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Smart Export Guarantee (SEG)

Dec 2019

Guidance for Anaerobic Digestion generators: SEG sustainability criteria and reporting requirements

Overview

This document is for anaerobic digestion (AD) generators in England, Scotland and Wales that wish to receive export payments under the Smart Export Guarantee (SEG). It explains how to demonstrate compliance with the sustainability criteria and reporting requirements in order to access a tariff under the SEG.

This is a guidance document only and is not a definitive technical or legal guide to the SEG. It is the installation owner or prospective owner's responsibility to ensure that they are aware of the requirements of the SEG Order and legislation (see associated documents).

This guidance does not provide general information on how the SEG works, or how to access a SEG tariff. For more information on this, please refer to our Smart Export Guarantee: Guidance for generators[1].

Context

On 10 June 2019 the Department of Business, Energy & Industrial Strategy (BEIS) laid legislation – the Smart Export Guarantee (SEG) Order 2019 - and amended the electricity supply licence conditions to introduce the SEG. This policy comes into force on 1 January 2020 and will ensure that any eligible small-scale low-carbon generators will have access to a tariff for their exported electricity.

Solar photovoltaic (PV), wind, hydro and anaerobic digestion (AD) installations up to 5MW and micro-combined heat and power (mCHP) up to 50kW will be able to receive a guaranteed export tariff under the policy, providing they are eligible.

The SEG is a market-led initiative, requiring certain electricity supply licensees to offer export tariffs to eligible generators. Suppliers are free to set their own SEG tariff[2] price (provided it is above zero pence at all times) and decide how their tariffs work.

[1] https://www.ofgem.gov.uk/publications-and-updates/smart-export-guarantee-guidance-generators

[2] 'SEG tariff' is not defined in the SEG Order or SLC, however, we use this phrase to mean the tariff offered to a SEG Generator in accordance with the SEG arrangements (provided that tariff is above zero pence).

Associated Documents

Guidance for SEG Licensees

Policy and legislation

Smart Export Guarantee Order 2019

Smart Export Guarantee License Conditions

The future for small scale low carbon generation: Smart Export Guarantee – government response

Contents

Executive Summary

The Smart Export Guarantee (SEG) makes sure that small-scale low-carbon generators receive payment for any electricity they export to the grid. The scheme requires certain licensed electricity suppliers to offer export tariffs to anaerobic digestion (AD), hydro, onshore wind, and solar photovoltaic (PV) exporters with a total installed capacity up to 5MW, and micro-combined heat and power (mCHP) with an electrical capacity of 50kW or less.

The obligation comes into force on 1 January 2020. It follows on from the Feed-in Tariff (FIT) scheme that closed on 31 March 2019.

This document provides guidance that Anaerobic Digestion SEG Generators should follow in order to meet the SEG sustainability and feedstock requirements.

1. Introduction

Chapter summary
Introduces the sustainability requirements and ongoing reporting obligations placed on anaerobic digestion (AD) generators in order to be eligible for a tariff under the Smart Export Guarantee (SEG).

1.1 In order to be eligible to receive a tariff from a SEG licensee, a generator seeking payments for an anaerobic digestion (AD) installation must demonstrate that all the electricity that they are claiming payments for has been produced using sustainable biogas.

1.2 AD SEG generators must also meet ongoing requirements to report against their feedstocks used in order to be eligible to receive SEG Payments for a period.

1.3 Installations provide declarations to Ofgem that detail sustainability and feedstock information. Where installations have a total installed capacity (TIC) that is greater than or equal to 1MW, installations also submit an annual sustainability audit report.

1.4 Ofgem will review the declarations and, where necessary, audit reports, and confirm installations' compliance with the requirements. A generator will be able to provide this confirmation to their SEG licensee to confirm ongoing eligibility for SEG payments.

1.5 AD SEG generators must also comply with the general SEG eligibility criteria. Further information on these criteria can be found in Chapter 1 of our SEG: Guidance for generators.[3]

Sustainable biogas

1.6 To be eligible to receive a tariff under the SEG, AD installations must use sustainable biogas. Sustainable biogas is biogas that either:

- meets the greenhouse gas criteria and is made from solid biomass that meets the land criteria,
- is made from feedstock which is waste, or
- consists of a combination of both of the above.[4]

1.7 The relevant definitions of these criteria for sustainable biogas are as follows:

a. The land criteria:

[3] https://www.ofgem.gov.uk/publications-and-updates/smart-export-guarantee-guidance-generators
[4] Smart Export Guarantee Order 2019: https://www.legislation.gov.uk/uksi/2019/1005/contents/made

- The land criteria refer specifically to the production of the raw material, such as at the farm, forest or plantation, used by the AD installation.
- The aim is to discourage use of biomass that was sourced from land with a high biodiversity and carbon stock value.
- There are two types of land criteria: for woody biomass and for non-woody biomass.
- More information on the land criteria can be found in chapter 7.

b. The greenhouse gas (GHG) criteria:

- The greenhouse gas criteria refer to the life cycle greenhouse gas emissions of the biomass being used by the AD installation.
- Every consignment of biogas cannot exceed the greenhouse gas threshold. The relevant maximum threshold will be 66.7gCO2e/MJ of electricity generated, falling to 55.6gCO2e/MJ of electricity from 1 April 2020 to 31 March 2025 and then to 50.0gCO2e/MJ of electricity from 1 April 2025 onwards.
- More information on the GHG criteria can be found in chapter 8.

c. Waste:

- Feedstock that is waste or feedstock wholly derived from waste is considered to satisfy the sustainability criteria automatically.

Ongoing obligations

1.8 There are a number of ongoing reporting obligations AD SEG generators must meet in order to receive confirmation from us that they have met their sustainability and reporting requirements and are therefore eligible for SEG payments.

1.9 These are the provision of a quarterly declaration, an annual declaration, and, for installations with a total installed capacity ≥1MW, an independent annual sustainability audit report. Failure to provide these reports to us will mean generators do not receive confirmation from us that they have met their sustainability and reporting requirements and SEG Licensees will not be obliged to make SEG payments for the periods they relate.

1.10 Further information about the ongoing obligations for AD SEG generators is available in chapter 2.

2. Ongoing obligations

Chapter summary

AD SEG Generators have ongoing obligations they need to meet in order to be eligible to receive SEG payments. These include confirming to Ofgem their initial intent to meet the SEG sustainability and reporting criteria, notifying their licensee of their AD Reporting Start Date, submitting quarterly and annual declarations to us, and, in the case of installations with a TIC ≥ 1MW, submitting an annual sustainability audit report.

2.1. In order to begin receiving payments, an AD SEG generator must notify Ofgem of their intent to request SEG payments and comply with the criteria set out in the Smart Export Guarantee Order 2019 (SEG Order)[5]. This is done by email using our SEG compliance declaration template[6].

2.2. This template contains a declaration confirming that the AD SEG generator intends to comply with the sustainability and reporting criteria set out in the SEG Order and that they will submit Fuel Measurement and Sampling (FMS) procedures to Ofgem. The AD SEG generator must sign, scan and email the completed template to: FuellingandSustainability@ofgem.gov.uk[7].

2.3. Once received, we will formally acknowledge receipt by email as soon as possible. The SEG generator should present Ofgem's email acknowledgement to their chosen SEG Licensee as part of their request for a SEG tariff.

2.4. Assuming the request is successful, the date of Ofgem's email acknowledgment (also known as the 'AD reporting start date' (see paragraphs 2.6-2.7 below)) will be the date from which a SEG licensee is obligated to make SEG payments. We recommend that AD SEG generators take a manual export meter reading as soon as possible following receipt of that email.

2.5. Ofgem's confirmation email will also explain the next steps that must be completed in order to receive SEG payments for each period. The first step will be to agree FMS procedures. Further information about the FMS process can be found in chapter 5.

AD Reporting Start Date

2.6. The date that Ofgem formally acknowledges receipt of an AD SEG generators SEG compliance declaration (as described in paragraph 2.3 above) is the AD Reporting Start Date.

2.7. The AD Reporting Start Date will be the first date from which all reporting obligation dates should be calculated. For example, if an installation has an AD Reporting Start Date of 10 February 2020, their first quarterly declaration should concern generation from that date until 9 May 2020 and be submitted to us within 28

[5] https://www.legislation.gov.uk/uksi/2019/1005/contents/made
[6] https://www.ofgem.gov.uk/publications-and-updates/smart-export-guarantee-anaerobic-digestion-declarations
[7] Postal declarations will also be accepted: Fuelling and Sustainability Team, Ofgem, 10 South Colonnade, Canary Wharf, London E14 4PU

calendar days after this on 6 June 2020. Failure to submit within this period will mean that Ofgem does not provide confirmation of compliance with the sustainability and reporting requirements which may in turn impact SEG payments.

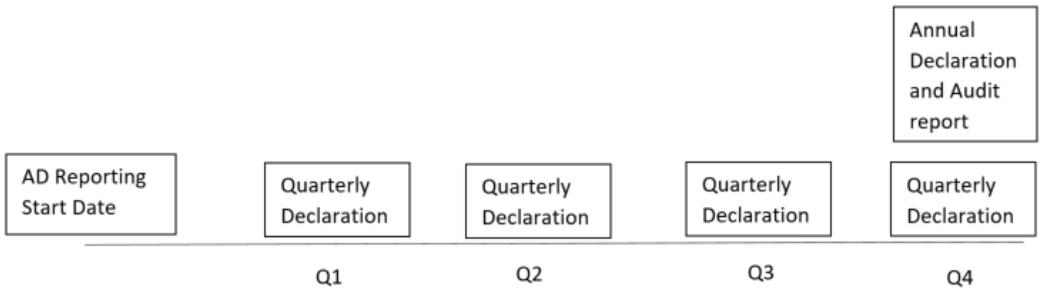
Quarterly and annual reporting requirements

2.8. In order to comply with the reporting requirements under the SEG, AD SEG generators must provide us with:

- **Quarterly sustainability declarations** relating to the sustainability criteria. This will be used to determine whether the installation used sustainable biogas during the period in question.
- **Annual feedstock declarations** relating to the feedstock criteria, including details of the consignment classification of the feedstocks used to generate electricity throughout the year. This will be used to monitor the use of feedstocks by the installation.
- For installations with a TIC of 1MW and above, an **annual sustainability audit report**. This will be used to verify the information contained in the two declarations mentioned above.

2.9. Failure to meet these requirements will mean that Ofgem does not provide confirmation of compliance with the sustainability and reporting requirements which may in turn impact SEG payments.

Figure 1: Declaration timings



Quarterly sustainability declaration

2.10. Except as provided for below, generators must submit a sustainability declaration each quarter against every consignment, which reports whether the consignment(s) of fuel met the GHG and land criteria, accompanied by a GHG emissions figure for that consignment(s). This must also state whether the biogas was made from solid biomass that met the land criteria.

2.11. We may request supporting information from the generator which we will use to verify the information contained in the declaration.

2.12. Any consignments classified as 'waste' do not need to meet the GHG and land criteria as biogas generated from feedstock that is waste is automatically considered to be sustainable biogas. However, generators must declare on a quarterly basis whether the fuel or feedstock is classified as a waste.

2.13. The template for this declaration is available from our website.[8]

2.14. We will review this declaration and, providing it is complete and satisfactory (ie each consignment has met the GHG and land criteria), provide a letter confirming the installation's compliance with sustainability requirements for that quarter.

2.15. Generators must submit their sustainability declaration to us within 28 days following the end of the relevant quarter. The relevant quarters are determined as every quarter from the AD Reporting Start Date of the installation.

2.16. Where the sustainability declaration is not provided by the relevant deadline or is provided but is incomplete or unsatisfactory, we will not be able to provide a letter confirming compliance with the sustainability requirements.

Annual feedstock declaration

2.17. Generators must also submit a feedstock declaration each year outlining all the consignments used in the reporting period. This declaration reports the following:

- The total amount of electricity generated during the period by the installation
- The type of feedstocks used (determined initially through FMS procedures) during the period that the installation used to generate electricity
- the proportion of the energy content of the biogas which was not derived from waste or residue, expressed as a decimal and rounded to 4 decimal places

2.18. We may request supporting information from the generator which we will use to verify the information contained in the declaration.

2.19. The type of feedstock used will be determined according to the fuelling classification process detailed in chapter 3.

2.20. The template for this declaration is available from our website.[9]

2.21. We will review this declaration and providing it is complete, provide a letter confirming the installation's compliance with the feedstock requirements for that year.

2.22. Generators must submit their feedstock declaration to us within 3 months following the end of the relevant year. The relevant years are determined as every year from the AD Reporting Start Date of the installation.

2.23. Where the feedstock declaration is not provided by the relevant deadline or is provided but is incomplete, we will not be able to provide a letter confirming compliance with the feedstock requirements.

[8] https://www.ofgem.gov.uk/publications-and-updates/smart-export-guarantee-anaerobic-digestion-declarations
[9] https://www.ofgem.gov.uk/publications-and-updates/smart-export-guarantee-anaerobic-digestion-declarations

Annual sustainability audit report (TIC of 1MW and above)

2.24. All SEG generators with AD installations with a TIC of 1MW and above must also provide an independent annual sustainability audit report demonstrating compliance with the sustainability and reporting requirements and have their sustainability data independently verified.

2.25. It is the responsibility of the generator to provide the annual sustainability audit report. This report must meet the requirements specified by the legislative framework[10] and be submitted to us within three months of each anniversary of the installation's SEG AD Reporting Start Date.

2.26. For example, if an installation had an AD Reporting Start Date falling on 30 April, the audit report must be submitted by 30 July each year covering the 30 April – 29 April period following each anniversary of the AD Reporting Start Date.

2.27. The purpose of the audit report is to provide independent assurance on the quarterly sustainability declarations, annual feedstock declarations and information provided by generators, to ensure there is evidence and information to support the stated fuel classification and sustainability of the fuel(s).

2.28. If the findings of the audit report show that one or more consignments declared in the previous year did not have adequate supporting information, we will not provide confirmation that you have met your reporting requirement for the year.

[10] SEG Order 2019: https://www.legislation.gov.uk/uksi/2019/1005/contents/made

2.29. The legislative framework sets out the requirements on how the audit report is to be prepared, including that it must:

- be prepared by a person who is not the generator or a connected person,
- be prepared in accordance with the ISAE 3000 (Revised): Assurance engagements other than Audits or Reviews of Historical Financial Information dated 9 December 2013 or an equivalent standard,
- state whether anything has come to the attention of the person preparing the report to indicate that the sustainability information is not accurate, and
- considers, in relation to each consignment:
  - whether the systems used to produce the sustainability information are likely to produce information which is reasonably accurate and reliable,
  - the suitability of the frequency and methodology of any sampling carried out for the purpose of obtaining or checking the data on which the generator relied in preparing the sustainability information,
  - whether there are controls in place to protect the sustainability information against material misstatements due to fraud or error,
  - the robustness of the data on which the generator relied in preparing the sustainability information.

