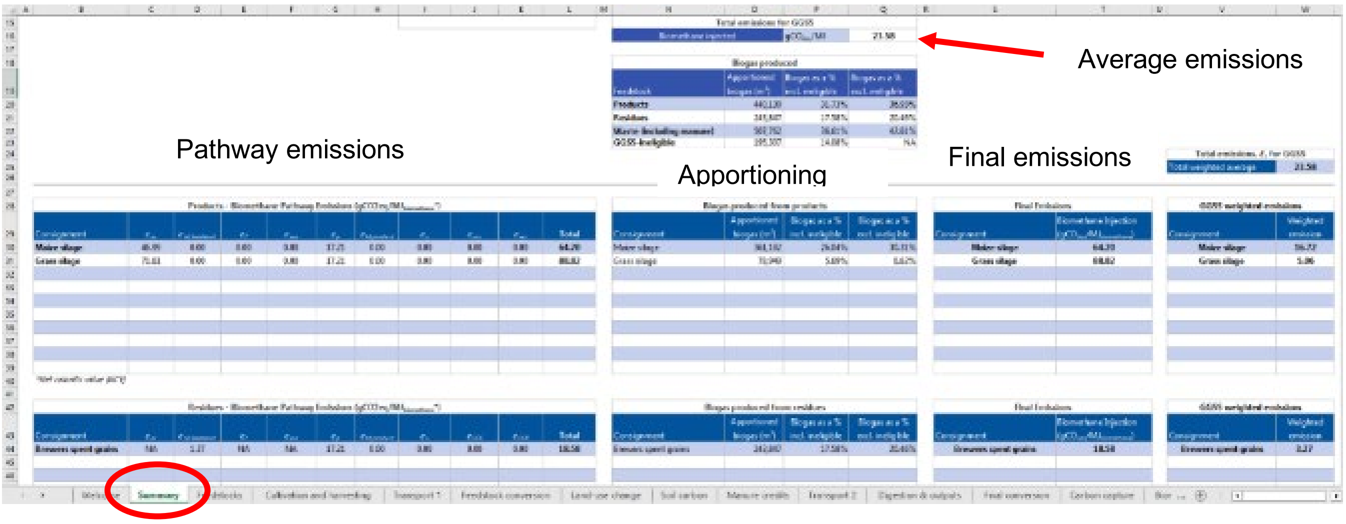


Figure 31: Overview of the Summary worksheet.

Products, residues, wastes, manures and GGSS-ineligible feedstocks are presented separately on this worksheet (scroll down to view the results for each category).

On the left, pathway emissions are shown. This is a summation of the emissions at each of the process steps, as allocated to biomethane and calculated per feedstock.

In the centre, the percentage of biogas produced from each of the feedstocks is shown (i.e. the allocation to each feedstock).

On the right, final emissions are shown. These are also weighted (based on apportioning) on the far-right-hand side. These individual weighted values do not need to be reported, but they allow the total emissions to be calculated.

Total emissions

The total emissions value for all feedstocks is shown at the top (cell Q18) in gCO_{2eq}/MJ biomethane injected. For the GGSS, this must be below 24 gCO_{2eq}/MJ.

Feedstock breakdown

Sites claiming GGSS must meet the feedstock restrictions, which stipulates that 50% of the biomethane produced must be derived from wastes or residues. Therefore, the percentage of biomethane produced from each feedstock category must be reported to Ofgem, in addition to the emissions associated with each consignment. This can be found in rows 22 to 25.

Each feedstock has emissions associated with it, measured in gCO_{2eq}/MJ biomethane injected. These are weighted and added to get the total emissions. However, Ofgem also require the reporting of the individual numbers (although there is no emissions threshold for individual feedstocks under GGSS).

Annex A – GHG calculations and sustainability reporting

To ensure sustainability, GGSS participants must comply with sustainability reporting requirements. Sustainability standards consist of 2 criteria:

- Greenhouse gas (GHG) criteria, whereby participants need to demonstrate a minimum lifecycle GHG saving of 70% against the EU fossil-comparator. This equates to a maximum GHG impact of 24g CO_2eq per MJ biomethane.
- Land criteria, which restricts the use of biomass sourced from land with high biodiversity or high carbon stock value such as primary forest, peatland or wetland.

All participants are required to self-report against the GHG and land criteria, as set out in the GGSS Guidance[15].

The Biomethane GHG Calculator is used to self-report against the GHG criteria.

Reporting against land criteria is not covered by the Calculator.

Feedstock classification and impact

In addition to the GHG criteria, there is also a specific feedstock requirement, which requires at least 50% of the biogas produced to be derived from wastes or residues (i.e. not products) within a reporting year.

As the 50% threshold applies to a year, and the GGSS GHG Calculator applies to a reporting period (3 months), **the GGSS GHG Calculator cannot be used directly to calculate whether the annual 50% threshold has been reached**. However, feedstock apportioning is an inherent part of the GHG Calculator. Apportioning of biogas between the feedstocks is shown in the central part (columns N to Q) of the Summary page. These biogas numbers for each feedstock can be used at the end of the reporting year in order to demonstrate whether the 50% threshold has been met.

As set out in the GGSS Guidance, feedstocks are classified according to the following definitions. These classifications influence the reporting requirements for each feedstock type, and what emissions need to be factored in the lifecycle emissions calculations, as set out below.

