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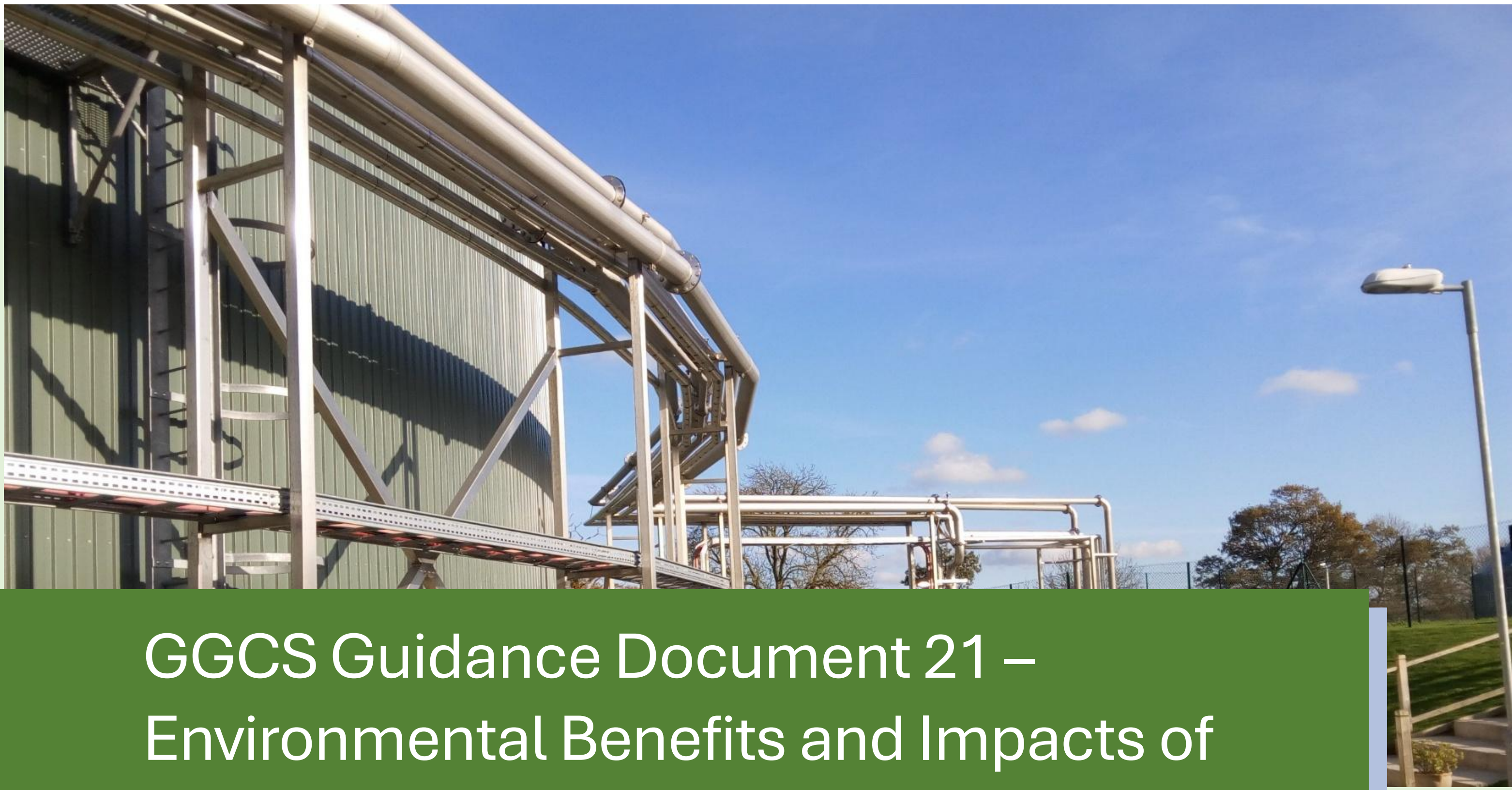

GGCS Guidance Document 21 – Environmental Benefits and Impacts of Biomethane

Version 1.2 – July 2026

1. INTRODUCTION

This guidance document aims to inform GGCS members, green gas consumers, and other interested parties about the environmental benefits of green gas, as well as the impacts of its production and use.

The guidance will support our members in accurately marketing RGGOs and help them conform to the GGCS Scheme Rules that they should be "honest and transparent" in such marketing.

It will also support consumer confidence in the benefits of buying green gas, raise their awareness about its status as a "low, but not zero" carbon gas and provide a summary of how Greenhouse Gas (GHG) emissions from green gas production are calculated.

Unless otherwise mentioned the green gas referred to in this document is biomethane from anaerobic digestion, which constitutes 95%+ of all RGGOs issued by the GGCS. The general principles set out below will apply to both biopropane and hydrogen and specific references are made to those gases at different points.

For further information about reporting use the use of biomethane as a consumer, please refer to GGCS Guidance Documents 12 and 15 here: https://www.greengas.org.uk/news/ggcs-guidance-documents.

NB: This document is not intended as a technical guide on complying with the Sustainability Criteria of the Non-Domestic Renewable Heat Incentive (NDRHI), Green Gas Support Scheme (GGSS), or Renewable Transport Fuel Obligation (RTFO), or on creating GHG inventories as a consumer. Readers may find that they will need additional advice and sources of information to explore the topics below in more detail.

2. GREEN VS RENEWABLE AND LOW VS ZERO CARBON

Products are often described as "green" or "sustainable", but these are umbrella terms that may or may not mean that a product:

- is produced from a renewable source
- creates waste or not when it is used
- has significant Greenhouse Gas (GHG) emissions from its production (while still being lower than an equivalent product)
- has low GHG emissions from its production and use
- has zero or close to zero GHG emissions from its production and use

The GGCS believes that environmental claims should be substantiated and evidenced, and that "greenwash" is misleading and ultimately damaging to real progress in tackling environmental issues.