2.29. The report must consider and report on each consignment of biomass used during the 12 month period preceding the relevant anniversary of the SEG AD Reporting Start Date, and must be supplied regardless of the conclusion reached by the independent auditor. Organising the verification is the responsibility of the generator. The report must be submitted within 3 months of the end of the reporting period.

2.30. Installations that do not provide the audit report within the required timeframe will not be considered to have met their sustainability and reporting requirements. We will therefore not provide them with confirmation of compliance, and so licensees will be permitted to refuse to pay any tariff.

How to submit the declarations and audit report

2.31. The declarations and annual sustainability audit report must be submitted by email to our Fuelling & Sustainability team, at FuellingandSustainability@ofgem.gov.uk.

2.32. The email must clearly state the MPAN and address that the information corresponds to.

2.33. For the declarations, all fields of the declaration must be completed, and every consignment of fuel used must be reported against in both declarations.

3. Fuel Classification

Chapter summary

This chapter outlines the fuel classification process, key definitions and how generators can classify their fuels based on the feedstock consignments used in their AD installation. This process is necessary to report against both the quarterly sustainability declaration and annual feedstock declaration.

3.1. As set out in chapter 2, in order to be eligible for SEG payments, AD installations must use sustainable biogas. This is biogas either:

- meets the greenhouse gas criteria and is made from solid biomass that meets the land criteria,
- is made from feedstock which is waste or which is wholly derived from waste, or
- consists of a combination of both of the above.

3.2. In order for a generator to know what GHG and land criteria they are required to meet and report against, they need to first understand the classification of their fuel and feedstock(s).

3.3. The term 'fuel classification' refers to the determination of whether the fuel or feedstock is a product/co-product, waste or a type of residue. These classifications will enable you to report accurately in your quarterly sustainability and annual feedstock declarations. They may also impact your compliance with the land criteria.

3.4. Generators will need to gather evidence to demonstrate the classification of their fuel. Where the installation has a TIC that is greater than or equal to 1MW they will need to demonstrate this to their independent auditor as part of their annual sustainability audit. Where the installation has a TIC smaller than 1MW they may be requested to provide this by their SEG licensee.

3.5. A fuel classification flow diagram is available on our website, for use on FIT, RO, and SEG.[11]

Waste and residues

3.6. Biogas that is made from feedstock that is classified as waste is considered automatically to be sustainable biogas. It is not necessarily the final fuel that needs to be considered as a waste or type of residue. It is also possible to classify fuels based on the material from which the final fuel was made. For example, where the biogas is produced from a feedstock that is a waste, this should be classified as a waste.

[11] Available at: https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-and-feed-tariffs-fuel-classification-flow-diagram

3.7. Certain residues are also automatically considered to meet the land criteria. In addition, residues are only required to report emissions against the GHG criteria during and from the process of collection only.

Definitions

3.8. What constitutes a waste or a residue relies on interpreting the legislative framework, the Renewable Energy Directive (RED), European Commission (EC) communications, and the existing UK and EU law on waste.

Definition of waste

3.9. The legislative framework defines 'waste' to have "the meaning given in Article 3(1) of Directive 2008/98/EC of the European Parliament and of the Council on waste and includes excreta produced by animals". This Article provides the meaning of waste as "any substance or object that the holder discards or intends or is required to discard".

3.10. Further guidance on this definition was published in August 2012 by the Department for Environment, Food and Rural Affairs (DEFRA) titled 'Guidance on the legal definition of waste and its application'.

3.11. The Environment Agency has an important role under the Waste Framework Directive (WFD), in determining whether a substance is a waste or is derived from waste. As far as possible, a consistent approach will be taken, but there may be times when a material is classified as a waste by the Environment Agency but this is not definitive for the purpose of the SEG.

Definition of residues

3.12. The RED was amended by the EU directive to reduce indirect land use change for biofuels and bioliquids.12

3.13. "Processing residue" means a substance that is not the end product(s) that a production process directly seeks to produce; it is not a primary aim of the production process and the process has not been deliberately modified to produce it.

3.14. "Agriculture, aquaculture, fisheries and forestry residues" means residues that are directly generated by agriculture, aquaculture, fisheries and forestry, and does not include residues from related industries or residues from processing".

3.15. This definition of residues from agriculture, aquaculture, forestry and fisheries, can be interpreted to mean that such residues are those 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 from this are considered processing residues.

3.16. Residues from arboriculture are not defined in the legislative framework. However, in line with DECC's consultation response in August 2014[13] arboricultural residues are considered to be material from woody plants and trees planted for landscape or

[12] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015L1513&from=EN
[13] https://www.gov.uk/government/consultations/biomass-sustainability

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.

Considering fuel classification

3.17. Appendix 2 sets out an indicative list of common classifications for materials. It is not intended to be an exhaustive list and therefore if a material is not on the list, it does not mean the substance is not a waste or a type of residue.

3.18. We may periodically review and update this list, if sufficient evidence emerges to indicate that a substance should be treated differently. Where further information comes to light we will liaise with other relevant parties such as the Renewable Transport Fuels Obligation (RTFO) administrator and the RHI, FIT and RO schemes with the potential to reassess if we deem necessary.

3.19. Furthermore, while we endeavour to be as consistent as possible with other government departments, there may be occasions where our role and responsibilities under the legislative framework lead us to a different approach on the same material.

3.20. It is necessary under SEG for us to take a view on whether a substance is a type of residue or a waste. Please note that this is relevant only to the reporting requirements of the SEG, and is not for other external purposes. Our view will have no influence on the Environment Agency when it is making decisions on substances. This applies both to the common classification tables at Appendix 2, and to any subsequent views we reach on wastes and residues.

Approach for generators

3.21. When considering the classification of a fuel, we recommend that generators first refer to the common classification tables at Appendix 2 of this document. If the fuel is listed in the common classification tables, and fit the table description, the generator will need to gather evidence to support the identified classification. This evidence needs to be presented to the auditor as part of the annual sustainability audit report where applicable, or to us on request.

3.22. If the generator considers their biomass to be a waste or type of residue that is not covered in the common classification lists, as either the material is not listed or the way the material was produced does not correspond with the common classification, they should provide their proposed classification as part of their FMS questionnaire and include evidence and reasoning for this classification, for review by us.

3.23. Any discussions in respect of fuel classification must occur before submission of any declarations, otherwise we may not be able to verify compliance with the sustainability and reporting requirements.

Process for fuel classification discussions

3.24. The FMS questionnaire will contain questions referencing fuel classification. Where the generator considers the fuel to be a waste or a type of residue which is not covered in the common classification tables, we will ask the generator to provide evidence of the fuel classification. Generators can also request our view on the fuel

classification when they consider the fuel classification indicated by these tables is not appropriate for a particular material.

3.25. To facilitate this, we have developed a number of questions to ensure the generator presents relevant information to support any further discussion. These questions will be made available to the generator during the FMS approval process, where necessary.

3.26. We will consider the information provided by the generator. During this process, we may seek further information from other parties. The generator should be aware that the information they provide to us may be shared.

3.27. If the information is unclear or incomplete, we will ask the generator for further information in order to provide our view on fuel classification.

3.28. Any view from us on fuel classification is not 'a decision' or 'official approval' and does not remove the requirement for evidence of fuel classification to be assessed at audit. For installations with a TIC of 1MW and above, we expect the generator's independent auditor to consider all the relevant evidence and, where necessary, seek further information, as part of the annual sustainability audit. We will not consider it sufficient for the auditor to rely solely on the correspondence between us and the generator as part of the fuel classification review.

3.29. Where the audit disagrees with the classification, or further information comes to light from other sources, we will review the case. Should the additional evidence result in the classification being inappropriate we will need to consider the impact this has on the way the generator has reported.

Demonstrating compliance

3.30. Where the generator is seeking to report on the basis of a fuel classification, whether for a material specified in the common classifications list or otherwise, they should be prepared to have evidence in support of the declaration as this may be checked by us, their licensee, or where applicable their auditor as part of their annual sustainability audit.

3.31. Where a voluntary scheme is not being used, or does not cover fuel classification, useful documentation may include:

- Permits and certificates (such as waste transfer notes or end-of-waste certificates) issued by the Environment Agency.
- Process flow diagrams which set out how the material is created.
- Information regarding the uses of the material and its value in the market place.

3.32. This evidence will be verified by the annual sustainability audit report if applicable. This means that a generator must demonstrate to the auditor's satisfaction that the biomass used is as per the common classifications list or those specified in the FMS procedures agreed by us. Suppliers may also wish to check this information to ensure compliance with the sustainability criteria.

4. Consignment and mass balance

Chapter summary
Generators must report per consignment of biomass in relation to their quarterly and annual declarations. This chapter provides information on how to determine a consignment and what steps the generator should take if consignments are mixed.

4.1. The legislative framework requires generators to report per consignment of biomass.

4.2. To report accurately against the sustainability criteria for each consignment of biomass, and for the information to be verifiable, the sustainability information must be traceable through the supply chain. This concept of traceability from raw material to end product is known as the 'chain of custody'.

4.3. For ease of reporting, the most straightforward chain of custody system is 'physical segregation'. This is where the consignment of biomass is not mixed with any other consignment and therefore the biomass, and its associated sustainability characteristics, can be easily traced through the supply chain from start to end.

4.4. Where consignments are mixed, we recommend that generators use a mass balance system in order to report against the sustainability requirements. This accounts for their biomass fuel on an input equals output basis but does not require physical separation of different consignments.

Determining a consignment

4.5. To identify whether a mass balance chain of custody system is required, the generator must first determine the number of consignments they are using and whether these are being mixed at the installation or elsewhere in the supply chain. We recognise that the generator may not necessarily be aware of every detail of the supply chain. However, they should ensure that they are seeking the relevant information from their supplier to understand whether they are receiving biomass that is a single consignment or a mix of consignments.

4.6. The legislative framework does not define 'consignment'. However, we interpret this as needing to be based on the main characteristics that could influence whether a fuel is considered as sustainable. This interpretation is in line with the policy intent and has the same meaning as that used for sustainability reporting of biomass electricity under the RO[14], FITs and RHI schemes.

[14] As stated in the Government Response to 'Providing Certainty, improving performance' July 2012 consultation: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/128679/Gov_response_to_non_domestic_July_2012_consultation_-_26_02_2013.pdf

4.7. The term 'consignment' in relation to biogas is interpreted to mean the quantity of biogas attributable to the consignment of feedstock from which that biogas was made.

4.8. We refer to these as the 'sustainability characteristics' of the fuel. For practical reasons, we consider the following sustainability characteristics should be taken into account:

- Feedstock type[15]
- Country of origin[16]
- Classification of the fuel (waste, processing residue, product etc.)
- Compliance with land criteria
- Compliance with GHG criteria

This list is not a definitive legal guide.

4.9. The GHG characteristic will be determined as having been applied by considering the portion of the material with the largest emissions and whether this meets the relevant GHG emission threshold. If it does not, even if all other characteristics are the same, it cannot be considered the same consignment.

4.10. There is no 'timeframe' considered to be applicable to a consignment. It is for the generator to determine what consignments of biomass should be reported to us each quarter based on what is considered to have been used over the quarter.

4.11. Provided materials have identical sustainability characteristics (as listed above), these can be considered as a single consignment for the purposes of data collection and reporting under SEG. The same approach is taken on the RO, FIT and RHI schemes.

4.12. Where your feedstock has a binder added to it we will need to consider whether this is a separate consignment. If the binder is greater than 2% of the feedstock then this will be considered to be a separate consignment and you will need to report against the sustainability criteria for it. If it is 2% or less then you can assume that it has the same sustainability characteristics as the rest of the feedstock.

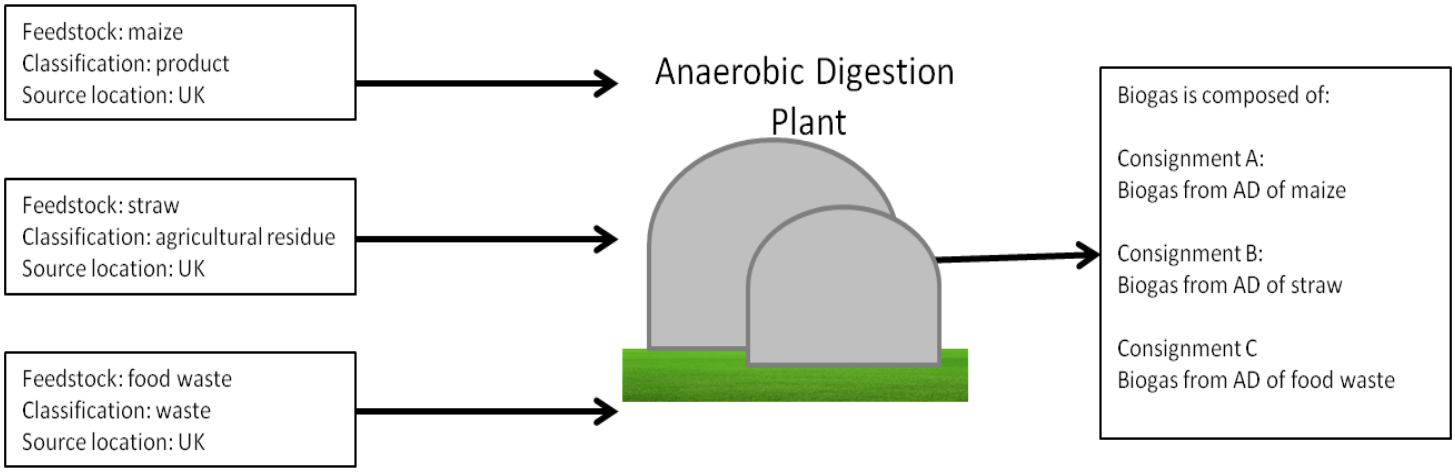
4.13. Where there are a number of source locations in the same country of origin (for example maize silage sourced from numerous locations in the UK) and the sustainability characteristics are the same, the overall carbon intensity for aggregated consignment is given by calculating a weighted average (by quantity) of all the carbon intensities.

4.14. To assist generators, figure 2 provides an example of determining consignments.

[15] This is to ensure that different types of biomass are not grouped together, eg wood cannot be considered the same as sunflower pellets

[16] UK can be considered as a single country of origin

Figure 2: Example of determining a consignment for biogas from AD



4.15. The example shown in figure 2 is of a UK-based AD eligible installation. In this example, all feedstock inputs are from the same country of origin, none are certified by a voluntary scheme and each would satisfy the land and GHG[17] criteria. The main determining factors here as to the number of consignments within the biogas is based on the fact that the feedstocks and their fuel classifications differ.