[15] Ofgem (2024) Green Gas Support Scheme guidance, available at https://www.ofgem.gov.uk/publications/green-gas-support-scheme-guidance

Definition of 'waste'

The GGSS Regulations define 'waste' as having "the meaning given in section 75(2) of the Environmental Protection Act 1990". This in turn defines waste as "*anything that is waste within the meaning of Article 3(1) of the Waste Framework Directive*".[16]

Article 3(1) of the Waste Framework Directive provides the meaning of waste as "*any substance or object that the holder discards or intends or is required to discard*".

All feedstock that may be classified as waste should be considered carefully by operators to ensure the waste hierarchy[17] has been followed and alternative markets have been considered before using them in AD.

The manipulation or modification, including contamination, of the state or condition of a substance or object in an attempt to make it fit the definition of a waste will not be considered a waste for the purposes of the GGSS.

Definition of 'residue'

Residues are not defined in the GGSS Regulations, but a residue is interpreted to be a substance that is not the end product or products that a production process directly seeks to produce; it is not the primary aim of the production process and the process has not been modified to produce it.

Residues from agriculture, aquaculture, fisheries and forestry residues are directly generated by the respective industries and do not include residues from related industries or processing. This includes residues generated in the process of harvesting the material being sought. Once the product is removed from the point of harvest and processed elsewhere, any residues generated are considered processing residues.

Co-products will not be considered residues in cases where they have been deliberately diverted from viable alternative uses.

Residues from arboriculture are not defined in the GGSS Regulations. However, in line with the DECC consultation response on the legal definition of waste in August 2014[18], arboriculture residues are considered to be material from woody plants and trees planted for landscape or amenity value that are removed as part of tree surgery usually in gardens, parks or other populated settings, and utility arboriculture such as the verges of roads and railways. Residues from arboriculture should not include forestry residues.

[16] Directive 2008/98/EC of the European Parliament and of the Council on waste and includes excreta produced by animals

[17] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69403/pb13530-waste-hierarchy-guidance.pdf

[18] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/343005/Response_to_Biomass_Consultation.pdf

Registered biomethane producers should seek additional guidance from Ofgem if liquids which are not classified as waste are to be used in their installation, as such feedstocks are ineligible for support under the GGSS Regulations.

Definition of ‘product’

Products are not defined in the GGSS guidance but a consignment not fitting the description of a waste or residue will be classified as a product.

Products (and co-products) are the primary aim of a process, the production of which is deliberately optimised to increase, enhance or protect quantity, quality or economic value, with markets other than energy. Co-products will have considerable comparable value to the primary output, in value or in energy.

Fuel Measurement and Sampling (FMS) procedures

Prior to reporting the use of new types of feedstock (consignments), participants must apply to Ofgem to modify their Fuel Measurement and Sampling (FMS) procedures, to obtain approval for the use and classification of such. Classification of the feedstocks is also important as it not only confirms the eligibility of the feedstocks for support, but it also dictates what GHG and land criteria need to be complied with. Table 1 sets out what criteria must be reported against each fuel category.

Table 1: Land criteria and GHG reporting requirements for different fuel categories

Fuel category	**Land criteria**	**GHG criteria**
Waste	Exempt	Zero GHG emissions prior to the process of collection
Processing residues	Exempt	Zero GHG emissions prior to the process of collection
Agricultural residues	Reporting required	Zero GHG emissions prior to the process of collection
Products and co-products	Reporting required	Full LCA emissions

Annex B – biomethane yields and feedstock characteristics

If feedstocks are used where the biomethane potential is known per tonne of fresh matter or dry matter (DM), but not of volatile solids (VS), these can be accommodated by entering 100% for VS and, if applicable, for DM.

This is because the apportioning between feedstocks is calculated from the biomethane yield per tonne of fresh matter (FM).

As an example, a sample of maize silage is sent to three laboratories with different reporting conventions. The following three lab reports are returned:

- Report from Lab 1:
  - Dry matter content: 330 g/kg
  - Ash content: 16.5 g/kg
  - Biomethane potential: 340 Nl/kg_{ODM}
- Report from Lab 2:
  - Dry matter content: 330 g/kg
  - Biomethane yield: 323 Nm^3/t_{DM}
- Report from Lab 3:
  - Biomethane yield: 107 Nm^3/t

All three lab reports give the same result, in terms of biomethane yield per tonne of fresh matter, as long as the missing value are given as 100%. This is shown in Table 2.

Table 2: The key data for maize silage as analysed by the 3 example labs.

Lab number	%DM	%VS	Biomethane yield, Nm^3/t_{VS}	Biomethane yield, Nm^3/t_{DM}	Biomethane yield, Nm^3/t_{FM}
Lab 1	33%	95%	340	323 [340*95%]	106.59 [340*95%*33%]
Lab 2	33%	100%	(323)	323 [323*100%]	106.59 [323*100%*33%]
Lab 3	100%	100%	(107)	(107) [107*100%]	107 [107*100%*100%]

For clarification:

Fresh matter (FM) is the unmodified weight of the feedstock, in the state in which it is delivered. The fresh matter content of every feedstock is 100%.

Dry matter (DM) is the FM without the moisture content. Livestock fodder and AD feedstocks are often described in terms of their DM because water/moisture has no biomethane yield or calories. Percentage DM and percentage moisture sum to 100%. In the wastewater sector, the term ‘total solids’ (TS) or ‘total suspended solids’ (TSS) is sometimes used in place of ‘dry matter’. This is because a conventional dry matter oven test does not work on very watery samples, and the suspended solids must first be filtered out.