As such, the GGCS Scheme Rules set out that a "Green Gas" is a gas that comes from a renewable or non-renewable source and has a lower GHG impact than its fossil-derived equivalent. The type of gas will be stated on a RGGO and its Cancellation Statement. We therefore believe that the term "green" can be applied when describing any green gas we issue RGGOs for and for RGGOs representing biomethane and biopropane "renewable" is also an appropriate label.

From this starting point, further information within the GGCS system provides users and consumers with information on "how green" a gas is, both about the nature of the renewable or non-renewable inputs used and levels of GHG emissions from its production and use. For example, a Cancellation Statement may show that the GHG thresholds within the NDRHI or GGSS have been met or they may show an actual GHG number.

GGCS will not issue RGGOs for any gases that have not been shown to our satisfaction to meet a recognised sustainability standard.[1]

See Section 6 for more details on our expectations on how different terms should be used.

3. SUPPLY LICENCE OBLIGATIONS, THE UK GOVERNMENT GREEN CLAIM CODE AND EUROPEAN LEGISLATION

Any GGCS member who holds a Gas Supply licence should pay due regard to clause 0.3[2] which sets out the requirement to be *"fair, honest [, and] transparent"*. These requirements are referenced in relation to domestic and micro business consumers and the GGCS believes they should also be applied in relation to commercial and industrial consumers.

GGCS members should also be aware of the UK Government's Green Claims Code[3] which includes the following six principles:

1. **Be truthful and accurate:** businesses must live up to the claims they make about their products, services, brands, and activities.

2. **Be clear and unambiguous:** the meaning that a consumer is likely to take from a product's messaging and the credentials of that product should match.

3. **Not omit or hide important information:** claims must not prevent someone from making an informed choice because of information which has been left out.

4. **Only make fair and meaningful comparisons:** any products compared should meet the same needs or be intended for the same purpose.

5. **Consider the full life cycle of the product:** when making claims, businesses must consider the total impact of a product or service. Claims can be misleading where they do not reflect the overall impact or where they focus on one aspect of it, but not another.

6. **Be substantiated:** businesses should be able to back up their claims with robust, credible and up to date evidence.

The GGCS will use the same principles during any assessment of whether a member has been *"honest and transparent"* in their marketing of green gas.

GGCS members active in European Member states should be aware of the *"The Empowering Consumers for the Green Transition (ECGT) directive"* that comes into force in September 2026 to *"strengthen consumer protection rules against greenwashing"*[4]. There is more information on the

[1] GGCS may import RGGOs from other registries where sustainability information is not included in the RGGO. Consumer of those RGGOs should make their own checks on the sustainability standards in the country of production.
[2] https://www.ofgem.gov.uk/industry-licensing/licences-and-licence-conditions
[3] https://greenclaims.campaign.gov.uk/
[4] Sustainable consumption - European Commission

European Commission's website and GGCS' understanding is that it mirrors the principles set out in the UK's Green Claim's Code.

4. REQUIREMENTS OF GGCS MEMBERS

As stated in the introduction, this guidance intends to help members conform with the GGCS Scheme Rule that they should be *"honest and transparent"* when marketing green gas.

Where members do not comply with GGCS Scheme Rules, then the Scheme Sanction Policy may be used.[5]

If a GGCS member is found to be in breach of the UK Government Green Code Claim, it will trigger the GGCS to assess whether the member has breached the GGCS Scheme Rule requirement to be *"honest and transparent"*.

5. KEY TERMS AND PRINCIPLES

The following section contains information on the topics the GGCS considers essential to address when accurately describing the environmental benefits and impacts of biomethane.

5.1 Biomethane is a low but *not* zero carbon green gas

The production, transport and consumption of biomethane creates GHG emissions which vary significantly depending on the inputs and production process but are always above zero[6].

Gas produced under the NDRHI may have a GHG impact from its production process, of up to 125 gCO_2e/kWh NCV, which is a 38% reduction compared to the combustion emissions of fossil methane (natural gas).

Gas produced under the Green Gas Support Scheme (GGSS) may have a GHG impact from its production process of up to 84 gCO_2e/kWh NCV, which is a 58% reduction compared to the combustion emissions of fossil methane.

According to GGCS analysis of Ofgem data on NDRHI claims, actual GHG values for crop-based biomethane are usually around 80-110 gCO_2e/kWh NCV and for waste and residue-based biomethane are around 35-80 gCO_2e/kWh NCV.

The lowest common CO_2 value of 35 gCO_2e/kWh NCV would represent an 82% reduction compared to the combustion emissions of fossil methane.

Emissions beyond the production point should also be recognised and values related to those areas are considered in section 5.6 below.

Therefore, we believe it is inappropriate to describe biomethane as "zero carbon" and it should instead be described as "low carbon".

[5] See Guidance Document 1 or 2 for details of the Scheme Sanction Policy: https://www.greengas.org.uk/news/ggcs-guidance-documents

[6] For more information about reporting GHG impacts under Scopes 1 and 3 see GGCS Guidance Document 15, available here: https://www.greengas.org.uk/news/ggcs-guidance-documents

An exception to this statement applies when negative GHG values are included for manure use and/or carbon capture and further guidance is provided on this topic below, in Section 5.2.

This principle also applies to biopropane and hydrogen where there will also be emissions arising from the production and distribution process. For biopropane we use the RTFO GHG threshold of 118 gCO_2e/kWh NCV as our reference point. For hydrogen we use the Low Carbon Hydrogen Standard threshold of 72 gCO_2e/kWh NCV.

5.2 What about negative emissions from manure use or carbon capture?

GGCS recognises that the methodology within the NDRHI and GGSS allows for negative GHG emissions to be included in calculations of the impact of the biomethane production process (see Sections 7for details).