4.16. Once the number of consignments has been determined the generator will need to establish whether the consignments are mixed at the installation or elsewhere in the supply chain. A mass balance system will need to be used to trace the biomass and its associated sustainability characteristics.

4.17. Where the generator and parties in the supply chain are making use of a relevant voluntary scheme, as per the guidance in chapter 6, they should follow the voluntary scheme rules for the purpose of tracking sustainability information associated with each consignment of biomass.

4.18. In the event that a mass balance system is required, and the generator and parties in the supply chain are not making use of a voluntary scheme recognised in this respect, this chapter provides further guidance on the types of mass balance and good practice for setting up a system.

Overview of mass balance

4.19. A mass balance system is a system in which sets of sustainability characteristics remain assigned to consignments. The sum of all consignments withdrawn from the mixture is described as having the same sustainability characteristics, in the same quantities, as the sum of all consignments added to the mixture. A party in the chain of custody cannot sell more output with certain biomass data than its sourced input with the same biomass data.

4.20. Mass balance systems should be used where a mixing of consignments takes place, either at the generator's site or down the supply chain. This is to ensure that the biomass and its associated sustainability data are verifiable. The onus is on the generator to implement the appropriate process and procedures.

[17] The biogas from each feedstock would meet the GHG criteria separately.

4.21. Although consignments with different sustainability information can be physically mixed, sustainability information cannot be mixed between different consignments of biomass. For example, if a generator has two types of biomass in a single storage container such as 'short rotation forestry from Canada' and 'thinnings from Germany', the information could not be swapped between the consignments. A generator could therefore not assign the outgoing consignment as 'short rotation forestry from Germany'.

Types of mass balance systems

4.22. There are typically two ways of reporting claims through mass balance systems.

- When using **proportional mass balance**, any quantity of fuel removed from a mixture containing different consignments must be assigned the sustainability characteristics in the same proportions as the original mixture. For example, if a solid biomass mixture is 400 tonnes of 'A' and 600 tonnes of 'B' when you extract an amount of biomass from the mixture you apply these proportions to the extracted amount (for example, 40 per cent is 'A' and 60 per cent is 'B'). See figure 3.

- When using **non-proportional mass balance**, any quantity of fuel removed from a mixture containing different consignments does not require the sustainability characteristics to be assigned based on the proportions of the mixture. Instead it allows the sustainability characteristics to be assigned freely, as long as what is being assigned is not in greater amount than in the original mixture. For example, if a solid biomass mixture is 400 tonnes of 'A' and 600 tonnes of 'B' when you extract a volume of biomass you are free to set out whether it composes all of 'A', 'B' or a combination of the both. However, you should not declare that you have more volume of either 'A' or 'B' than the mixture in the first instance. See figure 4.

4.23. Generally, we are content for the generator to determine which mass balancing system to use within their supply chain. However, we note the following constraint that the generator, and parties within their supply chain, should follow:

- When making use of the non-proportionate method, we recommend that data assigned to a quantity of biomass should be done on a 'first in first out' (FIFO) basis – the consignment that was first added to the mix should be the first to be reported being used. This reduces the risk that there is an amount of unsustainable biomass within the mix which is never assigned to an extracted quantity of biomass. If a party does not follow a FIFO approach the independent auditor may wish to consider this risk as part of the annual verification process.

4.24. There may be other examples of where the use of one particular method should be followed, such as the use of the proportionate method where there are technical reasons for a quantity to be a specific blend. In general general, the feedstock reported by parties should be representative of the feedstock mixture and parties should have a consistent and transparent reporting process.

Figure 3: Example of proportional mass balance

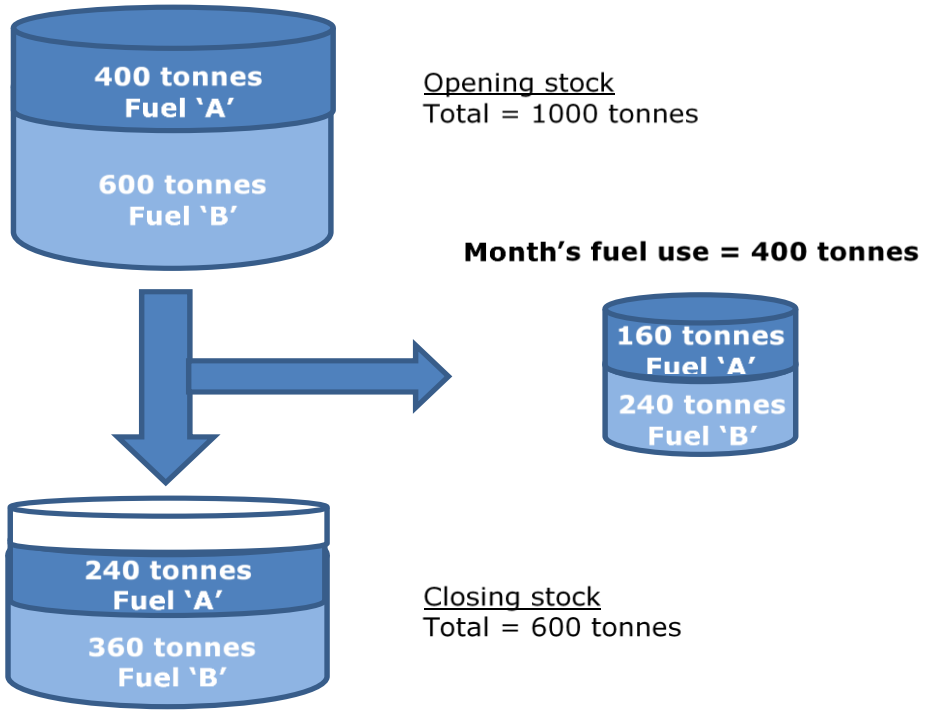
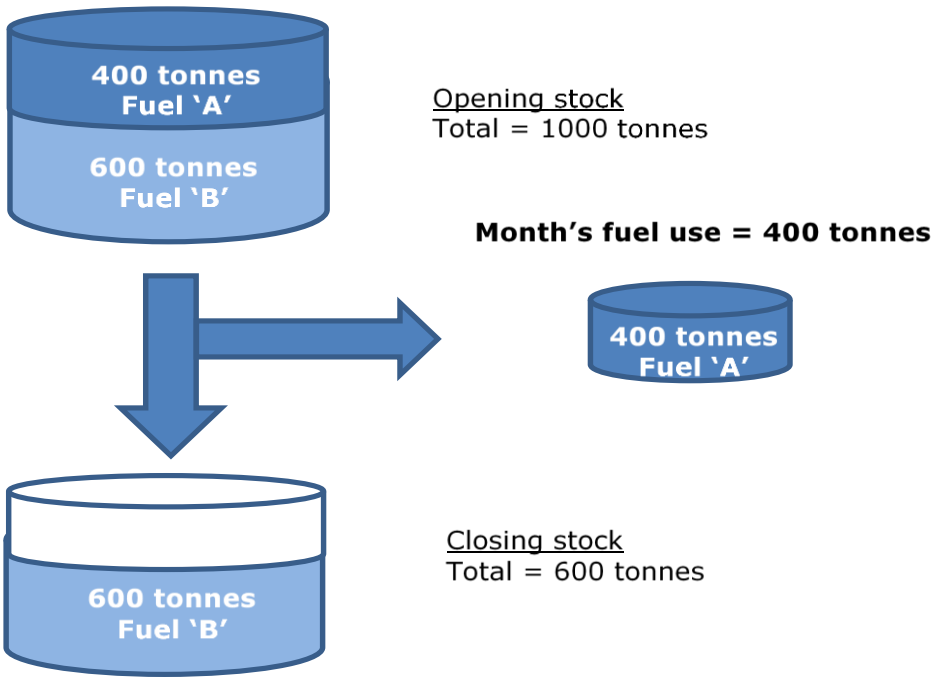


Figure 4: Example of non-proportional mass balance



The operation of a mass balance system

4.25. Each party in the supply chain, which is at any point the legal owner of the product, will need to put in place the administration necessary to maintain the mass balance chain of custody.

Level at which the mass balance should take place

4.26. The mass balance should be operated at the level of a 'site' that a company owns/operates. For the purposes of mass balance sustainability requirements, a 'site' is defined by the EC as 'a geographical location with precise boundaries within which products can be mixed'.18 A site can include multiple silos or tanks, as long as they are at the same physical site.

4.27. Should a party wish to manage the data at a more detailed level of granularity then this is also acceptable. For example, a company could operate mass balance at the level of individual storage containers within a site. The mass balance however is not recommended to be operated over multiple physical sites that a company owns.

Timeframe within which the mass balance should be conducted

4.28. It is recommended that parties in the supply chain undertake a periodic review of site-level sustainability data at least on a monthly basis.

4.29. It is acknowledged that, due to the way the supply chain currently operates, it may be challenging for some parties in the supply chain to conduct a monthly mass balance review, particularly at the agricultural end of the supply chain. Therefore the maximum period over which the mass balance has to be achieved, can be longer than one month but must not exceed one year.19

4.30. Parties using a certified voluntary scheme must use the mass balance timeframe of that scheme.

Passing information through the supply chain

4.31. The use of a mass balance chain of custody system promotes information regarding a particular consignment of biomass to be passed down the supply chain. Whilst the physical evidence does not need to move through the supply chain with the biomass it is recommended that there is sufficient information with the generator for them to have confidence in reporting to us against the sustainability criteria on a quarterly basis. Any information or evidence should be kept and made available if required for verification purposes.

4.32. It is good practice if generators inform parties earlier in the supply chain of what is required to demonstrate compliance with the sustainability criteria. This will ensure that relevant information moves along the supply chain.

4.33. Records of commercial transactions should enable parties in the supply chain, including auditors, to trace back through the supply chain to verify any

[18] Definition available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:160:0001:0007:EN:PDF
[19] Generators should note that lengthy balancing timeframes may add a layer of complexity and thus hinder the ability of verifiers to confirm whether the sustainability criteria have been met

sustainability data claims made. A company that sells biomass should specify certain information on the invoice or documentation they share with the buyer.

4.34. Generators may wish to seek additional information from their biomass supplier to be confident that the biomass they are buying meets the sustainability criteria.

Demonstrating compliance and record keeping

4.35. Where a generator is not mixing consignments they do not need to use a mass balance approach. They must, however, be able to demonstrate to an auditor's satisfaction that the biomass is traceable through the supply chain, as the licensee may request this information to show compliance with the sustainability criteria.

4.36. Where consignments are being mixed, a generator should demonstrate they have a suitable mass balance in place to allow for traceability of the biomass and its associated sustainability characteristics.

4.37. Where the generator is making use of a voluntary scheme to demonstrate compliance with mass balance, they should ensure they have the appropriate certification documentation to demonstrate this to their auditor.

4.38. Where a generator is using a mass balance chain of custody which is not covered by a voluntary scheme, they should collect information to demonstrate they have a suitable mass balance approach in place.

4.39. This will require not just the generator, but also parties within the supply chain to maintain suitable evidence. Clear, detailed and transparent records are vital to support sustainability reporting under the SEG and to facilitate the annual sustainability audit process where relevant.

4.40. Each party in the supply chain should keep records that concur with the information on the invoices, to enable sustainability data claims to be traced back through the supply chain. This will be required for audits. Table 1 sets out the recommended records to maintain and example formats for these records are found in Appendix 5.

Table 1: Recommended records and associated information for mass balance

Record type	Information to record
Input and output records of biomass data and sustainability information Input records refer to the biomass and sustainability related information for products purchased from a supplier. Output records refer to the biomass and sustainability related information for products sold to a buyer.	• An invoice reference(s) • Description of the physical product to which the biomass data refer • Volume of physical input/output to which the biomass data refer • Supplying/receiving company • Transaction date • Any biomass and sustainability information.
Conversion factor records	• To which input product it refers

These records refer to the conversion factor of inputs to outputs and associated actual input data. Each party in the supply chain can maintain records of its own conversion factors. A party may have more than one conversion factor. If no records are kept for the conversion factor a standard input value must be used.	• To which output product it refers • The units in which the conversion factor is expressed • The value of the actual conversion factor • When the specific conversion factor was valid • The calculation and supporting documentation that determines the conversion factor.
Periodic inventory of biomass data These records provide an insight into the balance of biomass and sustainability information. Besides helping companies to manage their input-output balance, these records also assist in the verification of a party's mass balance records. Periodic inventories are recommended to be conducted on a monthly basis.	• Inventory of biomass and sustainability information at the beginning of the respective period. It must be clearly specified whether this is expressed in input-equivalents (before conversion factor) or output-equivalents (after conversion factor). • Volumes of inputs with identical biomass and sustainability information in the respective period. These volumes must coincide with the input records described above. • Volume of outputs with identical biomass and sustainability information in the respective period. These volumes must coincide with the output records described above. • Conversion factor(s) used in the respective period. • Inventory of biomass and sustainability information at the end of the respective period (including the carbon intensity of the stock). It must be clearly specified whether this is expressed in input-equivalents (before conversion factor) or output-equivalents (after conversion factor). • Purchase and sales invoices should be retained.

5. FMS procedures

Chapter summary
This chapter provides guidance to generators on Fuel Measurement and Sampling (FMS) procedures. These are necessary in order to accurately complete your quarterly and annual declarations. An outline of the data submission and supporting information requirements are also included.

5.1. An FMS procedure is the general term that we use to describe the agreement with generators of suitable procedures for the measurement and sampling of their fuels. These are required in order to determine:

- the quantity of fuel used in a quarter
- consignment classification of the fuel used in a quarter for the purposes of sustainability
- consignment classification of the fuel used in a year for the purposes of feedstock declarations
- the management of mixed consignments
- the energy content of the fuel used in a quarter

5.2. FMS procedures are required to ensure that:

- SEG payments are only guaranteed for electricity that is generated using sustainable biogas.
- Generators have established appropriate procedures to report against their sustainability and reporting requirements.
- The amount of eligible electricity is determined according to the energy content of each of the fuels used in a particular quarter to generate electricity. It is because of this calculation that applicants need to propose and agree an FMS regime with us.

When to submit FMS procedures

5.3. We will request that you fill out an FMS questionnaire as soon as you notify us of your intent to seek SEG payments.

5.4. Once the FMS questionnaire is completed and sent to us we will work to agree FMS procedures, which will be used to determine the consignments that will be used to report on the generator's compliance with the sustainability and feedstock requirements.

5.5. Installations will not receive confirmation from us of compliance with sustainability and reporting requirements for each relevant period until we have agreed the FMS procedures that they will use in order to report.