Volatile solids (VS) is the part of the dry matter that burns away / volatilises upon combustion, leaving the ash. As neither moisture nor ash have a biomethane potential, AD feedstocks are often referred to per tonne of volatile solids. In the wastewater sector, the term volatile suspended solids (VSS) is sometimes used in place of VS. The term organic dry matter (ODM) can also be used interchangeably. It is important to note that VS/VSS/ODM can be given as a percentage of DM or as a percentage of FM. For example, maize with 33% DM and 95% VS (as a % of DM) can, occasionally, be described as having 31.35% VS (as a % of FM).

Annex C – using low-emission fertilisers

If a feedstock grower is using low-emission fertilisers, these can be entered into the tool manually. This can be done in the ‘Reference values’ worksheet under row 342.

The name, emissions factor and the source of the emissions factor must be given in $gCO_2eq/kg_{nitrogen}$. Evidence must be retained for audit. Under the Cultivation and harvesting worksheet, the newly added fertiliser can now be selected from the dropdown menu.

Low in-field emissions fertiliser Emission Factors

Fertiliser	Emission Factor ($gCO_{2eq}/kg_{nitrogen}$)	Source
Anna's fertiliser	2,000.0	Anna's fertiliser brochure

Soil N_2O Emission factors

Fertiliser nitrogen type	Emission Factor ($kgCO_{2eq}/kg_{nitrogen\ applied}$)	Source
Inorganic	6.163	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
Organic	6.628	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
Low in-field emissions fertiliser	4	Anna's fertiliser brochure

P_2O_5 Fertiliser Emission Factors

Fertiliser	Emission Factor (gCO_{2eq}/kg_{P2O5})	Source
Triple superphosphate (TSP)	541.7	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)
Rock phosphate	95.0	Solid and Gaseous Biomass Carbon Calculator 2.0 (build 36)

Transport 1 | Feedstock conversion | Land-use change | Soil carbon | Manure credits | Transport 2 | Digestion & outputs | Final conversion | Biomethane transport | Carbon capture | Reference values

Like any other fertiliser added manually, the fertiliser must then also be listed in the corresponding part of ‘Conversion factors (fertiliser composition)’ section (Cells I51:O51). It is essential that the naming matches in both sections, otherwise the equations will not calculate the emissions correctly.

Other fertiliser compositions

Fertiliser	%N	$\%P_2O_5$	$\%K_2O$	$\%SO_3$	%nutrient	Source
Anna's fertiliser	100%					Anna's fertiliser brochure

P_2O_5 fertiliser compositions

Fertiliser	%N	$\%P_2O_5$	$\%K_2O$	$\%SO_3$	%CaO	Source
Triple superphosphate (TSP)		48%				HGCA Carbon footprinting tool June 2014
Rock phosphate		25%		23%		HGCA Carbon footprinting tool June 2014
Mono-ammonium phosphate (MAP)	11%	52%				HGCA Carbon footprinting tool June 2014
Di-Ammonium-Phosphate (DAP)	18%	46%				HGCA Carbon footprinting tool June 2014
P_2O_5 fertiliser (unspecified)		100%				

K_2O fertiliser compositions

Fertiliser	%N	$\%P_2O_5$	$\%K_2O$	$\%SO_3$	%CaO	Source
Potassium chloride/Muriate of Potash (MOP)			60%			HGCA Carbon footprinting tool June 2014
K_2O fertiliser (unspecified)			100%			

Soil carbon | Manure credits | Transport 2 | Digestion & outputs | Final conversion | Biomethane transport | Carbon capture | Reference values

Annex D – land use and soil carbon accumulation

Where there is evidence that the land used for feedstock cultivation has experienced an increase in carbon stock, this is associated with a negative carbon emission (carbon credit) and there are two ways that this can be reported.

If the change in carbon stock can be attributed to a change in land use (rare), this should be reported under emissions from land-use change, e_l. If the change in carbon stock can be attributed to changes in agricultural practice (such as no tillage), this should be reported under emissions from soil carbon accumulation, e_{sca}.

Calculating emissions from land-use change

The method for calculating emissions from biomethane production includes the provision to account for emissions (or emissions savings) from land-use change, termed e_l. However, there are virtually no circumstances in biomethane production under the GGSS where land-use change is relevant.

If cropland has been used to cultivate the feedstock, and this cropland has been in use previously as cropland, then no land-use change has occurred and this worksheet can be left blank.

If cropland has been planted with perennial crops for AD (e.g. silphium, miscanthus), this is still deemed cropland under the IPCC definition and no land-use change has occurred.

Where the land has been significantly improved only by changes in agricultural management, such as low/no tillage, this does not constitute a land-use change and should instead be accounted for under soil carbon, e_{sca}.

There are some theoretical scenarios in which land-use change could occur in biomethane production under the GGSS. As an example, it may be possible to convert arable land into permanent grassland and use the grass as a feedstock for AD and claim GGSS on the produced biomethane. As arable land and permanent grassland are different uses of land as defined by the IPCC, this would constitute a land-use change. Another example is the use of severely degraded land for crop cultivation.

In both these cases, the land-use change would be associated with a carbon saving. The carbon saving can be calculated with the following equation:

e_l= 3.664 x ($CS_R - CS_A$) / 20

Where:

e_l= annualised greenhouse gas emissions from carbon stock change due to land-use change, measured as mass of CO_2-equivalent per hectare.