The use of negative GHG emissions can balance out the positive GHG emissions from the production process and may lead to biomethane which has a zero or negative GHG emission value.[7]

We provide information in this guidance and on our website explaining how negative values can be applied within this process. Where RGGOs and associated Cancellation Statements carry an actual GHG value, then they will also state if negative values from carbon capture and or manure use have been applied in the calculation of that value.

The key aspect for GGCS members is to ensure that any claims they make around biomethane GHG values, whether that value is low, zero, or negative, should include clear information on how that calculation was made and the role of negative values.

Claims based on carbon neutrality or negative values from the use of carbon capture should make it clear if that carbon is being stored in the medium- or long-term (50-1000 years) or being released within a short time frame i.e. using in food and drink manufacturing and released within weeks or months.

All parties should be aware that where carbon dioxide is released in a short time frame any negative emissions claims will not be valid within the Greenhouse Gas Protocol's (GHGP) methodology. Similarly, any negative GHG values used related to the use of manure will not be valid within the GHGP's methodology because they represent a counterfactual and not an actual saving.

5.3 Will biomethane be zero carbon in the future?

GGCS believes that biomethane producers can drive down the GHG emissions arising from its production and (without any GHG credits from manure or carbon capture) it may be a zero carbon, or close to zero carbon, gas in the future.

This can be done by replacing fossil fertiliser with organic digestate and compost, increasing the use of wastes and residues, using zero-emission vehicles for the transport of feedstocks and using

[7] If 100% of CO_2 is captured from the biogas to biomethane upgrading process then the GHG intensity of biomethane is reduced by 39.6 gCO_2e/MJ (Assessment of impact on biogas producers of proposed changes to sustainability criteria, NNFCC (2016)):
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/577055/Annex_E_-_Report_on_sustainability_criteria.pdf
A negative credit of 45 gCO_2e/MJ can be used within the GGSS when using manure.

only low and zero-carbon electricity and gas to power the production process. It will also be vital to achieve a very low methane leakage rate e.g. below 0.5%.

5.4 Does the GHGP allow you to report biomethane use as zero carbon?

See our guidance on the GHGP for full details[8] and note that these rules are subject to an ongoing review process by the administrators of the GHGP.

Convention since 2015 has been that the Scope 1 emissions from the combustion of biomethane can be reported as very close to zero and that the CO_2 released is biogenic and can be reported off scope.

The reason that Scope 1 emissions occur (even if you consider all CO_2 released to be biogenic) is that a small amount of methane will remain un-combusted and be released to atmosphere and any combustion will generate an amount of NO_X which is a greenhouse gas.

The UK Government's GHG conversion factors from 2025 give a value of 0.38 gCO_2/kWh[9] for these "combustion" emissions.

Emissions arising from the production process and transport of biomethane to the consumption point should be reported by a gas consumer as part of their Scope 3 emissions.

Even if a consumer is not publishing their Scope 3 emissions they should still recognise within their reporting i.e. in an explanatory note, that their use of biomethane has upstream emissions and avoid describing their consumption as zero carbon or carbon neutral unless they have taken steps to offset the relevant Scope 3 emissions.

Refer to Sections 5.1 and 5.2 on how negative emissions used by a biomethane producer may or may not be able to be included in a consumer's Scope 3 reporting.

5.5 Comparing biomethane to fossil methane (natural gas)

Relevant GHG thresholds from the NDRHI or GGSS, or an actual GHG calculation can be referenced to indicate the level of carbon savings vs fossil methane.

A common approach is to compare GHG emissions from the combustion of fossil methane (natural gas) against GHG emissions from the production and transport of biomethane (with the combustion emissions of biomethane being considered as biogenic and "zero carbon").

However this does not provide the full comparison of emissions from production of both gas types, transport to users and combustion. That comparison is given below using standard emission factors.

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[8] See GGCS Guidance Document 15, available here: https://www.greengas.org.uk/news/ggcs-guidance-documents

[9] [Greenhouse gas reporting: conversion factors 2025 - GOV.UK](#): 0.10625 $kgCO_2/GJ$ = 0.0010625 $kgCO_2/MJ$ @1000 MJ per GJ = 0.0003825 $kgCO_2/kWh$ @ 1 kWh per 3.6 MJ = 0.3825 gCO_2/kWh @ 1000 g per kg.

5.6 Using offsets to create a carbon neutral product

Consumers and suppliers may seek to make their gas consumption or supply "carbon neutral" through a combination of matching their gas consumption with green gas via RGGOs and purchasing carbon offsets (also referred to as carbon credits).

GGCS believes that any use of offsets should be made explicit and that the correct methodology for suppliers and consumers to achieve carbon neutrality in this way is to purchase offsets that cover the upstream emissions (production), midstream (transport) and downstream (combustion) emissions of both the fossil gas and biomethane (or other green gas) being supplied or consumers, and not just the downstream emissions from the combustion of fossil gas.

5.7 Upstream, midstream and downstream emissions related to fossil gas and biomethane

The table below gives the GGCS view of where GHG emissions will arise from supply of both gas types and the gCO_2e NCV values we believe are applicable. These values maybe updated in future publications of emission factors or GGCS members may use other recognised and credible values where appropriate.

All values have been quoted using Net Calorific Value in line with the NDRHI and GGSS approach but gCO_2e Gross Calorific Value (Higher Heating Value) may be used if recommended by a recognised GHG accounting methodology or a relevant auditor. For simplicity with have stated only the gCO_2e Net Calorific Values in this document. All CO_2 values are for Carbon Dioxide equivalent.