5.6. If there are any changes to your feedstock or FMS procedures you will need to submit an amended FMS questionnaire to fuellingandsustainability@ofgem.gov.uk. You should also ensure you agree these changes with us before making them at your installation.

Format of FMS procedure – 'FMS questionnaire'

5.7. The proposed FMS procedures must be provided on the Microsoft Word template available on our website.[20]

5.8. Depending on your specific circumstances different sections of the FMS questionnaire will need to be completed. More information on this and a note on instructions for completing FMS procedures are available on our website.[21]

Agreement of FMS: Case-by-case approach

5.9. We recognise that no single installation is identical to another and that different installations will use combinations and quantities of fuels from different sources. We will therefore agree FMS procedures on a case-by-case basis, according to the specific setup and conditions at each installation.

5.10. However, before agreeing FMS procedures, we must be satisfied that the approach you are proposing is capable of adequately demonstrating ongoing compliance with the sustainability criteria and reporting requirements as set out in the legislative framework.

5.11. The onus for the production of suitable FMS procedures lies with the generator. However, we can look at any source of information that may be used to determine that the sustainability requirements and feedstock criteria are met (whether or not this information has been provided by the generator).

5.12. Measuring the volume of biogas used to generate electricity in a quarterly period is required in order for the generator to report on the sustainability of the biogas. As biogas is formed from feedstock it is important to account for any carryover of the feedstock from the previous quarter. This means that the weight of any feedstock carried over from the previous quarter must be measured in the quarter of use.

5.13. A restrictive approach to accounting accurately for the weight of feedstock(s) used within a quarter could mean that measurements had to be taken at the stroke of midnight on the last day of each quarter. Since this is not practical we will accept measurements taken +/- 3 days of the end of the quarterly period, in line with the approach taken on the RO, FIT and RHI schemes.

5.14. We encourage generators to take weight measurements of stock carried over from one quarterly period to the next at the same time each quarter so that the qualifying percentage (proportion of electricity used that came from eligible sources) can be measured accurately.

[20] Available at: https://www.ofgem.gov.uk/publications-and-updates/fit-anaerobic-digestion-fuel-measurement-and-sampling-fms-questionnaire-and-guidance-note

[21] Available at: https://www.ofgem.gov.uk/publications-and-updates/fit-anaerobic-digestion-fuel-measurement-and-sampling-fms-questionnaire-and-guidance-note

5.15. When assessing measurement and sampling information for stock carried over from one quarterly period to the next, we will take a pragmatic approach. For example, where an installation uses unsustainable fuels and submits relevant information on stock levels, we may be able to accept estimates of stock levels (as opposed to requiring sheds to be emptied and stock taken back over weighbridges) in circumstances where we are satisfied that the proposed estimation techniques offer an acceptable level of accuracy and reliability.

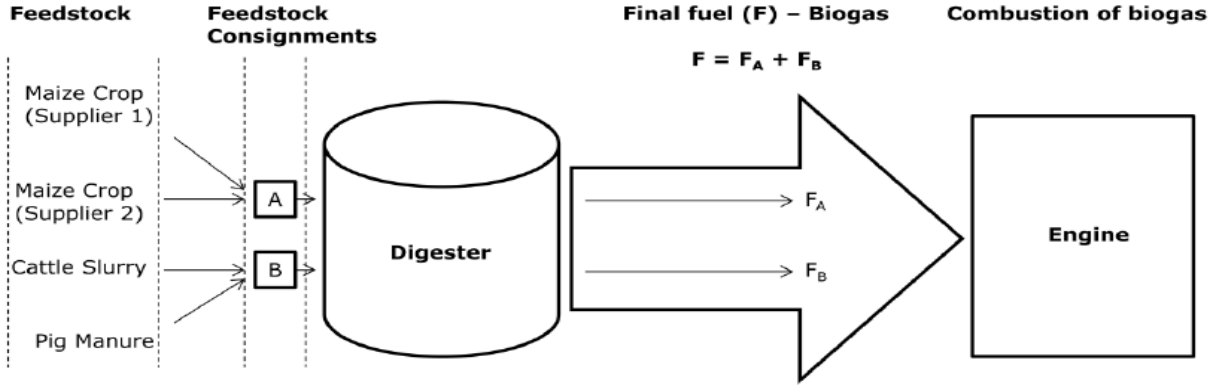
Reporting by consignment

5.16. As part of the FMS process, we require generators to consider whether they are using multiple consignments, and whether there is any mixing of these consignments at the installation site or in the supply chain. For further information on mixing of consignments and mass balance systems, see chapter 4.

5.17. Sustainability characteristics are passed from the feedstock to the final fuel (biogas). Therefore, a consignment of biogas is derived from a feedstock consignment. A feedstock consignment consists of any feedstocks that have identical sustainability characteristics.

5.18. In figure 5 below, the final fuel (biogas) for combustion is apportioned according to Consignment A and Consignment B. The example shows how an applicant can group feedstock with identical sustainability characteristics together to form Feedstock Consignment A (Maize crop from two different suppliers). Feedstock Consignment B represents waste feedstocks (pig manure and cattle slurry) which are considered to be sustainable.

Figure 5: Example of how to apportion biogas derived from multiple feedstock consignments.



5.19. The resulting final fuel (F), in this case biogas, can then be apportioned according to the consignments of Consignment A and Consignment B.

5.20. Generators can use our Biogas Apportioning Tool[22] to apportion their resultant biogas, which requires the user to input the mass (dry or wet) of each feedstock

[22] Available at https://www.ofgem.gov.uk/publications-and-updates/non-domestic-rhi-and-fit-biogas-and-biomethane-apportioning-tool

used. Together with built in default literature data on biogas yield and moisture content, the tool calculates the percentage contribution due to each feedstock. This tool can be used by SEG, FIT and RHI generators.

5.21. Generators are welcome to propose an alternative method to apportion their biogas, and will need to demonstrate its suitability.

Measuring and sampling fuels – weight measurements

5.22. The following table provide examples of how you may wish to weigh your feedstock.

Table 2: Example of weight measurement using a weighbridge and stock calculation

Question	**Weight measurement using a weighbridge**	**Weight measurement using a weighbridge and stock calculation**
When is the weight measurement taken?	At installation on delivery.	At installation on delivery and stock calculation at quarter end.
How is the weight measurement taken?	By totalising weighbridge deliveries.	By totalising weighbridge deliveries and performing a stock calculation at the end of each quarter.
How often is the weight measurement taken?	Every delivery.	Every delivery and at a stock calculation at the end of each quarter.
How is fuel carried over from one quarter to the next accounted for?	Stocks run down at quarter end.	By a stock calculation at quarter end. This can be done typically by transit over a weighbridge, survey of the stockpile, or level measurement of a bin.
Are any industry standards met?	The British Standard BS EN 30012-1 for weighbridge calibration. This presents in detail methods of calibration for static weighing devices and for determining periodic confirmation intervals. This is reviewed with further details in the following code of practice: Code of Practice for the Calibration of Industrial Process Weighing Systems, Institute of Measurement and Control, October 2003.	
How is accuracy ensured?	Weighbridges will normally achieve an accuracy of +/- 0.5% of the load. Generators with public weighing equipment have responsibilities to ensure that they can perform their duties competently and honestly. No one may operate public weighing equipment unless they hold a certificate	Accuracy can be maximised by operating the stocking area so as to reduce the remaining quantity to a very low level at the period end. This could be achieved by separating each period's stock. Weighbridges will normally achieve an accuracy of +/- 0.5% of the load. Generators with public weighing equipment have responsibilities to ensure that they can perform their duties competently and

	from a Chief Trading Standards Officer. If the weighbridge is not at a public weighing facility, good practice would be that the weighbridge is operated as if it were, and that the appropriate certificate is obtained. Regular calibration is an integral part of the quality assurance of all weight measurements.	honestly. No one may operate public weighing equipment unless they hold a certificate from a Chief Trading Standards Officer.

6. Demonstrating compliance and voluntary schemes

Chapter summary
This chapter sets out how voluntary schemes can be used to demonstrate compliance and the different types of recognised voluntary schemes.

Demonstrating compliance with the criteria

6.1. When the generator is reporting that they meet the sustainability criteria, or are using feedstocks that automatically meet the land criteria, they should retain the relevant evidence which demonstrates their compliance.

6.2. Generators can show that they comply with the sustainability criteria by collecting information and/or using voluntary schemes as evidence. Any information or evidence should be kept by the relevant party and made available if needed for verification, even if it is held by the supply chain. This does not need to be in paper copy – electronic format is acceptable.

6.3. Other people in the supply chain may have some of the evidence (for example, evidence for meeting land criteria). The generator should have enough information to be confident about reporting sustainability information to us. For this, the generator may be relying on contractual agreements.

6.4. If you want to read more about the type of information and data which may be considered relevant evidence to demonstrate compliance refer to the greenhouse gas and land criteria sections of the document.

6.5. Aside from the option to collect evidence, it is also possible to use voluntary schemes to demonstrate compliance.

Recognised voluntary schemes

6.6. Voluntary schemes are certification schemes used to assure us that a fuel meets part or all of the sustainability criteria. These schemes often provide further information and additional guidance on demonstrating compliance with the relevant criteria.

6.7. Voluntary schemes typically have a specific scope for which they are recognised. The generator of an eligible installation may use more than one voluntary scheme or a combination of voluntary schemes and collect other information.

6.8. If all or part of the supply chain is covered by a voluntary scheme, the operator can use this as evidence for demonstrating compliance with the relevant aspects of the SEG sustainability criteria. If there is a break in the voluntary scheme certification in the supply chain, the certification cannot be used as automatic compliance.

6.9. To be registered with a voluntary scheme, the relevant party will typically be audited by an independent third party to ensure compliance with the scheme rules, before they can obtain certification by that voluntary scheme. Further audits will normally be needed to maintain certification, according to the requirements of that scheme.

6.10. The generator may make use of voluntary schemes approved by the EC or recognised by the UK government to demonstrate compliance with the SEG sustainability criteria (see Appendix 1).

6.11. Any voluntary schemes which are neither EC-approved nor recognised by the UK government may still be used to demonstrate compliance with aspects of the SEG sustainability criteria, but these will be considered alongside other evidence as part of the annual independent sustainability audit. The independent auditor will need to review the voluntary scheme to consider which aspect(s) of the SEG sustainability criteria the scheme rules correspond with.

Using EC-approved voluntary schemes

6.12. The EC formally assesses voluntary schemes[23] for biofuels to judge whether the schemes demonstrate compliance with the RED sustainability requirements, including the GHG and land criteria, the mass balance and auditing requirements. These schemes may be approved for a specific feedstock or geographical location as well as a specific scope only, eg the land criteria, and/or the GHG criteria and/or the methodology to calculate actual values, and/or the mass balance.

6.13. The EC has approved a number of voluntary schemes, and member states are required to accept these as demonstrating compliance with the criteria. Any decision by the EC made before the UK's EU Exit day takes precedence over any assessment made by the UK government, or other member states. We will recognise any voluntary scheme recognised by the EC from the date the EC decision takes effect, subject to parties in the supply chain being audited against the version of the voluntary scheme the EC decision refers to.[24] Decisions made by the EC after EU Exit day do not take precedence over assessments made by the UK government. However, we may choose to recognize these decisions where they align with UK law.

6.14. EC decisions on voluntary schemes will be published on the EC's transparency platform.[25] This also includes a useful table noting the schemes and their scope.

Using UK-recognised voluntary schemes

6.15. In 2012 we benchmarked a number of voluntary schemes against the RO's protected land criteria for non-woody biomass under the ROO 2009 (as it then was) for use on the RO scheme. In 2015 our RO team also undertook an exercise to

[23] It is the responsibility of voluntary schemes to apply to the EC for recognition against the RED
[24] EC decisions take effect 20 days after publication in the *Official Journal of the European Union*
[25] http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm

benchmark these schemes against the ROO 2015 sustainable source land criteria for woody biomass for the purpose of the RO scheme. The results of this exercise can also be used on the SEG, FIT and RHI schemes. Please see Annex 2 of the RO: Sustainability Criteria[26] guidance.

[26] Available at: https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-sustainability-criteria

7. Sustainability - land criteria

Chapter summary

This chapter provides information on the land criteria that generators must report against in their quarterly sustainability declarations and describes how to demonstrate compliance.

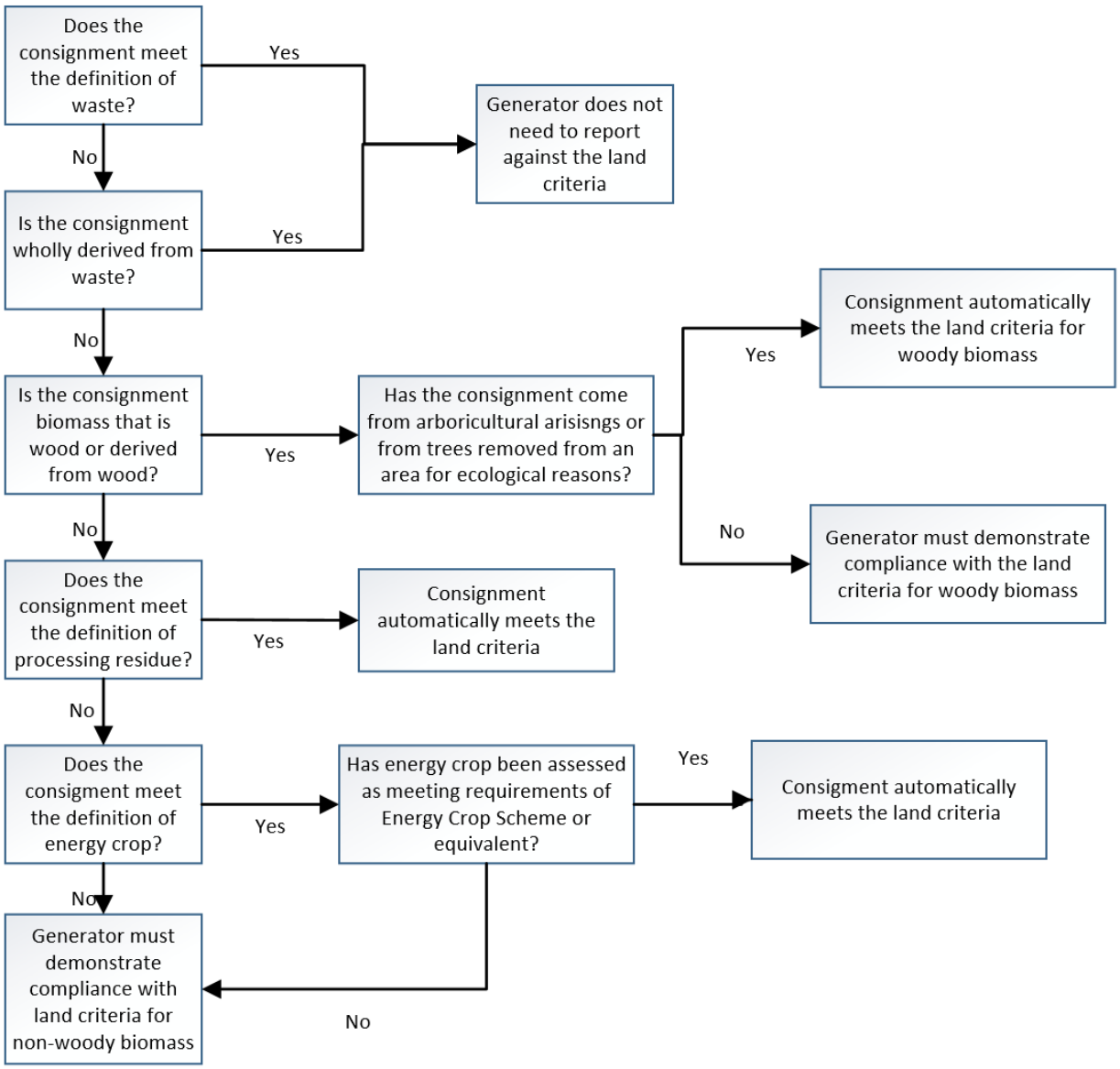
7.1. The land criteria aims to protect land with a high biodiversity value and high carbon stock values.