3.664 is the conversion factor to convert the mass of carbon into carbon dioxide, obtained by dividing the molecular mass of carbon dioxide by the molecular mass of carbon, 44.01 / 12.011. The number has no units.

CS_R= the carbon stock per unit area associated with the reference land use (measured as tonnes of carbon per hectare, including both soil and vegetation). As the emissions are annualised over 20 years, the reference year must be 20 years before the actual year.

CS_A = the carbon stock per unit area associated with the actual land use (measured as tonnes of carbon per hectare, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier.

20 is the number of years used for the calculation.

Note that CS_R and CS_A include soil carbon and the carbon in the vegetation. However, for crops (including perennials used for AD), the vegetation is considered to have zero carbon. Therefore, for AD feedstocks, CS_R and CS_A are the same as the soil organic carbon.

Values for soil organic carbon, and therefore carbon stock, can be obtained through laboratory measurements. Alternatively, soil organic carbon in mineral soils can be determined by region, as explained in OJ L 151, 17.6.2010. It should be noted that this method by region also takes account of improvements in soil carbon from changes in land management, normally reported under e_{sca}.

N.B. If soil carbon accumulation has been accounted for here, it should not be accounted for a second time in the Soil carbon worksheet.

Use of severely degraded land

It may be possible to cultivate a crop for AD on severely degraded land[19]. In this case, a fixed carbon credit, e_B, is awarded for the conversion of severely degraded land. To use this, select “yes” under “Can e_B be applied?”.

[19] ‘Severely degraded land’ means land that, for a significant period of time, has either been significantly salinated or presented significantly low organic matter content and has been severely eroded.

Calculating emissions from soil carbon accumulation

Where the land has been significantly improved by changes in agricultural management, such as low or no tillage, this should be accounted for under soil carbon, e_{sca}.

$e_{sca} = 3.664 \times (CS_R - CS_A) / 20$

Where:

> e_{sca} = annualised greenhouse gas emissions savings from improved agricultural management of feedstock (measured as mass of CO_2-equivalent per hectare).
>
> 3.664 is the conversion factor to convert the mass of carbon into carbon dioxide, obtained by dividing the molecular mass of carbon dioxide by the molecular mass of carbon, 44.01 / 12.011. The number has no units.
>
> CS_R= the carbon stock per unit area associated with the reference land use (measured as tonnes of carbon per hectare, including both soil and vegetation). As the emissions are annualised over 20 years, the reference year must be 20 years before the actual year.
>
> CS_A = the carbon stock per unit area associated with the actual land use (measured as tonnes of carbon per hectare, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier.
>
> 20 is the number of years used for the calculation.

Note that CS_R and CS_A include soil carbon and the carbon in the vegetation. However, for crops (including perennials used for AD), the vegetation is considered to have zero carbon. Therefore, for AD feedstocks, CS_R and CS_A are the same as the soil organic carbon.

Values for soil organic carbon, and therefore carbon stock, can be obtained through laboratory measurements. Alternatively, soil organic carbon in mineral soils can be determined by region, as explained in OJ L 151, 17.6.2010.

Annex E – manure bonus

There are several frequently asked questions around the manure bonus.

How should the manure bonus should be calculated?

The manure credit is given in the GGSS Method document as 45 gCO_2eq per MJ of manure. N.B. It is very uncommon to describe manure in MJ. However, there is a convention within biofuels and biomethane carbon accounting to refer to everything in MJ.

> * For e_{sca} a bonus of 45 $gCO_{2eq.}$ / MJ manure shall be attributed for improved agricultural and manure management in case animal manure is used as a substrate for the production of biogas and biomethane.

It is not immediately obvious how this manure bonus should be applied.

To calculate the bonus:

- calculate the MJ of manure used (LHV) in a reporting period,
- calculate the gCO_2eq using −45 gCO_2eq per MJ of manure,
- divide by the biomethane output in the same reporting period.

How is the manure credit calculated in the Excel tool?

- The fresh weight of each manure consignment (t), shown in column D, is multiplied by the dry matter content (%), shown in column E, to give the equivalent dry weight of that manure consignment (t), shown in column F.
- To convert dry weight to energy content, a factor of 12 MJ/t_{dry} is used[20], and the resulting MJ of manure are shown in column G.
- Using the manure credit value of 45 gCO_2eq per MJ of manure, the MJ of manure in column F are converted to gCO_2eq and the result is shown in column G. This is the total manure credit associated with each manure consignment.
- The total credit associated with each manure consignment is divided by the apportioned biogas output for that consignment.
- The apportioned biogas output is calculated from the apportioned biogas yield for each feedstock, shown in the Digestion & outputs worksheet in column G, and given as MJ_{biogas}/t_{input}, where t_{input} is the fresh weight. The apportioned biogas for each feedstock is calculated by multiplying this apportioned biogas yield by the weight of the feedstock. This gives the manure credit per MJ of biogas for each feedstock, shown in column L.

[20] This value can be found in Table A2 on page 182 of Giuntoli J, Agostini A, Edwards R and Marelli L (2017) Solid and gaseous bioenergy pathways: input values and GHG emissions: Calculated according to methodology set in COM(2016) 767: Version 2, EUR 27215 EN, Publications Office of the European Union, Luxembourg. Available at: http://doi.org/10.2790/27486

- To obtain the manure credit per MJ biomethane for each consignment, on the Summary worksheet in column F, the manure credit per MJ of biogas is divided by the net efficiency for biomethane production (found under Digestion & outputs, cell K104), which takes into account loses from biogas upgrading.