Emission Type	Biomethane	Fossil Gas (Methane)
Upstream – emissions from production of gas	Emissions will arise from the production process including collecting feedstocks, compressing gas, and methane leaks. These are captured in GHG values calculated for the NDRHI or GGSS or within voluntary scheme certification e.g. ISCC. Threshold values are always quoted on RGGOs and can be used. Actual values can be recorded by producers at the request of their counterparties.	Fossil gas can come from a range of sources with varying emissions. The UK Government's emission factors give a value of 33.47 gCO_2e /kWh NCV based on a European Commission report from December 2015.[10]

[10] Greenhouse gas reporting: conversion factors 2025 - GOV.UK

Midstream – emissions from transport of gas from production to consumption (generally via a gas grid)	No emissions from the midstream are included in the NDRHI or GGSS methodology; however, they will be given in any ISCC Proof of Sustainability document. The UK Government's RTFO guidance has previously stated that 0.15% losses in the grid is a reasonable assumption, which would generate 2.7 gCO_2e/kWh[11].	Emissions from the gas grid are included in the upstream value given above. If quoted separately then the UK Government's RTFO guidance has previously stated that 0.15% losses in the grid is a reasonable assumption, which would generate 2.7 gCO_2e/kWh[12].
Downstream – emissions from combustion	The CO_2 released is considered to biogenic and can be reported as zero (depending on the reporting rules being followed). 0.38 gCO_2e /kWh NCV from methane slip and NO_X emissions should be accounted for (see Section 5.4 above).	The standard natural gas factor[13] can be applied: 202.70 gCO_2e /kWh NCV

An example of good and bad practice of how the table above could be applied is provided below.

Bad practice – carbon neutral claims without any offsets for upstream biomethane emissions or upstream/midstream fossil gas emissions		
Type of Claim	**RGGOs/offsets used**	**Result**
10% biomethane	Purchase and cancel RGGOs equivalent to 10% to total gas consumption/supply (by kWh).	No offsets have been purchased to cover the upstream emissions from biomethane production which may be as high as 125 gCO_2/kWh, or for the midstream emissions from grid losses (2.70 gCO_2e /kWh) or combustion emissions (0.38 gCO_2e /kWh).

[11] 0.15 kWh = 0.000108kg CH_4 at 3.6 MJ/kWh and 50 MJ/kg. Based on 1 kWh being 0.072 kg of CH_4 with a Global Warming Potential (GWP) of 25.

[12] 0.15 kWh = 0.000108kg CH_4 at 3.6 MJ/kWh and 50 MJ/kg. Based on 1 kWh being 0.072 kg of CH_4 with a Global Warming Potential (GWP) of 25.

[13] Greenhouse gas reporting: conversion factors 2025 - GOV.UK

90% fossil gas	Purchase and cancel offsets equivalent to 90% to total gas consumption/supply (by kWh) * emission factor for combustion of methane (202.70 gCO_2e/kWh).	No offsets have been purchased to cover the upstream or midstream emissions from fossil gas production (33.47 gCO_2e/kWh NCV).

Good practice – recognise the upstream and downstream emissions for fossil gas and biomethane		
Type of Claim	**Action by supplier**	**Result**
10% biomethane	Purchase and cancel RGGOs equivalent to 10% to total gas consumption/supply (by kWh). Purchase offset equivalent to the emissions arising from the production of the biomethane using either a default value e.g. 125 gCO_2e/kWh NCV, an actual value recorded on a RGGO or a PoS. A small amount of GHG emissions from methane loss in the grid ~3 gCO_2e/kWh and emissions at the point of combustion ~1 gCO_2e/kWh.	All emissions associated with this gas production, transportation and use are now matched to offsets.
90% fossil gas	Purchase and cancel offsets equivalent to: 90% to total gas consumption/supply (by kWh) * emission factor for combustion of methane (202 gCO_2e/kWh NCV). An upstream emission factor of 60 gCO_2/kWh (higher than the government's stated figure, but a conservative approach).	Use of fossil gas leads to emissions upstream of its combustion e.g. energy used and methane leaks during the extraction and transport of fossil methane through pipelines. For these kWh to become carbon neutral offsets should be purchases to cover these emissions as well as the emission from combustion.
General Marketing	Transparently describe your process and calculations with reference to the principles of the UK Gov's Green Claim's Code. Full details may not be part of all marketing materials but links are included to your website where these calculations are set out.	

5.8 Biomass inputs to produce biomethane are renewable, but not unlimited

Biomethane has the potential to play a significant role in helping the UK reach net zero; however, the feedstocks required for its production are limited by the amount of available wastes and residues e.g. food waste, manures, and sewage sludge, and the amount of crops that are deemed appropriate to grow for energy production.

Current UK production of biomethane is approximately 5.5 TWh/year with research produced by the Green Gas Task Force showing the potential for this to grow to 50 TWh by 2030 and 120 TWh by 2050.[14]

Total UK gas consumption was approximately 650 TWh in 2024[15]. Therefore, even if shifting electricity production to renewables, efficiency measures, and electrification of heating reduced that to 250 TWh/year, biomethane meets only ~50% of that demand. NESO'S Future Energy Scenario's most ambitious pathway shows 38% of gas demand coming from biomethane by 2050[16].

GGCS members should recognise that biomethane and production and consumption is a positive step the UK can take now to decarbonise and has significant room to grow. However, in the long-term, demand reduction through energy efficiency, electrification, and the use of other types of green gas will very likely be necessary.

When marketing biopropane GGCS members should consider the best available evidence and recognise that it is currently produced and distributed in small quantities being around ~100 GWh in 2025. The liquid gas industry has set a target of 100% renewable based supply by 2040[17] covering approx. 7 TWh of demand. Some analysis of feedstock availability has been conducted when setting that target, but further research is needed establish the details e.g. what % may need to be imported and availability in competition with other demands e.g. Sustainable Aviation Fuel (SAF).

5.9 Renewable inputs still have environmental impacts

While crops grown for biomethane and biopropane production, as well as those crops that ultimately become residues and wastes, are renewable there is a GHG impact from their growth, harvesting, collection, and processing.