7.2. Every consignment of feedstock that is not wholly derived from waste must meet the land criteria for an installation to receive a SEG tariff. Use of any feedstock (other than waste) that does not meet the land criteria means that generation may not be eligible for a SEG tariff. Please also note that all liquid feedstocks that are not wastes automatically do not meet the definition of sustainable biogas for SEG AD installations.

7.3. The land criteria refer specifically to the production of the raw material, ie at the farm, forest or plantation. They do not apply to any other steps further down the supply chain.

7.4. There are two types of land criteria: the land criteria for woody biomass and the land criteria for non-woody biomass. The type of feedstock used will affect which type of land criteria to report against.

Figure 6: Overview of land criteria requirements (for non-liquid consignments)



Feedstocks deemed sustainable for the land criteria

7.5. A fuel that is not wood or derived from wood and is classified as a waste or a residue automatically meets the land criteria (for more information on fuel classification please see Chapter 3). When submitting the quarterly declaration, the generator should specify the classification of fuel. The generator will need to collect information to justify the applied fuel classification where submitting independent audit reports to Ofgem (for installations over 1MW) or where requested by the licensee.

7.6. Aside from the fuel being waste or wholly derived from waste there are no exemptions to demonstrating compliance with the land criteria based on fuel classification for wood. However, arboricultural arisings and trees removed from an area for ecological reasons are deemed to be sustainable, and therefore automatically meet the land criteria for woody biomass.

7.7. For fuels that are not waste or wholly derived from waste, the generator must demonstrate compliance with the relevant criteria (either the wood or non-wood land criteria).

Land criteria for woody biomass

7.8. If the biomass used to generate electricity was wood or derived from wood, and is not classified as waste or wholly derived from waste, the generator is required to report against the land criteria for woody biomass.

7.9. The Woodfuel Advice Note[27] has been published by BEIS to provide accessible advice and guidance on the requirements and how to demonstrate compliance against them. It is recommended that generators refer to this document to become more familiar with the requirements.

7.10. There is a '70:30 threshold' which applies in demonstrating that woodfuel meets the land criteria:

- In line with the European Union Timber Regulation (EUTR) 100% of woodfuel used must meet the legality requirement and either:
  - at least 70% of each consignment must meet the sustainability requirements outlined in the Woodfuel Advice Note, or
  - at least 70% of all the woodfuel used in a quarterly period must meet the sustainability requirements outlined in the legislative framework.
- the fuel used is certified by an environmental quality assurance scheme[28] that has been benchmarked by the RO (see Chapter 6) which ensures that at least 70% of the biomass certified by the scheme meets the sustainability requirements outlined in the Woodfuel Advice Note.

7.11. Evidence to demonstrate compliance with the land criteria for woody biomass should include evidence that traces the biomass from the source to the end user. There are two routes to demonstrate compliance outlined in the Woodfuel Advice Note, which reflect what we would expect to be used:

- Category A evidence: Through the use of Forest Stewardship Council (FSC) certificate scheme or the Programme for the Endorsement of Forest Certification (PEFC) certification scheme.
- Category B evidence: Through the collection of bespoke evidence that demonstrates compliance with the criteria. The 'risk-based regional approach' can be used with this method.

7.12. Both routes of demonstrating compliance are described in more detail in the Woodfuel Advice Note.

7.13. We recognise that it may be challenging to meet the criteria via the use of Category B evidence. To support this, our RO team have benchmarked these schemes against

27 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/594136/Woodfuel_Advice_Note_v2_Feb2017.pdf

28 "environmental quality assurance scheme" means a voluntary scheme which establishes environmental or social standards in relation to the production of biomass or matter from which a biomass is derived

the ROO 2015 legislation. The results of this exercise have also been adopted on RHI and the SEG.

7.14. There are two scenarios in which woodfuel can be 'deemed sustainable' against the woodfuel land criteria:

- The woodfuel was residue from arboriculture. In line with BEIS' consultation response in August 2014,[29] arboricultural 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.

- The woodfuel was removed for the purpose of restoring or maintaining the ecosystem of an area which was not a forest.

7.15. 'Deemed sustainable' woodfuel can count towards the 70% sustainable proportion in mass balance calculations.

7.16. Further advice on how to comply with these requirements has been published by BEIS. This includes the Woodfuel Advice Note, guidance on the consignment and mass balance approach, and guidance on the checklist approach to the risk-based regional approach to demonstrating compliance.[30]

7.17. A number of different documents have been produced to explain the woodfuel land criteria, and we recommend that generators refer to these. We have not replicated the detail in this guidance document.

Land criteria for non-woody biomass

7.18. If the biomass used to generate electricity was wood or derived from wood, and is not classified as waste or wholly derived from waste, the generator is required to report against the land criteria for woody biomass.

7.19. Certain types of non-woody biomass automatically meet the land criteria. These are where the biomass was an arboricultural residue, a processing residue, or was an energy crop which received financial assistance under the Energy Crops Regulations 2000(b) or equivalent financial scheme.

7.20. All other non-woody biomass cannot be obtained from a protected source in order to meet the land criteria. This means that the requirements are not met if the biomass was obtained from any of the following:

- land which at any time during or after January 2008 was primary forest,

- land which at any time during or after January 2008 was land designated for nature protection purposes (unless production of that biomaterial did not interfere with purposes for which this land was designated),

[29] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/343005/Response_to_Biomass_Consultation.pdf

[30] Available at: https://www.gov.uk/government/publications/woodfuel-guidance-version-2

- highly biodiverse grassland, unless the harvesting is necessary to preserve the grassland status,
- land which at any time during January 2008 was peatland (unless the cultivation and harvesting of biomaterial did not involve the drainage of previously undrained soil),
- a former continuously forested area, or
- a former wetland area.

7.21. If a land-use change is permitted under the criteria (eg non-highly biodiverse grasslands to cropland), then a carbon stock calculation resulting from the land-use change will need to be performed. The associated GHG emissions will need to be calculated and added to the supply chain emissions. The relevant GHG threshold will still need to be met for the fuel to be compliant with the GHG criteria.

Residue

7.22. Biomass which is not wood-based but can be classified as a processing residue will be considered to have met the land criteria.

7.23. In such cases the generator will need to be able to demonstrate that their fuel has been correctly classified as a residue, and the type of residue.

Energy crops

7.24. An energy crop will be considered to meet the land criteria where financial assistance has been paid under the Energy Crops Scheme for that energy crop, or under an equivalent financial assistance scheme.

7.25. The Energy Crop Scheme is managed by Natural England and offers grants to farmers in England for establishing miscanthus and short rotation coppice for their own energy use or to supply power stations. The scheme closed to new applications on 31 August 2013.

7.26. If a generator is making use of an energy crop which is supported under a scheme which is thought to be equivalent to the Energy Crops Scheme, they will need to set out the case clearly making a comparison to the requirements of the scheme against the Energy Crops Scheme for consideration.

Demonstrating compliance

7.27. To demonstrate compliance with the land criteria, the generator can use relevant voluntary schemes and/or collect evidence to support the land use from where the biomass was sourced. We benchmarked a number of voluntary schemes against the land criteria in 2012. If the generator is using any of these schemes, they should refer to Chapter 5 and Appendix 1 for more information.

7.28. If the generator seeks to collect evidence to demonstrate compliance with the criteria, they should do this by collecting information on the land use of the farm/plantation in January 2008 (and after this date, where applicable).

7.29. The following types of evidence could be useful in demonstrating compliance: aerial photographs, satellite images, maps, land register entries/databases and site surveys.

7.30. The evidence can be direct or indirect with regard to the format of the information supplied. For example, you could demonstrate compliance with the criterion about primary forest with evidence such as:

- An aerial photograph of the land, showing that it is planted with short rotation forestry (direct), or
- A map of all the primary forests in the region, showing the land to fall outside of them (indirect).

Other useful resources

7.31. It may be useful for generators to draw on other sources of guidance to help them determine the land use and gather evidence of this to demonstrate compliance with the land criteria.

7.32. The EC has produced a guidance document to help identify the status of the land in January 2008 for demonstrating compliance with land criteria. This was produced for use with bioliquids and biofuels to demonstrate compliance with the RED land criteria, but is also useful for solid biomass and biogas where the same criteria are relevant. It is available on the Transparency Platform.[31]

7.33. For UK-sourced biomass, DEFRA is a useful source of information about land use. They have a list of evidence sources in the UK that might be useful for generators to demonstrate compliance with the land criteria. This list has been designed specifically for biofuels under the RTFO and is not exhaustive. Generators may need to draw on several sources as the work done by DEFRA was not done specifically to show compliance with the SEG sustainability criteria.[32]

7.34. The European Committee for Standardization[33] (CEN) has published sustainability standards for bioliquids and biofuels, including one titled 'biodiversity and environmental aspects related to nature protection purposes' (published August 2012). This provides guidance on evidence that the production of raw material has not interfered with nature protection purposes for the land criteria. This may also be useful in relation to biomass and biogas.

7.35. The Forestry Commission, Forestry Commission Scotland, Natural Resources Wales and other countryside agencies may be able to help generators, as they have useful resources and guidance on providing evidence.

[31] Inventory of data sources and methodologies to help identify land status. Available at http://ec.europa.eu/energy/renewables/biofuels/sustainability_criteria_en.htm
[32] Available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/2625/rtfo-supporting-claims-compliance.pdf
[33] CEN Sustainability criteria for biomass: http://www.cen.eu/cen/Sectors/Sectors/UtilitiesAndEnergy/Fuels/Pages/Sustainability.aspx

Land categories

7.36. To establish whether the land that the biomass comes from meets the criteria, the generator must consider what type of land it is, ie the land category.

7.37. To help, table 3 shows some common land categories and indicates which land categories may comply with the land criteria.

7.38. The categories 'cropland', 'grassland' and 'forestland' specifically refer to the land cover. The categories 'peatland' and 'wetland' refer to other characteristics of the land, such as soil properties, that are not mutually exclusive with cropland, grassland or forest. For example, a forest may be located on peatland, and grassland may be located on a wetland. 'Peatland', 'wetland' and their variations should always be considered as taking precedence over the land types 'cropland', 'grassland' and 'forestland' and their variations. For example, if a plantation is located on peatland this should always be considered as peatland, irrespective of whether it had forest or grassland on it.

Table 3: Categories of land and whether they comply with the land criteria

Land category	**Description**	**Land Criteria**
Cropland - non-protected	The Cropland is not in a nature protected area. This category includes cropped land, (including rice fields and set-aside[34]), and agro-forestry systems where the vegetation structure falls below the thresholds used for the forest land categories.[35]	Complies.
Cropland – protected	Same as above, but the Cropland is in a nature protection are	Complies if evidence is provided that shows the production of the fuel did not interfere with the nature protection purposes of the land. The appropriate evidence will depend on the specific nature protection purposes; however, this might be expected to include evidence of actions taken to avoid damage to or actively maintain the nature protection purposes. Evidence could also be provided through reporting a voluntary scheme that meets the RED biodiversity criteria.
Primary forest	This is namely forest and other wooded land of native species, where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed.	Complies only if the solid biomass was obtained previous to January 2008. If the solid biomass was obtained during or after 2008, this does not comply.

[34] 'Set-aside' is a term related to the EU's Common Agricultural Policy (CAP). It refers to land taken out of production to reduce the risk of food surpluses, while increasing the opportunity for environmental benefit. From 2007 set-aside land has been abolished under the CAP.
[35] EC Communication 2010/C 160/02 considers that perennial crop plantations, including oil palm plantations, are classified as cropland.

Continuously forested area (forest >30%)	Continuously forested areas, namely land spanning more than one hectare with trees higher than five metres and a canopy cover of more than 30%, or trees able to reach those thresholds in situ.[36].	Complies only if the status of the land has not changed. Evidence of the nature and extent of the forest will need to be provided for the time the raw material was harvested.
Highly biodiverse grassland	This can be either: Highly biodiverse grassland that is natural, namely grassland that would remain grassland in the absence of human intervention and which maintains the natural species composition and ecological characteristics and processes; or Highly biodiverse grassland that is non-natural, namely grassland that would cease to be grassland in the absence of human intervention and which is species-rich and not degraded, unless evidence is provided that the harvesting of the raw material is necessary to preserve its grassland status.	This does not comply unless the harvesting is necessary to preserve the grassland status.
Wetland	Namely land that is covered with or saturated by water permanently or for a significant part of the year.	Complies only if the status of the land has not changed. Evidence of the nature and extent of the wetland will need to be provided for January 2008 and the date when the raw material was harvested.
Peatland	Land consisting largely of peat.	Complies only if the land was *not* peatland in January 2008, unless evidence is provided that the cultivation and harvesting of that raw material did not involve drainage of previously undrained soil.
Settlement	All developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories. Examples of settlements include land along streets, in residential (rural and urban) and commercial lawns, in public and private gardens, in golf courses and athletic fields, and in parks, provided such land is functionally or administratively associated with particular cities, villages or other settlement types and is not accounted for in another land use category.[37]	Complies.

7.39. In some cases, the actual land cover may not be the same as the land category designated in a country's land registry. Generators who find themselves in this situation should consider the actual land cover rather than that stated in the registry. For example, it is feasible that the land is or was designated for future

[36] Article 17, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF
[37] Definition from IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, 2006

agricultural purposes in a land registry, but the actual land cover (if you visit the site) is forestland. In this example, the land should be considered as forestland.