Why is the manure credit in the tool under e_{sca} larger than -45?

Or

Why are the default values for AD sites using manure larger negative numbers than -45?

In the typical and default emissions tables, there are a range of scenarios showing the final emissions associated with the biomethane generated in each scenario. Most of these are even lower than -45 (see Table 3).

Table 3: Typical and default values for biomethane.

Biomethane production system	Technological option	Typical greenhouse gas emissions (g CO2eq/MJ)	Default greenhouse gas emissions (g CO2eq/MJ)
Biomethane from wet manure	Open digestate, no off-gas combustion[6]	-20	22
	Open digestate, off-gas combustion[7]	-35	1
	Close digestate, no off-gas combustion	-88	-79
	Close digestate, off-gas combustion	-103	-100

It is important to note that the manure credit of -45 gCO_{2eq}/MJ manure is per MJ of manure. In contrast, these are scenarios for biomethane from wet manure are per MJ of biomethane.

The details are further explained and illustrated by way of examples below.

Firstly, it is important to understand the context for the manure credit. This is the emissions that are avoided by not doing conventional manure management. Conventional manure management is assumed to involve open manure storage facilities (Figure 32). These are associated with an emission of CH_4 and N_2O, two powerful greenhouse gases[21].

[21] More information on the manure credit can be found in section 5.2.1 of Giuntoli J, Agostini A, Edwards R and Marelli L (2017) Solid and gaseous bioenergy pathways: input values and GHG emissions: Calculated according to methodology set in COM(2016) 767: Version 2, EUR 27215 EN, Publications Office of the European Union, Luxembourg. Available at: http://doi.org/10.2790/27486

When using AD for manure management, the open storage of raw manure/slurry is avoided (Figure 33). There may be fugitive emissions from other parts of the AD process, but these are accounted for as part of emissions from digestion.

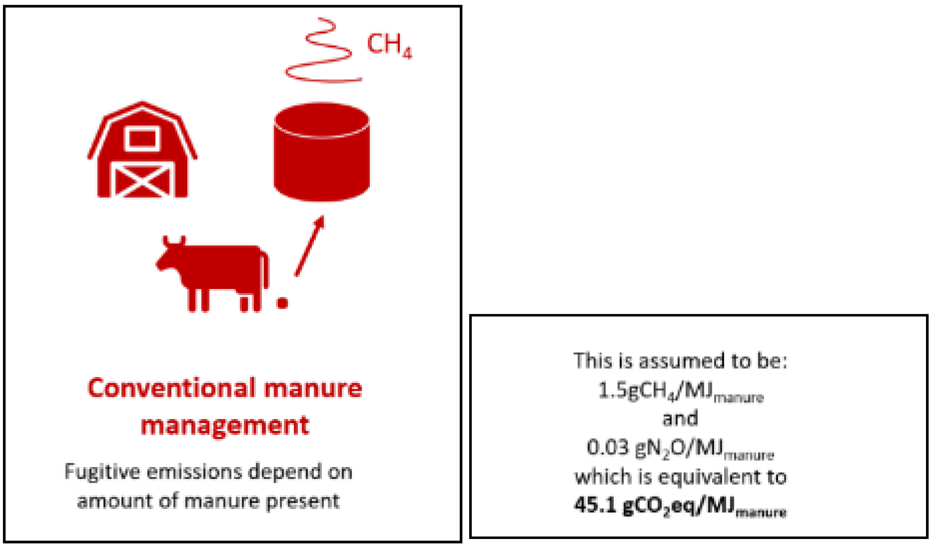


Figure 32: Conventional manure management.

The manure credit accounts for the avoided emissions, given that manure is not stored for long periods in the conventional manner (Figure 34).