Renewable inputs should not be harvested at an unsustainable rate and undue pressure for land use change should be avoided.

The GGCS believes that the UK government has put in place reasonable provisions to limit the use of crops for biomethane production. These can be explored in detail within the documentation for the NDRHI and GGSS and are summarised below:

- GHG emissions arising from the production, collection, processing of crop feedstocks into biomethane must be calculated and shown to be below a set threshold.

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[14] The Green Gas Taskforce | Key reports and findings
[15] Future Energy Scenarios 2025: https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents
[16] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2020-documents
[17] https://www.liquidgasuk.org/policy/liquid-gas-uk-the-industrys-journey-to-2050

- Crops used in biomethane production must not be grown on land that has been converted from a use with high carbon and/or biodiversity values e.g. primary forest, land designated for nature protection purposes, highly biodiverse grassland, peatland, a former continuously forested area, or a former wetland area[18].

- Plants commissioned since 2018 must generate at least 50% of their biomethane from wastes and residues to receive financial support for all of their output.

For biopropane, the GGCS does not issue RGGOs for production from palm oil products and those inputs will no longer be incentivised within the Renewable Energy Directive (relevant to biofuel quotas in the EU) by 2030.

6. EXAMPLES OF GOOD AND BAD PRACTICE IN COMMUNICATING THE ENVIRONMENTAL BENEFITS AND IMPACTS OF BIOMETHANE AND BIOPROPANE

Example of bad practice	Example of good practice
Biomethane/biopropane is zero carbon and does not produce any carbon emissions.	Biomethane/biopropane is lower carbon than natural gas/fossil propane, but does create GHG emissions during the production process.
The biomethane/biopropane we supply is zero carbon.	The biomethane/biopropane we supply is low carbon. or The biomethane we supply is zero carbon. GHG emissions from the production process are balanced out by the carbon savings from using manure and capturing the carbon dioxide from the biogas upgrading process, as allowed by UK Government guidance. Customers should consult with their internal or external sustainability advisors on the validity of negative GHG values from manure use and carbon capture.
The gas we supply is carbon neutral.	The biomethane we supply is carbon neutral which means the GHG emissions from the production to consumption point have been matched to the purchase of high quality carbon credits/offsets. For more information about our carbon credits/offsets see here [provide link].

[18] OFGEM (2022) Non-Domestic Renewable Heat Incentive – Sustainability Self-Reporting Guidance (version 2)

Example of bad practice	Example of good practice
Biomethane is a renewable product that can completely replace our use of fossil fuels.	Biomethane can make a significant contribution to the UK reducing our need for fossil gas. It is a renewable product, but there are still environmental impacts from its production and use that are carefully monitored against rules set by the UK Government.
Biomethane can be produced from a range of wastes and residues *(with no reference to whether RGGOs sourced represent wastes, residues or products (crops))*.	We supply biomethane produced only from wastes and residues. or We supply biomethane produced from energy crops which are a renewable source for which the UK Government sets clear sustainability rules.

6. VARIATIONS IN GHG CALCULATION METHODOLOGIES

The GGCS does not conduct GHG calculations for biomethane production[19] and all such calculations should be carried out by a qualified expert. Below is our indicative guide to which emissions are incorporated into calculations within each scheme. The purpose of the table is to highlight the complexity and variations that may occur and provide a starting point for consumers to hold further discussions with biomethane producers and traders.

Methodology	NDRHI[20]	GGSS[21]	RTFO[22]	GHGP
GHG from Crop Production	Calculation with actual or default values	Calculation with actual or default values	Calculation with actual or default values	Calculation with actual or default values
GHG from Waste Inputs	No calculation required	Emissions from point of collection included	Emissions from point of collection included	Deemed to be zero. Definition of waste may vary from NDRHI/GGSS/RTFO

[19] GGCS collect evidence that those calculations have been carried out by qualified experts and that they show relevant thresholds have been met.

[20] OFGEM (2022) Non-Domestic Renewable Heat Incentive – Sustainability Self-Reporting Guidance (version 2)

[21] Department for Business, Energy & Industrial Strategy (2021) Methods of calculating greenhouse gas emissions: “actual value method” and “default value method”

[22] assets.publishing.service.gov.uk/media/69a80c033b5b78231d1a9b78/dft-rtfo-compliance-guidance-26.pdf

Methodology	NDRHI[20]	GGSS[21]	RTFO[22]	GHGP
GHG from Residue Inputs	Emissions from point of collection included	Emissions from point of collection included	Emissions from point of collection included	Deemed to be zero. Definition of residue may vary from NDRHI/GGSS/RTFO
Consignment by consignment or average emissions?	kWh from each feedstock must meet the GHG threshold	Average of all GHG emissions across all kWh produced	kWh from each feedstock must meet the GHG threshold	Average of GHG emissions across all kWh produced
Negative GHG emission for use of manure?	No	Yes – 162 gCO_2e/kWh	Previously allowed. Use restricted from Jan 2024 onwards	No – counterfactual emission reductions not recognised. GHG value used should not include any negative credit
Methane leakage from biomethane plant	Yes – default values are 1% from AD and 1% from gas upgrade. Literature or actual values can be used.	Yes – (subject to conditions being met) default values are 1% from AD and 3% from gas upgrade processes[23] . Literature or actual values can be used.	Yes – deemed to be 1% from AD and 1% from gas upgrade Literature or actual values can be used.	Yes – any acceptable literature values can be used
Imported electricity inputs to production process	Yes – at grid average without any use of GoO	Yes – at grid average without any use of GoO	Yes – at grid average without any use of GoO	Yes
Fossil gas inputs into production process	Yes	Yes	Yes	Yes
Energy used in gas	No	No	No	Unclear

[23] For further details see: [Guidance for reporting fugitive methane emissions on the Green Gas Support Scheme]

Methodology	NDRHI[20]	GGSS[21]	RTFO[22]	GHGP
transportation to consumers				
Methane Leakage during transportation to consumers	No	No	Yes	Unclear
Negative GHG credit from capture of CO_2 during gas upgrading	Yes – if transported off site	Yes – if transported off site	More information needed	No – unless long-term storage is assured
Combustion of Biomethane	No	No	No	CO_2 considered as biogenic and off scope. Residual GHG from NO_X and methane slip reported in Scope 1

7. MORE DETAILS OF THE ENVIRONMENTAL IMPACT OF BIOMETHANE PRODUCTION

This section provides more details on how CO_2 emissions are calculated at each stage of the biomethane production process. As detailed in the table in Section 6, calculations can vary according to the methodology used.