7.40. Cropland specifically refers to land that is under the control of a farm or plantation. It is possible that the land at a single farm is not exclusively cropland, but also includes other land uses (for example, forestland). If the land cover does include forestland, the generator will have to demonstrate that there has been no conversion of that forestland after January 2008. However, if the land used to produce the feedstock is cropland, 'cropland' should be reported.

7.41. The land category 'cropland - non-protected' can be reported only if the land in question fully meets the land criteria. Similarly, the land category 'cropland – protected' can be reported only if the generator has evidence that the production of the raw material, from which their biomass is sourced, did not interfere with the nature protection purposes of the land.

Energy crops

7.42. An energy crop will be considered to meet the land criteria where financial assistance has been paid under the Energy Crops Scheme for that energy crop, or under an equivalent financial assistance scheme.

7.43. Generators must be able to demonstrate that their fuel meets the definition of energy crop in order to demonstrate that the land criteria have been met in accordance with the previous paragraph.

7.44. In addition to this, suitable evidence will also need to be available to demonstrate that the energy crop has been assessed as meeting the requirements of the Energy Crop Scheme, or equivalent, and to show that financial assistance has been paid. As with any of the evidential requirements, the generator may need to provide a suite of evidence rather than relying on a single document for the purpose of sustainability audit reports or requests from licensees. Here are examples of what this evidence may be:

- a copy of the offer letter signed by the energy crop grower,
- confirmation of the payment of the grant, and
- additional confirmation that the requirements set for the grower have not been breached, requiring the repayment of the grant.

8. Sustainability – greenhouse gas criteria

Chapter summary

This chapter provides information on the greenhouse gas criteria that generators must report against in their quarterly sustainability declarations. It also outlines the GHG thresholds and describes the methodologies to calculate the GHG emissions for each consignment of feedstock.

8.1. The land criteria aims to protect land with a high biodiversity value and high carbon stock values.

8.2. The relevant maximum GHG thresholds can be seen in table 4.

8.3. Reporting of GHG emission values must be per consignment of feedstock used for each quarterly period, given in grams of CO2 per MJ of electricity (gCO2e/MJ electricity).

8.4. Every consignment of feedstock must meet the GHG threshold for your installation to be eligible to receive a tariff under the Smart Export Guarantee (SEG). Use of any feedstock that does not meet the GHG threshold may not receive a tariff under the SEG. Please also note that all liquid feedstocks that are not wastes are deemed to be unsustainable for AD installations.

Table 4: GHG emission thresholds for AD installations

	From 1 May 2017 to 31 March 2020	**From 1 April 2020 to 31 March 2025**	**From 1 April 2025 onwards**
GHG emission threshold	66.7gCO_{2eq}/MJ electricity	55.6 gCO_{2eq}/MJ electricity	50.0gCO_{2eq}/MJ electricity

8.5. Throughout this chapter we refer to GHG emissions of biomass as 'carbon intensity'. This is measured in terms of the lifecycle GHG emissions associated with the biomass as carbon dioxide equivalent (CO_{2eq}). It therefore includes GHG other than carbon dioxide (eg methane and nitrous oxides).

Allocating GHG emissions – waste and residues

8.6. For calculating GHG emissions, the RED makes it clear that for wastes and residues, the GHG calculations are only required from and during the process of collection of the waste or residue.

8.7. 'Process of collection' refers to the beginning of the process of collection which includes all emissions involved in collecting the waste or residue, and further processing and transport. This is not necessarily the same as the point of collection, which is often considered to be the point where the material is collected by another party, as any emissions arising after the residue was created but before it is

collected should also be taken into account. For example, there may be emissions associated with machinery used to gather the residue into storage containers ready for collection.

8.8. Alternatively, residues from agriculture may be collected from different fields, which is considered to be the starting point of this residue. The collection of these residues, transportation (and any associated processing) will need to be calculated and allocated to the final fuel.

Performing GHG calculations

8.9. Where a generator is required to calculate the carbon intensity of their fuel, they have the following methods available to them:

- Default value method
- Actual value method

8.10. Where a generator has a choice between the default value method and actual value method it will be up to them to determine their preferred approach, noting the following:

- The actual value method can be time consuming and may require a large amount of verification. However, employing this method may allow the generator to understand more about their supply chain and where carbon savings can be made.
- The default value method provides a much less burdensome route than the actual value method to demonstrate that the GHG criteria have been met. This method can only be used for installations with a capacity of less than 1MW. Default carbon intensities are conservative; this means they are expected to be higher than the emissions calculated using the actual value method. Only certain fuels are covered.

8.11. If more than one fuel is being used, and the generator is able to choose between the actual value method and the default value method, they could choose to use both methods. For example, they may use the default value method for biogas from wheat and straw and the actual value method for biogas from maize.

Default value method

8.12. The default value method involves using a default carbon intensity of the fuel(s) being used for the purpose of reporting GHG emissions to us.

8.13. The fuels which have default values associated with them are set out in the legislative framework. For ease of reference, the default values are replicated in Appendix 3.

8.14. Please note that installations using these fuels which have a TIC ≥1MW will not be eligible to use the default value method. They must therefore use the actual value method.

8.15. The default carbon intensities may also only be reported if emissions from land use change are not greater than zero (see Appendix 3 for how to calculate these). For

fuel chains in which land use has changed, the default value can only be used if combined with the emissions from the land use change.

8.16. The generator must be able to demonstrate that the fuel specified for which they are utilising the default carbon intensity value corresponds to the actual fuel they are using.

8.17. The default values for GHG emissions savings for the various biomass feedstocks only provide the carbon intensity of the fuel itself, and not the electricity generated, which needs to be reported to us. Therefore, before reporting to us, the generator must perform a single calculation using the default value and the actual conversion efficiency of the eligible installation. This calculation is set out in paragraphs 8.27 and 8.28

Actual value method

8.18. The actual value method involves assessing the carbon intensity for each stage within the fuel lifecycle. The methodology for this GHG calculation is set out in the legislative framework. It refers to Part C of Annex 5 of the Renewable Energy Directive[38] (RED) and includes some specific modifications to the methodology specified in the RED to tailor its applicability to the SEG.

8.19. The methodology specifies which GHG emissions must be accounted for when determining the carbon intensity of the biomass. In calculating emissions, the actual value method does not specify that all values must be actual data associated to their specific circumstances. A generator can make use of actual data which are relevant to their specific supply chain alongside standard input data from relevant sources such as academic literature.[39]

8.20. For example, actual data could be the transportation distance from the point of feedstock collection to the installation, whereas standard input data may be a literature value of the carbon intensity for the type of fertiliser used.

8.21. If you are using the carbon calculator[40], there is reference to 'default fuel chains' and 'default values'. These are not related to the values provided in the legislative framework for the 'default value method.' The 'default values' provided in the calculator are typical or indicative values that should be adapted for your fuel chain where needed. There are no restrictions on which generators can make use of these values – but it must always be considered whether they require adapting for the generator's particular fuel chain(s). You can find a user guide for the carbon calculator in a subsidiary document on the carbon calculator page on our website, which provides information on how to use these default values and default fuel chains.

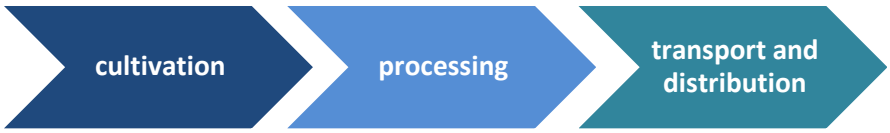
8.22. According to the methodology, the total carbon intensity of biomass is the sum of the following, minus any emission savings[41]:

[38] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN
[39] There is some standard input data pre-built into the Carbon Calculator that generators can make use of if appropriate for their fuel
[40] https://www.ofgem.gov.uk/publications-and-updates/uk-solid-and-gaseous-biomass-carbon-calculator
[41] Emission savings may be related to soil carbon accumulation via improved agricultural management, carbon capture and storage/replacement and excess electricity from co-generation, in line with the RED methodology.

- emissions from the extraction or cultivation of raw materials
- annualised emissions from carbon stock changes caused by land-use change (if applicable)
- emissions from processing
- emissions from transport and distribution

8.23. These can be broadly categorised into three main stages as shown in figure 7.

Figure 7: Summary of key steps in GHG calculations



8.24. In an actual supply chain, there may be more than one transport or processing step. Figure 8 provides an example of a typical fuel chain.

Figure 8: Example of a crop to electricity generation fuel chain through the production of biogas: sugar beet

(KEY: Dark blue: Cultivation and harvesting, Teal: Transport and distribution, Blue: Processing, Orange: Electricity generation.)

8.25. Where, due to a material's fuel classification, the emissions must be calculated 'from the process of collection' the methodology for calculation is the same except there will be no emissions associated with cultivation.

8.26. Where material is added to solid biomass to act as a binding agent or to reduce the emissions of dust, carbon dioxide, methane or nitrous oxide from the use of the biomass, the material will be considered as having zero GHG emissions, as long as it does not exceed 2% of the biomass in terms of weight.

GHG emissions and efficiency calculations

8.27. For AD installations producing electricity only, the GHG emissions value to report to us must be calculated using the following formula:

$$\frac{E}{\eta_{el}}$$

8.28. For AD installations producing both heat and power, the GHG emissions value to report to us must be calculated using the following formula:

$$\frac{E}{\eta_{el}}\left(\frac{\eta_{el}}{\eta_{el}+C_h\times\eta_h}\right)$$

Where:

E = the GHG emissions expressed in grams of $CO_{2(eq)}$ per MJ of electricity produced from the production of the biomass or biogas

η_{el} = the efficiency of the plant in the generation of electricity, which is equal to A/F, where:

A = the total electricity generated by the installation from all fuels used in that installation (MJ)

F = the energy content (net calorific value) of all those fuels (MJ) used to generateelectricity

η_h = the efficiency of the installation in the generation of heat, which is equal to H/F, where:

H = the total heat produced by the installation in the form of liquid or steam in the relevant quarter from all fuels used in that installation

C_h = 0.3546 where the temperature of the heat produced by the installation in the form of liquid or steam is <150°C; or = (T – 273)/T, where T is the temperature in Kelvin of the heat produced by the installation in the form of liquid or steam.

Allocation factors, input data, and emission factors

8.29. When working through the actual value method, you will likely make use of allocation factors for co-products, input data and emission factors. The following sections provide further information on these terms and how to use them.

Allocation factors

8.30. In some cases, when a feedstock is produced, other useful products are made at the same time. These are termed 'co-products'.

8.31. In these cases, it is important that all of the emissions at the point at which the co-products are produced are split between the different co-products. This proportioning of emissions is referred to by the term 'allocation factor' which is determined by performing a calculation.

8.32. In most cases, the upstream emissions should be allocated between the different co-products based on the energy content (determined by net calorific value in the case of co-products other than electricity) of each co-product.

8.33. To calculate the emission factor follow these steps:

Step 1 – Calculate or look up the net calorific values of all products exported from the conversion plants

Calculate or look up the net calorific values of all products exported from the conversion plants (both the main exported product and all the co-products) – each of these values should be expressed in MJ/kg of product. NOTE: calorific values of common co-products are part of the list of standard emission factors.
Step 2 – Calculate total energy in each product
Calculate the total energy contained in each product exported from the eligible installation (the main product and the co-products) by multiplying the amount of product (expressed in kg of product) by its net calorific value. This gives the energy content of each exported product.
Step 3 – Sum the values
Sum of all values in Step 2 to give the total energy content of products exported from the eligible installation (expressed in MJ).
Step 4 – Calculate the proportion of emissions
For a particular product, divide the energy content of that product (Step 2) by the total energy content of products exported from the eligible installation (Step 3). This gives the proportion of emissions which should be allocated to that product. This can also be done for each of the co-products.

8.34. If one of the co-products during the production of the biomass is useful heat, then the emissions should be allocated between the different products by taking into account the energy content of all the co-products and the temperature of the useful heat based on this formula:

Allocating emissions when useful heat is co-produced

$$A_i = \frac{E}{\eta_i}\left(\frac{C_i\eta_i}{C_i\eta_i + C_h\eta_h}\right)$$

Where:
A_i = allocated GHG emissions at allocation point to co-product, *i*
E = total GHG emissions up to allocation point
η_i = the fraction of co-product, measured in energy content, defined as the annual amount of co-product produced divided by the annual energy input
η_h = the fraction of heat produced together with other co-products, defined as the annual useful heat output divided by the annual energy input
C_i = fraction of exergy in the energy carrier (other than heat), equal to 1
C_h = Carnot efficiency (fraction of exergy in the useful heat)

The Carnot efficiency, C_h, is calculated as follows:

$$C_h = \frac{T_h - T_0}{T_h}$$

Where:
T_h = temperature of the useful heat, measured in Kelvin at point of delivery
T_0 = temperature of surroundings, set at 273 Kelvin.
For T_h < 150°C, C_h is set to 0.3546.

8.35. If the co-product is excess electricity from co-generation during the production of biomass or biogas, the emission saving shall be taken to be zero.

Input data

8.36. When using the actual value method, generators are advised to focus on parameters which have an impact on the overall results, ie inputs that change the carbon intensity by more than 1% when included. Factors that should be considered include:

- nitrogen fertiliser application rate
- crop yield
- fuel consumption for cultivation
- transport distances and mode of transport
- process mass efficiency[42]
- fuel type and demand
- electricity demand
- co-product yield and energy content[43]

8.37. Aside from the restrictions noted in paragraph 8.36, it is possible to use standard input data in place of actual data. When using standard input data, the generator should be sure that values correspond to the type of biomass fuel being used at the eligible installation in terms of feedstock type, form, region of origin and if relevant, the drying technique.

8.38. A range of input data was agreed by BEIS (previously DECC at the time the decision was made) to be used in the carbon calculator. Appendix 3 sets out a number of these inputs. Where actual input data is being used, these are not required.

8.39. There are some forms of input data which are heavily interdependent. Table 5 below sets out these compulsory dependencies which generators must follow where they are using actual data for one of the inputs. For example, the yield of many crops is influenced heavily by the amount of nitrogen which has been applied, and as such, if actual data is provided for yield, actual data is also required for nitrogen input.

[42] Tonnes of product per tonne of input
[43] The energy content of co-products should be based on their lower heating value (LHV) (or net calorific value). By convention, the LHV is considered to be the heat released during the combustion of a fuel, with starting temperature at 20°C and end-state temperature at 125°C for all products. For the purposes of the carbon intensity calculations laid out in this guidance, LHV can either be found in scientific literature or measured in calorimeters.