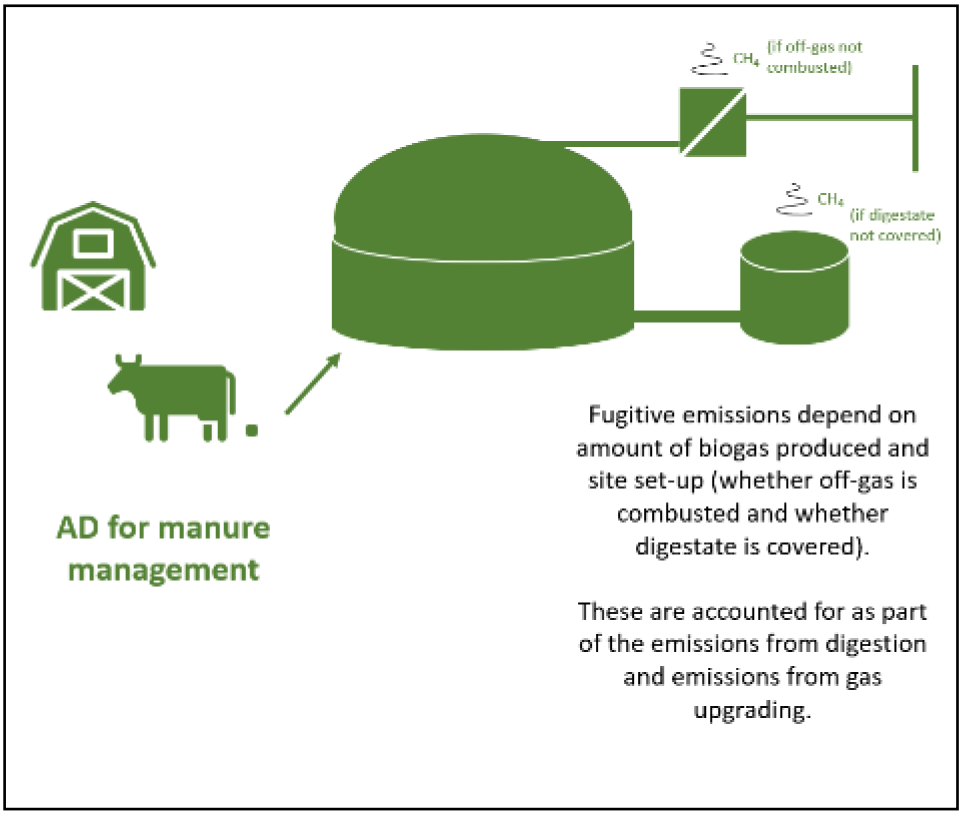


Figure 33: AD as manure management.

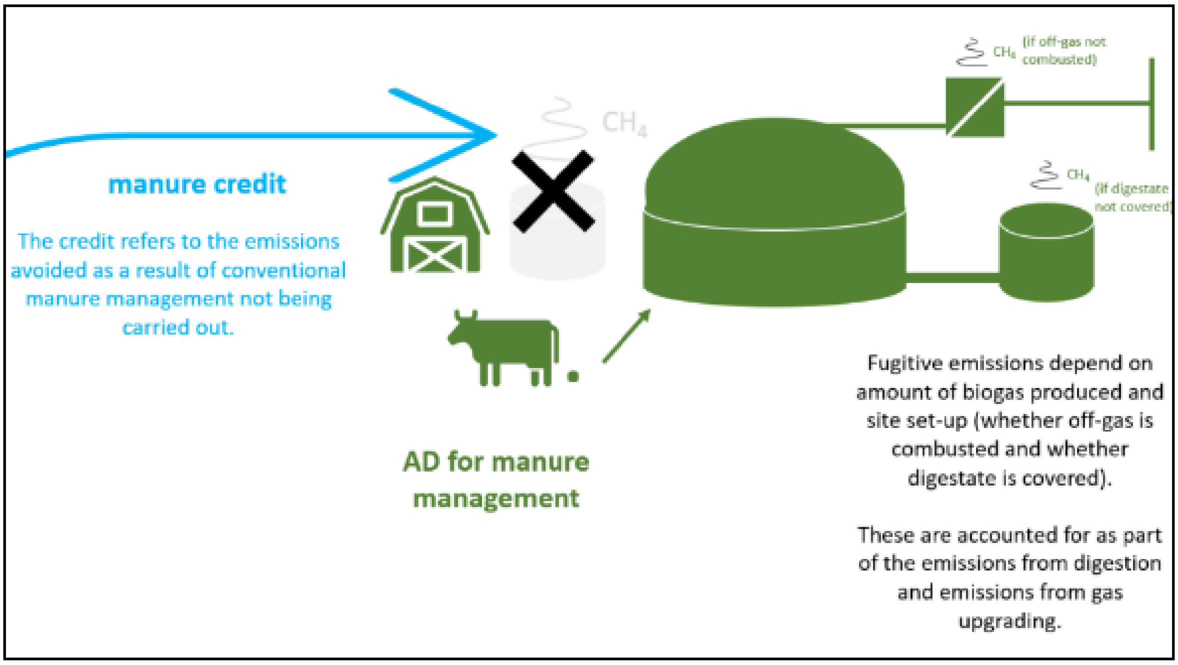


Figure 34: The manure credit.

Secondly, as emissions from conventional manure management are dependent on the amount of manure present, it is important to note that the credit is awarded based on MJ manure used, and that MJ manure used is not the same as MJ biomethane generated from manure owing to inefficiencies of the AD process (Figure 35). Not all the energy (MJ) in the manure is converted into biogas, with some energy (MJ) being retained in the digestate. Even considering only the MJ going to biogas, the biogas may be used elsewhere (e.g. a biogas CHP) in addition to being upgraded to biomethane.