7.1 Crop production

Growing crops involves various inputs and processes which result in GHG emissions. These are counted in the GHG calculations made within the NDRHI, GGSS, and RTFO, and include:

- production of fertilisers and pesticides produced from fossil fuels or other resources
- nitrous oxide released by bacteria breaking down nitrogen fertilisers
- consumption of fuel by tractors and farming equipment
- harvesting, processing, and transporting feedstocks from the field to the production facility

Increases or decreases in soil carbon content and the associated storage of, or release of CO_2 to the atmosphere can be included in emissions calculated for the NDRHI, GGSS, and RTFO. However we are not aware of any instances where these emissions are being measured and accounted for.

These carbon stock changes may need to be measured in the future to provide GHG values that are valid within the GHGP.

There is no accounting for indirect land use change in the NDRHI, GGSS or RTFO methodology but it is required by the GHGP Land sector and Carbon Removal Standard (under the concept of "agricultural leakage")[24].

7.2 Wastes and residues

GHG emissions are allocated to the initial product that was created and not to the residues and wastes that arise from the production process or remain after that product was used. For example:

- GHG emissions from grain used in whisky distilling are included in the GHG emissions of the whisky product and not in the residues remaining from that grain, which is then used to generate biomethane

- GHG emissions arising from livestock farming are allocated to the products created e.g. meat and cheese, and not to the manure which arises during the process

Recovering energy from wastes and preventing them from storage and disposal methods that do not capture methane emissions e.g. landfill without methane recovery, or open slurry lagoons, is an environmental benefit of biomethane production. However, GGCS members and consumers should be aware of links to the livestock industry and the discussions of the environmental impacts of that industry.

Under the GGSS GHG calculation methodology, using manure creates a negative credit of up to 162 gCO_2e/kWh within the overall GHG calculation. This methodology may not be valid under the GHGP and since January 2024 has not been allowed in the RTFO.

7.3 Transport of feedstocks (crops, residues, or wastes) to biomethane production sites

Crops are generally grown within a 10–20 mile radius of a biomethane plant and will be transported by road.

Wastes and residues may come from a variety of sources. For example, the collection of food waste from households and business which will involve collection vehicles making rounds.

Biomethane producers will use a standard factor for fuel use per mile and for GHG per litre of fuel use.

Under the NDRHI, wastes are deemed to have met the GHG criteria and no actual calculations of GHG emissions from transport are made. Residues are required to account for transport emissions from the point of collection.

The GGSS does require emissions from waste collection to be accounted for, which creates a more accurate assessment of the whole footprint of the production process and reduces the risk of wastes being transported over long distances.

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[24] Land-Sector-and-Removals-Standard.pdf

7.4 Methane leakage during the production process

Biomethane producers will aim to inject all methane produced into the grid; however, in any process there will be some level of leakage.

Methane has a significant Global Warming Potential (GWP) which is quoted in the Green Gas Support Scheme Greenhouse Gas Calculator as 25 gCO_2e[25].

For each 1% of methane leaked approximately 18 gCO_2 of emission occur (using the GWP 25 gCO_2e factor). Therefore, a production pathway where leakage is above 10%+ of the total will not generate any GHG benefit over the production and use of fossil gas.[26]

The NDRHI methodology allows standard values to be used of 1% leakage of all gas during the anaerobic digestion process and 1% during the biogas to biomethane upgrading process. This approach adds 36 gCO_2e/kWh.

The GGSS methodology allows standard values or 1% leakage of all gas from the anaerobic digestion process and a standard value of 3% leakage during the biogas to biomethane upgrading process[27], provided that an annual Leak Detection And Repair (LDAR) process is put in place and that digestate storage is covered,

This approach adds 72 gCO_2e/kWh which is very close to the GGSS threshold and therefore producers are likely to use an actual value for the upgrading process which can be provided by the equipment manufacturers, which we understand is often as low as 0.5%.

For fugitive emissions of methane, it should be acknowledged that there are technical challenges to their measurement, which makes the use of standard and default values common in GHG emission methodologies.

Where sites process wastes (being approximately 80% of all sites) an LDAR process will be required via the permitting processes overseen by the Environment Agency, the Scottish Environmental Agency, or Natural Resources Wales[28].

Any site participating in the AD Certification Scheme must also implement an LDAR process[29], as must any sites receiving payments under the Green Gas Support Scheme (GGSS).

Sites without a permit described above will almost certainly have an LDAR process in place as good business practice. GGCS has started confirming this via our Data Verification Statement (DVS) process from May 2026 onwards. The DVS will also require producers to declare which leakage rates they have used in their GHG calculations and report any leaks they have detected.

[25] The IPCC indicate that the methane GWP over 20 year is ~85 gCO_2e - Methane and climate change – Methane Tracker 2021 – Analysis - IEA; however, most approaches use the 100 year GWP factor.
[26] 11% leakage would result in the remaining kWh being linked to ~198 gCO_2e/kWh which is similar to the ~200 gCO_2e/kWh (HHV) of combustion emission from fossil methane. Considering that there are also emissions associated with feedstock grown, transport, processing etc in addition to any emissions from methane leakages then emissions from leakage need to be well below 200 gCO_2e/kWh in order to generate emission savings vs fossil gas use
[27] Refer to page 6: Guidance for reporting fugitive methane emissions on the Green Gas Support Scheme
[28] Fugitive Emission Strategy 2022
[29] AD Certification Scheme UK | ADBA | Anaerobic Digestion & Bioresources Association

NB: Where leakage rates appear to be significant i.e. 5%+, then GGCS may request further information on if GHG thresholds have been met and may not issue RGGOs or withdraw RGGOs already issued.