Table 5: Compulsory links between interdependent parameters

Input one	**Input two**
Crop production	
Crop yield[44]	Nitrogen fertiliser application rate
Nitrogen fertiliser application rate	Soil N_2O emissions[45]
Conversion	
Efficiency	Any co-product yield
Electricity or heat exported	Fuel use

Emissions factors

8.40. Emissions factors are used to calculate the GHG emissions associated with the production of an input material. For example, the emissions factor for nitrogen fertiliser provided in the carbon calculator for March 2015 is 4.57 kg of CO_{2eq} per kg of nitrogen applied ($kgCO_{2eq}/kgN$), based on the emissions from producing and transporting the fertiliser. This factor is used in combination with the application rate of the fertiliser (in kg N/ha) and the yield of the crop (in t/ha) to give the contribution of the use of the nitrogen fertiliser to the overall carbon intensity of the production of the crop (in $kgCO_{2eq}/t_{crop}$).

8.41. If actual data is unavailable, a value should be referenced from scientific literature. A copy of this literature or its detailed reference should be provided to the auditor as a part of the annual verification process if applicable, or to us if requested. The value used must fulfil the following requirements:

- the standard emission factor should be obtained from an independent and recognised author or organisation[46]
- it should also be based on the most up-to-date reference available, and
- it should be applicable for what it is being used for

8.42. When accounting for the consumption of electricity that is not co-produced within the biomass production installation, but which is imported from the grid, the emission factor for the electricity consumed should be equal to the average emission

[44] This compulsory link does not apply to sugar beet.
[45] Note that actual input data does not need to be collected for soil N_2O emissions; the IPCC Tier 1 methodology can be used as described in Step 4 of the table 5 in paragraph 6.42, which calculates N_2O emissions based N fertiliser input. If either of the Carbon Calculators is used, N_2O emissions are automatically calculated from the nitrogen fertiliser applied, using the same IPCC Tier 1 methodology.
[46] In the first instance, it is recommended to look to the EU Transparency Platform as the EC may decide to upload acceptable input data there.

intensity of the production and distribution of electricity in the "region" where the biomass is produced. The emissions intensity of production and distribution in different regions should be taken from an authoritative source, for example the latest version of the International Energy Agency CO_2 emissions from fuel combustion database.[47] A region may be a sub-national region, a country or a supra-national region. If electricity is co-produced, follow the steps as outlined in paragraph 8.33.

8.43. If the electricity is provided to the fuel production process from a power plant that is not connected to the electricity grid, generators may use a carbon intensity value for the production of electricity in that specific power plant. In this instance the party should still keep evidence of the source of this value.

The step-by-step method

8.44. The following steps explain how to calculate the carbon intensity of the biomass using the actual value method. Once the carbon intensity of the biomass has been calculated (Steps 1 to 10) it must then be converted into the appropriate units for reporting to us as shown in Step 11.

Table 6: Step by step approach for actual value method

Step 1 – Define the supply chain
Define the steps which occur during the production of the biogas. Each part of the process during which emissions are emitted is called a module, and therefore each supply chain is composed of a series of modules.
Step 2 – Identify the output of each module
Identify the main product which is exported from each module (for example wood chips, biogas). All emissions within a module should be calculated per unit of this product (ie in kg $CO_{2eq}/t_{product}$ or $kgCO_{2eq}/MJ_{product}$ if the product is a gas[48]).
Step 3 – Identify the inputs of each module
Within each module, identify all inputs (material and energy) which will have an impact of more than 1% on the final carbon intensity of the biomass. Each input must then be measured and expressed per unit of the exported product (ie in MJ or t input/t product).[49]
Step 4 – Identify appropriate emission factors

[47] Other sources may also be used.
[48] MJ is used as the unit of product of gaseous biomass rather than m^3 because energy content can change with pressure – this matches the UK Biomass and Biogas Carbon Calculator
[49] The use of nutrient recycling through the reuse of digestate can provide an advantage in terms of GHG emissions for crops used for anaerobic digestion. Although the first cultivation year is likely to be based on inorganic fertiliser application in order to produce digestate from AD, for the purposes of GHG calculations, the average annual inorganic fertiliser and digestate input over the life of the crop can be used.

For each input, find an appropriate emission factor. The emission factor is a factor used to calculate the GHG emissions that occurred during the manufacture and distribution of an input (in kg CO_{2eq}/t input or kg CO_{2eq}/MJ input). Paragraph 8.38 provides further information on emission factors.

Step 5 – Multiple inputs by emission factors

Within each module, multiply the inputs by their appropriate emission factors and sum the results. The summed total represents the total GHG emissions per unit of output for this module (the material that is transferred to the next module in the biomass chain). Any certified reductions of GHG emissions from flaring at oil production sites anywhere in the world should be deducted from the overall emissions from the production of the biomass.[50]

Step 6 – Accounting for co-products in conversion modules

Within each conversion module, identify if there are co-products. Co-products are products created (which are not wastes or residues) alongside the main product and to which some of the emissions generated should be allocated. If the co-product is a waste, the emission associated with disposing of that waste should be included in the calculation of the overall carbon intensity of the biomass used. Differing allocation factors are applied if the co-product is excess electricity. See paragraph 8.26 onwards for more information of allocation factors and the differing calculations.

Step 7 – Identifying efficiency of modules

For all modules, the efficiency (in unit output/unit input) of the module has been collected, as this is needed to establish the contribution that upstream emissions make to the final carbon intensity of the biomass. Typical efficiencies are:

- For a conversion module – generally lower than 1.
- For transport and distribution modules – can be 1 if no losses occur during the transport.

For a module converting biomass into biogas (eg an anaerobic digestion installation), the unit of the efficiency should be in MJ output/t input, and the value will usually be much bigger than 1.

Specifically for the cultivation module, make sure that the crop yield (in $t_{product}$/ha/yr) has been collected. Please note that N_2O emissions, from soil, which occur when nitrogen in the soil is converted to N_2O through naturally occurring processes, should also be included in the cultivation module.[51]

Step 8 – Calculating carbon intensity of each module

For each module, the contribution of that module to the total carbon intensity now needs to be calculated (in gCO_{2eq}/MJ). This is done by taking:

[50] European Commission, Annex V, Part C, paragraph 6, European Directive 2009/28/EC on the promotion of the use of energy from renewable sources, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:EN:PDF [accessed 17 August 2011].

[51] Biogeochemical models are the most sophisticated method for estimating these emissions from soils but are complex to use and require large amounts of data which are unlikely to be available. Instead, the RED recommends use of the IPCC methodology for estimating both direct and indirect N_2O emissions when performing actual calculations. The use of Tier 1 of this methodology is recommended here because it simply correlates N_2O emissions with nitrogen fertiliser application rates. See 2006 IPCC guidelines for National Greenhouse Gas Inventories, volume 4, chapter 11 http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_volume4/V4_11_Ch11_N2O&CO2.pdf)

- the total GHG emissions per unit of exported product for this module (as calculated in step 5)

- any emission savings for that module (as calculated in step 6)

- any allocation factor of the module or any downstream modules (as calculated in step 6)

- the efficiency of any downstream modules (as determined in step 7)

For each module performing this calculation:

$$\frac{(total\ GHG\ emissions\ of\ exported\ product - emission\ savings\ for\ module) \times (allocation\ factor\ of\ module\ or\ any\ downstream\ modules)}{efficiency\ of\ any\ downstream\ modules}$$

Step 9 – Calculating carbon intensity of supply chain

The biomass carbon intensity can now be calculated by adding up the contribution of each module as calculated in step 8. This carbon intensity is expressed in $kgCO_{2eq}$/MJ.

Step 10 – Converting carbon intensity into relevant units

The carbon intensity has to be converted to gCO_{2eq}/MJ biomass. For a biogas chain, this is done by multiplying the result of Step 9 by 1000 to convert the $kgCO_{2eq}$/MJ biogas to gCO_{2eq}/MJ biogas.

The energy content (ie lower heating value) of typical biomass types can be found in the standard emission factors list (see Appendix 3).

Step 11 – Final calculation for value to report to us

The legislative framework requires the carbon intensity to be reported in specific units in order to demonstrate whether the GHG threshold has been met.

For solid biomass or biogas, the value is reported in gCO_{2eq}/MJ electricity. This requires the operator to take into account the efficiency of the eligible installation.

For a non-CHP station, the following steps, using the value determined from step 10, are necessary to calculate the emissions from the use of the biomass to be reported to us:

$$GHG\ emission = \frac{emissions\ from\ production\ of\ biogas}{electrical\ efficiency\ of\ power\ plant}$$

The electrical efficiency of the power plant is determined by dividing the total amount of electricity generation by the eligible installation during the month (in MJ) by the energy content (based on lower heating value) of all the fuels used in generating that electricity during the month (in MJ)[52].

For a CHP station, the following steps, using the value determined from step 10, are necessary to calculate the emissions from the use of the biomass to be reported to us:

$$GHG\ emission = \frac{emissions\ from\ production\ of\ biogas}{electrical\ efficiency\ of\ power\ plant}\left(\frac{electrical\ efficiency\ of\ power\ plant}{electrical\ efficiency\ of\ power\ plant + C_h \times thermal\ efficiency\ of\ power\ plant}\right)$$

The electrical efficiency of the power plant is determined in the same way as for non-CHP stations above. The thermal efficiency of the power plant is determined by dividing the energy content (based on lower heating value) of all the heat supplied from the eligible installation to any premises[53] during the month[54] (in MJ) by the energy content (based on lower heating value) of all the fuels used in generating that electricity during the month (in MJ).

For 'C_h', if the temperature of the useful heat at delivery point is less than 423 Kelvin (K) the C_h is 0.3546. If it is greater than or equal to 423 K then subtract 273 from the temperature, and divide the answer by the temperature.

Land use change emission calculation

8.45. As set out in chapter 7 where there is a land use change, the emissions associated with this must be included within the GHG lifecycle emissions calculation. As the calculations will be required only in certain instances, they have been included in Appendix 4.

8.46. All calculations for land use change at present refer to *direct* land use changes. There are currently no requirements on generators to report or include in their carbon intensity calculations emissions from *indirect* land use change or from changes in land management practices if the land use classification does not change.

8.47. The land use change may not necessarily result in a loss of carbon to the atmosphere. It is possible that emission savings can be created from the soil carbon accumulation via improved agricultural practices and be accounted for within the GHG calculation. This calculation is available for use in all supply chains, regardless of the fuel state.

Degraded land bonus

[52] Where appropriate the operator can use the annual average efficiency of their power plant.

[53] If several useful heat sources are produced, then the denominator in this calculation is: the electrical efficiency added to the sum of all the useful heat streams' thermal efficiencies multiplied by their respective carnot efficiencies. Refer back to section 5.47 on allocation factors for more details.

[54] Where appropriate, it is acceptable to divide the annual heat figure from the previous year by 12 to get a monthly figure.

8.48. A bonus[55] of 29 gCO_{2eq}/MJ shall be attributed if evidence is provided that the land on which the feedstock was grown was not in use for agriculture or any other activity in January 2008 and falls into one of the following categories:

- severely degraded land including such land that was formerly in agricultural use
- heavily contaminated land

Where:

- '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
- 'heavily contaminated land' means land that is unfit for the cultivation of food and feed due to soil contamination

8.49. The bonus will apply for up to ten years from the date of conversion of the land to agricultural use, provided a steady increase in carbon stocks as well as a sizable reduction in erosion phenomena for land falling under (a) are ensured and that soil contamination for land falling under (b) is reduced.

Useful tools

8.50. It is up to the generator to determine which tool they will use to calculate their GHG emissions as part of the actual value method.

Carbon Calculator

8.51. SEG generators can use the UK Biomass and Biogas Carbon Calculator (for solid biomass and biogas fuel chains) which is available to download from our website[56].

8.52. This is owned by BEIS and was developed in accordance with the methodology as set out in the legislative framework. It is designed to facilitate the implementation of the life cycle calculation methodology for reporting the carbon intensity of fuels under SEG, FIT, RHI, and the RO.

8.53. The calculator automatically works out the total emissions of the module being edited, and the contribution of that module to the overall fuel chain. It also identifies the key inputs required for any particular module, depending on what type of module it is (for example cultivation, transport and distribution). Furthermore, accepted default emission factors are included in the calculator.

8.54. There is a user manual published alongside the calculator which explains how to use it.

Other tools

8.55. Other IT-based tools are available that a generator can use when calculating the GHG emissions for their fuel chain. Alternatively, generators could create their own tool. If a generator wishes to use a tool other than the UK Biomass and Biogas

[55] As set out in the RED - Annex V, Part C, Para 8.
[56] Available at https://www.ofgem.gov.uk/publications-and-updates/uk-solid-and-gaseous-biomass-carbon-calculator

Carbon Calculator, the onus is on them to ensure and demonstrate that it meets the methodology as set out in the legislative framework and that any inbuilt standard input data is appropriate.

Sources of information

8.56. In January 2013, CEN – the European Committee for Standardization - published a standard (EN 16214-4) titled 'Methods of the greenhouse gas emission balance using a life cycle analysis'[57] which generators may find provides useful guidance in calculating emissions. Whilst the document has been published specifically for biofuels and bioliquids, it will likely contain information useful for solid biomass and biogas fuel chains also.

8.57. There is further information published on the EC transparency platform[58] which generators may find useful for calculating GHG emissions, particularly land use change emissions, including:

- EC decision of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC
- The climate region and soil type data layers
- An annotated example of land use change emission calculations

8.58. The legislative framework does not necessarily provide practical direction to support generators (and parties within the supply chain) in calculating the carbon intensity of their fuel. Below are recommendations in relation to some common queries received by us. We have set these out in guidance to support a consistent approach.

8.59. This is recommended guidance only. The suitability of the approach taken by the generator in calculating the carbon intensity of the fuel will be subject to independent verification as part of the annual sustainability audit or during an audit run by us.

- In accounting for transport emissions the generator will likely consider the emissions associated for the single journey from 'A' to 'B', on the basis that the transport vehicle (for example lorry, ship) will be returning to 'A' or onto another destination with further separate cargo. In the event that the transport vehicle is returning empty, and therefore the journey has been solely for the transport of the biomass then it would be appropriate for the generator to factor in the emissions for the return journey. The values within the Carbon Calculator for energy intensity of transport are set up to account for an empty return journey.
- In accounting for transport emissions, the generator may wish to consider whether the biomass is the full cargo or whether this is only an aspect of what is being transported. In the event that the lorry, ship (or other transport mode) is carrying other cargo, the generator should seek to apportion the emissions accordingly.
- A default value for methane losses is provided in the Carbon Calculator for biogas and biomethane fuel chains. This is a conservative value, so it is not necessary to apply the additional 'conservative factor' of 40% utilised for other standard input values in the drying and processing modules.