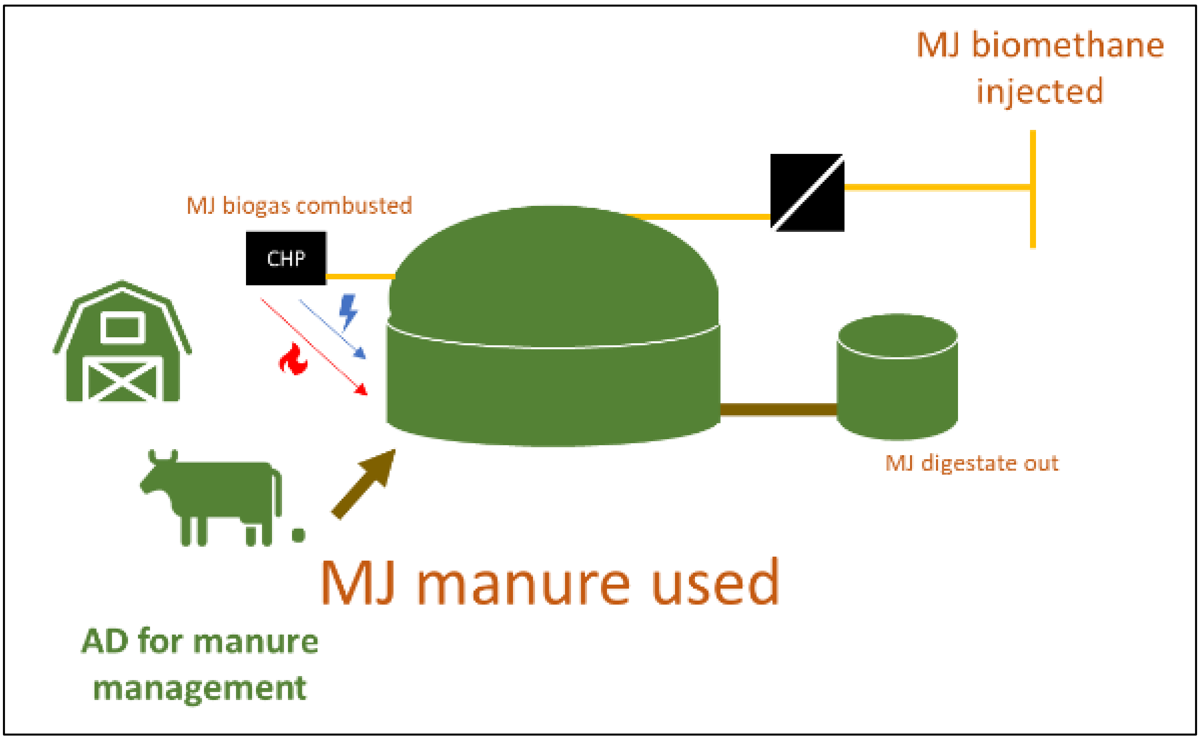


Figure 35: Manure credit is awarded based on MJ of manure used, not MJ biomethane generated.

The exact conversion efficiency between MJ of manure in and MJ of biogas out depends on the efficiency of each site, but an indicative value is around 0.42 MJ biogas per MJ manure. This would bring the manure credit to around −107 gCO_{2eq}/MJ_{biogas}. In addition, a portion of biogas can be used to generate process heat, which might bring the yield down to around 0.39 MJ biomethane per MJ manure, and the manure credit to around −115 gCO_{2eq}/MJ_{biogas}. In addition, an AD site may operate a pasteuriser, which may require additional biogas to generate enough heat, bringing the yield down to 0.34 $MJ_{biomethane}/MJ_{manure}$ and the manure credit to around −132 gCO_{2eq}/MJ_{biogas}.

Annex F – process energy supply

There are some frequently asked questions around accounting for emissions from process energy supply.

How should I proceed if my AD site uses a biogas CHP/boiler and a natural gas CHP/boiler?

In the Digestion & outputs worksheet, under 'Plant set up', please select 'yes' for all that apply. For example, if the site has one biogas CHP and one natural gas CHP, please select 'yes' for 'Is a biogas CHP used?' and 'yes' for 'Is a natural gas CHP used?'.

It is important to separate reporting of equipment using biogas from equipment using fossil fuels (like natural gas) as they are accounted for differently. Natural gas and other fossil fuels are accounted for based on the amount used and 'emissions factors' associated with their production and use. In contrast, biogas used for parasitic energy is accounted for by adjusting the process efficiency. While a site using biogas for process energy does not carry the burden of carbon emissions from fossil fuels, a site using biogas to generate process energy requires more MJ of biogas per MJ biomethane.

How should I proceed if my AD site has two or more of the same type of energy supply, e.g. two biogas CHPs?

In the Digestion & outputs worksheet, please treat two pieces of equipment using the same fuel as one single piece. For example, if there are two biogas CHPs, please select 'yes' for 'Is a biogas CHP used?' and enter the total biogas used or total electricity / heat generated among both biogas CHPs in the relevant boxes.

How should I proceed if my site uses LNG (liquified natural gas) in its CHP or boiler?

The tool does not differentiate between natural gas and liquified natural gas. Please proceed as though you were using natural gas.

How should I proceed if my site uses a heat pump for process energy?

No action needed. This will be taken into account in the higher 'imported electricity' figures.

How should I proceed if my site uses a different fuel?

If another fuel is used, this can be added in the 'Digestion fuel requirements' section in the green cells.

Digestion fuel requirements

Fuel	Unit	Value
Diesel	litres	
Natural gas	kWh	1,475

Add other fuel here

If the fuel is used in digestion and upgrading, please add a portion of the fuel under the Digestion and outputs worksheet and a portion under the Final conversion worksheet in the table ‘Upgrading and injection fuel requirements’.

Upgrading and injection fuel requirements

Fuel	Unit	Value
Diesel	litres	
Natural gas	kWh	25

If your fuel is not listed, it is possible to add a new fuel in the Reference values worksheet under ‘Fuel emission factors’. Please add the fuel name, the emissions factor in gCO_{2eq}/MJ and the source of this emissions factor.