GGCS will continue to monitor policy and regulation in this space and how its members measure and account for methane leakage and update this document and our website accordingly.

7.5 Energy used during the biomethane production processes

The biogas production process requires energy to power and heat a range of processes including:

- vehicles moving feedstock from storage to digestion tanks
- mixing and stirring of materials in digestion tanks
- pumping of materials between tanks
- heating of digestion tanks to create the optimal conditions for anaerobic digestion
- pasteurisation of feedstocks if required by regulations
- parasitic electricity demand and ancillary on-site processes

Upgrading biogas to biomethane can be done via a range of methods which all require energy inputs, for example:

- compression of biogas through membranes to separate the CO_2
- heating of CO_2 absorption materials before reuse

Depending on the method of upgrading, further compression of the biomethane may then be needed to bring it up to the pressure of the gas grid it is injected into.

7.6 Energy used to transport biomethane to an injection site

Some biomethane producers do not inject gas into the grid in the same location they have digested feedstocks, produced biogas, and upgraded it to biomethane. They compress the biomethane and transport it by road to an injection site which may be 50-100 miles away. Emissions from transport are included in the NDRHI and GGSS methodology and may represent approximately 10% of total emissions, equivalent to around 25 gCO_2/kWh.

7.7 Use of biogas produced on-site

Most biomethane sites will use some of their biogas to fuel a Combined Heat and Power (CHP) plant to provide on-site energy. This is usually lower carbon than using grid electricity or natural gas; however, there is a trade-off with lower amounts of biogas being available for subsequent upgrading to biomethane.

If biogas produced on-site is used to power the above processes, then this is either:

a) Given a GHG value depending on how the biogas is produced. As described in this paper, biogas is low carbon (not zero carbon) hence the GHG models allow for this by calculating the upstream emissions from biogas produced.

or:

b) Biogas is rated with a zero GHG factor and all GHG emissions are allocated to the end products being the biomethane and digestate.

The resulting GHG factor given to the biomethane is the same under both approaches.

If natural gas (fossil gas) is used the emissions from this natural gas use are incorporated into the overall GHG calculation using a standard value i.e. 204 gCO_2e/kWh NCV.

7.8 Energy used by CO_2 capture and purification

Where a biomethane plant captures the CO_2 from the upgrading process, the energy associated with the capture and purification process is incorporated into the GHG calculations. CO_2 capture requires energy primarily for the compression and liquefaction of the CO_2 so it can be fed into a tanker and transported for subsequent use. The electricity demand for this process is included in the GHG calculations as it forms part of the biomethane's facility operational energy requirements.

7.9 Negative GHG emissions from carbon capture

Biogas produced from anaerobic digestion is primarily a mixture of methane and carbon dioxide. When it is upgraded to biomethane the carbon dioxide is removed, can be captured, and used. Typical uses to date have been:

- in greenhouses to enhance plant growth rates
- carbonation of soft drinks and beer
- other uses in food and drink manufacturing

Options for long-term carbon storage (so-called Carbon Capture and Sequestration (CCS)) are currently being explored.

Regardless of the use of the carbon dioxide, if it is captured and taken off-site this can be incorporated into GHG calculations under the NDRHI and GGSS. The total amount of carbon dioxide captured is divided by the kWh of biomethane produced and a reduction of 72-108 gCO_2/kWh is typical[30]. This will depend on the gas quality, efficiency of the capture process, and system downtime.

However for this negative GHG factor to be valid under the Greenhouse Gas Protocol, the carbon dioxide needs to be stored over a long time frame, with continued monitoring[31].

[30] The theoretical maximum capture rate is minus 142 gCO_2e/kWh: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/577055/Annex_E_-_Report_on_sustainability_criteria.pdf
[31] Land-Sector-and-Removals-Standard.pdf

7.10 GHG arising from the transport of biomethane from producer to consumer

Biomethane is generally injected into the gas grid. It is chemically identical to fossil methane that composes the main volume of gas in the grid, and its injection does not result in additional emissions beyond those already arising from the operation of the gas grid.

However, a share of the emissions from grid operation could form part of some GHG assessments and are composed of:

- energy used for monitoring and control of gas flows within the grid
- methane leakage from the grid

These emissions are not accounted for in NDRHI or GGSS methodology as the incentives are based on the process up until the point of injection to the grid and these GHG emissions are outside the operational control of the biomethane producer.

The point at which GHG emissions are calculated differs between the RTFO and the NDRHI/GGSS. The RTFO is an obligation for fuel sales at the consumer pump, whereas the NDRHI/GGSS is for biomethane injected into the grid. Therefore, the RTFO does include *"emissions associated with the pumping and distribution through pipeline grids"* and emissions from *"any other transport or processing of the gas at any point in the chain of custody including any conversion to CNG or LNG and/or regasification"*[32] (DfT, 2022) and *"emissions associated with methane leakage from the grid"*[33].

DfT RTFO guidance in 2018 indicated that a methane leakage rate of 0.15% from the grid could be used. This equals ~3 gCO_2e/kWh so there is a small but material impact that should be accounted for.

There are also values for total methane emissions from the grid given in the National GHG inventory published by the UK government[34].

7.11 Emissions from the compression or liquefaction of biomethane before consumption

If gas is taken from the grid and then compressed or liquefied to make it ready to be used in transport, then the energy used in those processes will generate GHG emissions which should be accounted for by the consumer/vehicle operator.

7.12 Emissions arising from the construction of biomethane production facilities

Production of concrete, steel, plastics, and other materials used in the construction of biomethane sites will generate GHG emissions. However, in common with GHG values attributed to other energy types and generation methods e.g. fossil gas production or electricity from solar panels, these are not accounted for in the NDRHI or GGSS calculations. The EU Renewable Energy Directive (RED) II specifically states that "*Emissions from the manufacture of machinery and equipment shall not be taken into account*". The main reason for this is due to the relatively low

[32] DfT (2022) RTFO Guidance Update for Biomethane, Including as a Chemical Precursor
[33] DfT (2022) Renewable Transport Fuel Obligation Guidance
[34] [Greenhouse Gas Inventories for England, Scotland, Wales & Northern Ireland: 1990-2023 | National Atmospheric Emissions Inventory]

impact of so-called “embodied emissions” or “capital emissions” when compared to “operational emissions”.

To illustrate this, below is a simple example of the “embodied emissions” from a biomethane plant[35]:

			Emission Factor	Total GHG emissions		
Material	**Quantity**	**unit**	**kgCO2e / unit**	**kgCO2e**	**tCO2e**	**gCO2e**
Concrete	200	tonnes	131.76	26,351.78	26.35	26,351,780
Metals	100	tonnes	3,975.82	397,582.34	397.58	397,582,337
Plastic	20	tonnes	3,116.29	62,325.83	62.33	62,325,831
Diesel	50,000	litres	2.71	135,276.50	135.28	135,276,500
				621,536.45	**621.54**	**621,536,449**

Typical biomethane produced from biomethane plant per annum	40,000,000	kWh
	144,000,000	MJ
Life of plant under the NDRHI (actual lifetime will be longer)	20	years
Total biomethane produced over 20 years	800,000,000	kWh
	2,880,000,000	MJ
Emissions from construction	0.22	gCO2e / MJ
	0.78	gCO2e / kWh

[35] Please note this is a worked example for illustrative purposes only. It does not use actual values from a plant, so the results are provided to give an indication of the relative emissions of construction using estimated values and UK Government Emission Factors.

The figures above, while indicative, show that including the embodied emissions would add less than 1 gCO_2e/kWh, set against the NDRHI threshold of 125 gCO_2e/kWh. Therefore, they do not appear to be a significant factor in the GHG impact of biomethane production and would not be even if the quantities of materials used were substantially different to the assumptions used above.

7.13 Emissions arising from the construction of biopropane production facilities

Biopropane is produced in refineries such as Neste, Rotterdam and Phillips 66, Immingham. We do not have any data on the embodied emission of these facilities, but they are likely be low in comparison to the large energy outputs they have.

7.14 Emissions arising from the construction of hydrogen production facilities

There are range of electrolysis technologies which may have different level of embodied carbon. A 2025 literature review cites values of ~6 gCO_2/kWh[36]

8. BENEFITS AND IMPACTS OF OTHER TYPES OF GREEN GAS

The information in Sections 5, 6, and 7 relate to biomethane, but the principles in Section 2, 3, and 4 (e.g. being "honest and transparent") apply equally to the marketing of any green gas.

GHG calculation methodologies may vary slightly between different green gases depending on the nature of the production method and government support schemes and rules; however, they will be broadly similar in trying to capture a full picture of GHG emissions resulting from a production process.

Biopropane

The GGCS currently issues RGGOS for biopropane where the GHG methodology is the RTFO, ISCC-EU, or ISCC-Plus and the threshold met is 118 gCO_2e/kWh or lower.

Biopropane is currently produced in a refining process where either biogenic material, or a mixture of biogenic and fossil inputs, is processed to create a range for products such as biodiesel and SAF. The two current producers are:

- Phillips 66 in Immingham, UK – Renewable Fuels - UK | Phillips 66
- Neste in Rotterdam, Netherlands – Rotterdam refinery | Neste

GGCS issues RGGOs at the point biopropane is delivered into the distribution network of a propane supplier, either directly or on a mass balance basis. RGGOs are then allocated either to the customers of the supplier who has received the biopropane or can be transferred to other parties if a biopropane delivery is made to that party on a physical or mass balance basis.

[36] Life Cycle Emissions of Hydrogen Production Technologies in the Nordics: https://eu-opensci.org/index.php/ejenergy/article/view/7176#title-11

Hydrogen

GGCS has issued a small number of RGGOs for hydrogen produced from the electrolysis of water. The primary environmental impact of this process is the use of electricity which may or may not be from renewable sources. The UK Low Carbon Hydrogen Standard sets a threshold of 72 gCO_2/kWh which is comparable with the threshold for biomethane in the Green Gas Support Scheme[37].

Alongside electricity use inputs of water are sometimes cited as an environmental impact of green hydrogen production.

Hydrogen production from the splitting of methane (or other hydrocarbons) into hydrogen and carbon can be low carbon and green if the carbon is captured and stored. The GGCS has not issued any RGGOs from this production pathway.

9. CONCLUSIONS

The environmental benefits of biomethane, biopropane, and hydrogen should be honestly and transparently described and its impacts should also be acknowledged.

In particular, the carbon emissions arising from the production of green gases should be recognised.

Green gases should either be described as a "low carbon" energy source or, where it is described as "zero carbon" or "negative carbon", the relevant use of offsets or negative values from manure use or long- or short-term carbon capture should be described and with full accounting of the upstream (production) and midstream/downstream (transport and consumption) emissions.

Key rules and principles for these describing benefits and impacts are contained within the GGCS Scheme Rules, Gas Supplier licence obligations, and the UK Government Green Claims Code to which this guidance document provides further detail and context.

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[37] https://www.gov.uk/government/publications/uk-low-carbon-hydrogen-standard-emissions-reporting-and-sustainability-criteria