Fuel Emission Factors

Fuel	Emission factor (gCO_{2eq}/MJ)	Source
Diesel	70.58	DESNZ Greenhouse gas reporting: conversion factors 2023
HFO	79.23	DESNZ Greenhouse gas reporting: conversion factors 2023
HFO (for maritime transport)	77.41	DESNZ Greenhouse gas reporting: conversion factors 2023
Gasoline	64.99	DESNZ Greenhouse gas reporting: conversion factors 2023
Natural Gas	56.30	DESNZ Greenhouse gas reporting: conversion factors 2023
Methanol	99.57	BioGrace II Standard Values - Version 4a
Electricity (UK mix)	57.52	DESNZ Greenhouse gas reporting: conversion factors 2023
Electricity (EU mix LV)	150.10	BioGrace II Standard Values - Version 4a
Electricity (EU mix MV)	141.10	BioGrace II Standard Values - Version 4a
Rocket fuel	92.00	Supplier's own LCA

Add unlisted fuels here

Once the fuel has been added in the ‘Fuel emission factors’ section, it will be possible to select it from the drop-down menus for fuel requirements.

Digestion fuel requirements

Fuel	Unit	Value
Diesel	litres	
Natural gas	kWh	1,475

- Diesel
- HFO
- HFO (for maritime transport)
- Gasoline
- Natural Gas
- Methanol
- Electricity (UK mix)
- Electricity (EU mix LV)
- Electricity (EU mix MV)
- Rocket fuel

New fuels appear here

Please note that fuel use for new fuels can only be entered in MJ, as otherwise the tool will try and convert the units (but will not have the right data for fuel calorific value or density). Please make a note of the calculations used to convert your fuel use units into MJ in the Notes worksheet, as this may be required at audit.

Annex G – LCA methodology & digestate

When reporting GHG emissions for AD under RHI, FIT and RO, it was possible to allocate a portion of the process emissions to digestate as a co-product.

However, with the introduction of the manure bonus in GGSS reporting, the allocation of emissions to digestate can distort the emissions savings.

It is therefore now possible to toggle between two LCA modes: allocating emissions to digestate as a co-product, or not allocating emissions to digestate. Both are permissible under REDII: the difference is that one scenario considers digestate as a co-product and the other as a residue or waste.

When using very large volumes of manures, it is preferable to not allocate emissions to digestate.

Furthermore, there has been a change to digestate allocation (compared with the NNFCC RHI/FIT/RO tool, which follows slightly different accounting rules and should not be used for GGSS reporting) following feedback from key stakeholders. The current tool takes into account the fact that some digestate is used to grow the crops that generate the feedstocks used in the process. A simplification has been used here: it is assumed that the same digestate from a single quarter has been used to grow the feedstocks used in that quarter (although, in reality, the digestate in a given quarter is used to cultivate crops that will not be used till subsequent quarters).

The calculation is as follows: the tonnage of digestate applied to the crops is subtracted from the tonnage of digestate generated (and will default to zero if more digestate is used than was generated). Emissions can be allocated to the remaining digestate. This is similar to the tool’s approach to parasitic energy demand: the digestate used to cultivate feedstocks in a given quarter is handled as parasitic digestate demand.

It is important to enter all digestate data (separated and unseparated digestate) as failing to do so may lead to emissions appearing higher than they are.

Annex H - Total biogas and flared gas

Where sites lose significant volumes of biomethane to flaring (e.g. owing to restrictions from the gas grid), the carbon intensity of the generated biomethane can sometimes appear very high. This is because the site is accounting for 100% of the feedstock used, 100% the energy used on site, etc, but those emissions are being divided by the biomethane actually injected (not the biomethane generated and then rejected to flare). As a simplified example, if 1000 g CO_2eq GHG is emitted to generate 50 MJ of biomethane, then the carbon intensity of the biomethane is 20 gCO_2eq/MJ (1000/50). However, if 10 MJ is rejected by the gas grid and flared on site, and only 40 MJ are injected, the carbon intensity of the injected biomethane is 25 gCO_2eq/MJ (1000/40), which is over the threshold of 24 gCO_2eq/MJ.

The gas rejected to flare must be taken into account, since the GHG emissions were generated when making all the biomethane, not only the biomethane that was accepted by the grid. To account for flared gas, the tool has two alternative methods, depending on what data is available on site. The first is for sites where the total biogas generated by the digesters is metered (before it is used for biogas upgrading, or in a CHP or boiler). The second is a calculated method, for sites where total biogas is not metered.

If total biogas is recorded on site, this scenario should be selected in cell D92 and the total biogas entered in cell E99. In this case, the tool counts the biogas used in the CHP and boiler as well as the biogas needed to generate the injected biomethane and assumes that any difference in the sum and the entered total biogas represents biomethane that is lost to flare. If the calculated total biogas needed is higher than the total biogas entered, the tool will not consider the total biogas entered and also assumes that no gas has been flared.

If total biogas is not available, this scenario should be selected in cell D92. To account for flared gas in this scenario, flared gas should be recorded on site and entered into the tool under E138 to E142. Flared gas may be measured in different ways on different AD sites; ideally, the volume or energy content of the flared gas would be measured (and these can be selected from the drop-down menu in E138). However, this is rarely metered on site. Modern sites do, however, record for the hours of flare runtime (thus can also be selected in E138, with the runtime entered in E141). This can be combined with the capacity of the flare (Nm^3/h) (which can be entered in E142) in order to estimate the volume of flared gas.

This publication is available from: www.gov.uk/government/publications/methods-of-calculating-greenhouse-gas-emissions

If you need a version of this document in a more accessible format, please email alt.formats@energysecurity.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.