[57] Available at http://www.cen.eu/cen/Sectors/Sectors/UtilitiesAndEnergy/Fuels/Pages/Sustainability.aspx
[58] http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm

Generators who do not wish to use the default value for methane losses must be able to provide evidence and support for any alternative value they propose to use, to demonstrate that it is appropriate for their installation.

Appendices

Appendix 1– UK recognised voluntary schemes

1.1. As set out in chapter 6, in 2012 we benchmarked a number of voluntary schemes against the RO's protected land criteria for non-woody biomass (ROO 2009 (as amended)) for use on the RO scheme. An overview of the results of the exercise is available in table 9 below.

1.2. In 2015 our RO team also undertook an exercise to benchmark these schemes against the ROO 2015 sustainable source land criteria for woody biomass for the purpose of the RO scheme. Please see Appendix 2 of the Renewables Obligation: Sustainability Criteria guidance[59].

1.3. The results of these exercises will also be used when determining classification of consignments for the purposes of SEG compliance.

Scheme Name	Benchmarked Version	Land Criteria						Audit Criteria
		Conservation of primary and forest wooded other land	Conservation of protected areas	Conservation of wetlands	Conservation of continuously forested areas	Conservation of "10% to 30%" forested areas	Conservation of peatlands	
American Tree Farm System (ATFS)	2010-2015 Standard	No reference date	No reference date	No reference date, No specific reference to conversion of wetlands	No reference date	No reference date	Not covered	Yes
Canadian Standards Association (CSA)	CAN/CSA Z809-08	No reference date, Conversion permitted if "ecologically appropriate"	No reference date	No reference date, Criteria focus on water quality and quantity	No reference date	No reference date	Not covered	Yes
Green Gold Label	GGL v2010.1	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Natural England Energy Crop Scheme	2009	No reference date, No specific reference to primary forest (relies on protected areas)	No reference date	No reference date, No specific reference to wetlands (relies on protected areas)	Not covered	Not covered	Not covered	3rd party verification required Annual surveillance audits required
Programme for the Endorsement of Forest Certification (PEFC)	PEFC ST 1003:2010	Reference date of 31 Dec 2010, Conversion permitted under "justified circumstances"	No reference date	No reference date	No reference date	No reference date	Not covered	Yes
Sustainable Forestry Incentive (SFI)	2010 - 20	No reference date	No reference date	No reference date	No reference date	No reference date	Not covered	Yes

[59] Available at: https://www.ofgem.gov.uk/publications-and-updates/renewables-obligation-sustainability-criteria

	14 Standard							
UK Woodland Assurance Scheme (UKWAS)[60]	Second Edition, Nov 2008	Yes	No reference date for non-wooded areas	No reference date, No specific reference to wetlands (relies on protected areas)	No reference date	No reference date	Not covered	Yes

Table 9: Selected voluntary schemes benched against the non woody biomass land criteria

[60] UKWAS 2nd edition (2008) was the version benchmarked. We understand UKWAS 3rd edition has been publicly available since 1 December 2011.

Appendix 2– Common fuel classifications

2.1. These tables provide guidance on when substances should be considered products, residues or wastes only for the purposes of the sustainability criteria under the SEG.

2.2. It is not possible to lay down definitive or absolute rules for when particular materials will be considered waste, residues or products. A judgement has to be made taking into account the circumstances of each case, and applying the legislative framework, case law principles and other relevant indicators.

2.3. This is an indicative and not an exhaustive list. There may be further wastes or residues that are not on the list that still qualify as wastes or residues. We may periodically review and update this list on our website, if sufficient evidence emerges to indicate that a substance should be treated differently.

2.4. For more information on fuel classification, including definitions and reporting requirements please see chapter 3.

Table 10: Products

Material	**Description**
Virgin oils, including but not limited to: Palm, soy, rape, sunflower	Including, but not limited to, oils derived from palm, soy, rape and sunflower. The treatment of these materials and of the meal produced as part of the same process in the RED GHG calculations makes clear that these are to be treated as products.
High oleic acid rape seed oil	A product if grown as a fuel, or if grown as a product and diverted to use as a fuel. If used as fuel after being used for cooking then it will be a waste (as used cooking oil).
Short rotation coppice (SRC)	Short rotation coppice is grown specifically for use as a fuel and, as such, it is a product.
Short rotation forestry (SRF)	Short rotation forestry grown specifically for use as a fuel is a product.
Virgin wood	Virgin wood is timber from whole trees and the woody parts of trees including branches and bark derived from forestry works, woodland management, tree surgery and other similar operations. It does not include clippings or trimmings that consist primarily of foliage (though these may be forestry residues). Further information on virgin wood can be found in a statement from the Environment Agency: http://www.environment-agency.gov.uk/static/documents/Research/PS_005_Regulation_of_wood_v3.0.pdf
Miscanthus	This is commonly grown as a fuel crop and in these circumstances will be a product. If it is put to another use first, eg as animal bedding, before being used as fuel then it will be a waste.
Palm oil olein	The refined liquid fraction of palm oil is a product. If used for cooking before being used as fuel then it will be a waste (as used cooking oil).
Palm kernel oil	Palm kernel oil is a product. If used for cooking before being used as fuel then it will be a waste (as used cooking oil).
Material	Description
Acid ester	Esters are produced intentionally and are therefore a product.
Molasses	This material arises from the processing of sugar cane and sugar beet into sugar. It arises on the basis of a technical decision, and is considered a product.
Glycerol from virgin oils	The treatment of glycerol from virgin oils in the RED GHG calculations makes clear that it is to be treated as a product.
Crude tall oil	Crude tall oil arises from the process of pulping coniferous wood. The pulping process involves cooking woodchip in a chemical mixture and this gives rise to a soapy material which is separated from the pulp and liquor. It is then acidified and

	heated to convert it into crude tall oil. Crude tall oil is a product of the pulping process.
Brown liquor	This material arises during the pulping of wood. As for tall oil, it is considered a product.
Meal from virgin oil production	These materials' treatment in the RED GHG calculations makes clear that they are to be treated as products.
Sugar beet sludge	This is the pulp left over following sugar extraction. Its treatment in the RED GHG calculations makes clear that it is to be treated as a product.
Corn or wheat dried distillers grain (DDGS)	This material's treatment in the RED GHG calculations makes clear that it is to be treated as a product.
Palm Stearin	Palm stearin is produced alongside palm olein from the fractionation of crude palm oil. After the fractionation process, the mixture is filtered to separate stearin (solid form) and olein (liquid).
Palm fatty acid distillate	The treatment of PFAD in the RED GHG calculations indicates that it is to be treated as a product.
Tallow – Animal By-Product Category 3	Tallow, also called rendered animal fat, is the hard fat obtained from the whole or part of any dead animal through the process of rendering. It is then used as feedstock for the production of biodiesel or bioliquid as fuels. Annex V, Part D of the RED makes clear that animal oil produced from animal by-product classified as category 3 should be treated as product. A revised Animal By-Products Regulation 1069/2009 takes effect on 4 March 2011. Although the revised regulation does not appear to change this definition, no decisions have yet been made by a court or other panel on the basis of the new regulation. There is the possibility that once a decision is made, the status of tallow could change. The following documents underpin the Environment Agency's regulation of the process of producing biodiesel from rendered animal fat: http://www.environment-agency.gov.uk/static/documents/Business/MWRP_RPS_030_v2_biodiesel_22-12-10.pdf and http://www.environment-agency.gov.uk/static/documents/Business/Biodiesel_QP_NIEA_GEHO0311BTPC-E-E.pdf Note that the approach we have taken for category 3 tallow is that the generator does not have to make a response to the land criteria as the feedstock is neither cultivated nor obtained from land, as such the land criteria is considered to be automatically met. The generator should therefore select 'yes' in quarterly reporting. GHG emissions should be considered from the starting point of the material when it is generated at the abattoir/rendering plant.

Table 11: Residues from agriculture, aquaculture, forestry and fisheries

Material	Description
Forestry residues	Forestry residues are identified explicitly by the RED as residues. Following statements from the EC[61] and the Environment Agency[62], we consider forestry residues to be derived from "virgin wood" and to include all raw materials collected directly from the forest, whether or not as a result of thinning or logging activities. This may include (but is not limited to) materials such as tree tops, branches, brash, clippings, trimmings, leaves, bark, shavings, woodchips and saw dust from felling. Forestry residues do not include any residues from related industries, or residues associated with processing the virgin wood/raw material (for example sawdust from saw mills). These may be classed as processing residues (see below).
Arboricultural residues	Residues from arboriculture are not defined by the Orders or existing EC communications but can be considered to be biomaterial such as that which is removed as part of tree surgery, management of municipal parks and verges of roads and railways. Residues from arboriculture should not include forestry residues.
Straw	Straw is specifically named as an agricultural crop residue in the RED. Depending on whether the material was created during harvesting or processing will determine whether it must meet the land criteria or automatically does so. Straw is deemed to have zero GHG emissions prior to the process of collection.
Bagasse	Bagasse results from crushing sugarcane or sorghum. Bagasse is specifically named as an agricultural residue in the RED.

[61] European Commission, *Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling,* http://ec.europa.eu/energy/renewables/transparency_platform/doc/2010_report/com_2010_0011_3_report.pdf [accessed 14 December 2011].

[62] Statement from the Environment Agency http://www.environment-agency.gov.uk/static/documents/Research/PS_005_Regulation_of_wood_v3.0.pdf

	Depending on whether the material was created during harvesting or processing will determine whether it must meet the land criteria or is automatically does so. Bagasse is deemed to have zero GHG emissions prior to the process of collection.
Nut shells	Nut shells are specifically named as an agricultural residue in the RED. Depending on whether the material was created during harvesting or processing will determine whether it must meet the land criteria or is automatically does so. Nutshells are deemed to have zero GHG emissions prior to the process of collection.
Husks	Husks are specifically named as agricultural residues in the RED. Depending on whether the material was created during harvesting or processing will determine whether it must meet the land criteria or automatically does so. Husks are deemed to have zero GHG emissions up to the point of collection.
Cobs	Cobs are specifically named as agricultural residues in the RED. Depending on whether the material was created during harvesting or processing will determine whether it must meet the land criteria or automatically does so. Cobs are deemed to have zero GHG emissions up to the point of collection.
Tall oil pitch	Tall oil pitch is the remaining fraction of the fractional distillation process of crude tall oil. Tall oil pitch cannot be further refined. No matter which technical decisions are made in the fractional distillation, this fraction will remain. Tall oil pitch is therefore a residue of this process.

Table 12: Processing Residues

Material	**Description**
Vinasse	Vinasse results from the processing of sugar cane or sugar beet. The treatment of vinasse in the RED GHG calculations makes clear that it is to be treated as a residue.
Crude glycerol from processing of waste oils	Crude glycerol (from processing of waste oils) is specifically named as a residue from processing in the RED. The RED treats of glycerol from processing of virgin oils as a product – see above.
Palm processing residues: empty palm bunches, fibre and shell from palm oil production, palm oil mill effluent (POME)	These materials' treatment in the RED GHG calculations makes clear that they are to be treated as residues.
Saw dust from saw mills	This is a processing residue. Note that any deliberate change to the production process to increase the volume of sawdust resulting from processing would make the resulting material a product rather than a residue

Table 13: Wastes

Material	**Description**
Waste wood	Any waste wood, including "non-virgin" wood, will be considered a waste. Following statements from the Environment Agency, waste wood may include non-virgin timber off-cuts, shavings, chippings and sawdust from the processing of non-virgin timbers (whether clean or treated). The phrase "non-virgin" wood refers to materials such as post-consumer waste and construction and demolition waste.
Used cooking oil (UCO)	Commonly called "UCO" or "WCO" (waste cooking oil), this is purified oils and fats of plant and animal origin. These have been used by restaurants, catering facilities and kitchens to cook food for human consumption. They are wastes as they are no longer fit for that purpose and are subsequently used as either feedstock for the production of biodiesel as fuel for automotive vehicles and heating or as a direct fuel. The Environment Agency has further information on the process of producing biodiesel from UCO[63].
Brown grease (ex USA)	Brown grease is the grease that is removed from wastewater sent down a restaurant's sink drain. This is a waste.
Manure	As defined in the legislative framework.
Material	**Description**

[63] Further information can be found: https://www.gov.uk/government/organisations/environment-agency

Tallow – Animal By-Product Category 1	Tallow, also called rendered animal fat, is the hard fat obtained from the whole or part of any dead animal through the process of rendering. It is then used as feedstock for the production of biodiesel or bioliquid as fuels. Annex V, Part D of the RED makes clear that animal oil produced from animal by-product classified as category 1 should be treated as waste. A revised Animal By-Products Regulation 1069/2009 takes effect on 4 March 2011. Although the revised regulation does not appear to change this definition, no decisions have yet been made by a court or other panel on the basis of the new regulation. There is the possibility that once a decision is made, the status of tallow could change. The following documents underpin the Environment Agency's regulation of the process of producing biodiesel from rendered animal fat: http://www.environment-agency.gov.uk/static/documents/Business/MWRP_RPS_030_v2_biodiesel_22-12-10.pdf and http://www.environment-agency.gov.uk/static/documents/Business/Biodiesel_QP_NIEA_GEHO0311BTPC-E-E.pdf
Municipal Solid Waste	This is a waste.
Construction and demolition wastes	For the purposes of generation, this category will be mainly waste wood.
Meat/bone meal	This is a waste.
Food waste	Whether from manufacturers, retailers or consumers, this will be a waste.
Waste pressings from production of vegetable oils	When a vegetable material such as olives is pressed to produce vegetable oil, the pressed material consisting of pips, skins, flesh etc. remains. This may be used as a fuel. The purpose of the process is to produce oil; the pressings are therefore wastes.
Olive pomace	As above.
Soapstocks	From oil de-acidification; again an output from vegetable oil refining that will be waste.
Distillation residues	Distillation residues are what are left over following the distillation of products such as biodiesel, oil or petrochemicals, so will be wastes.
Food crops affected by fungi during storage	These are wastes.
Food crops that have been chemically contaminated	These are wastes.

2.5. Following the introduction of the land criteria for woody biomass we undertook some work to provide guidance on how certain types of wood should be classified.

2.6. As with the common classification tables, it is not possible to lay down definitive or absolute rules for when particular wood types will be considered waste, residues or products. A judgement has to be made taking into account the circumstances of each case, and applying the legislative framework, case law principles and other relevant indicators. This is not a definitive list and there may be some wood types not covered.

Table 14: Wood definitions and classifications

Material	Description	Classification
Bark	Tough outer surface of tree trunks and other woody plants	Forest residue or arboricultural residue (depending on where the residue is generated)
Clippings/trimmings	Primarily leaves and the stems on which the leaves grow	Forest residue or arboricultural residue (depending on where the residue is generated)
Construction and demolition waste wood (sometimes called recycled wood)	Woody material from construction or demolition sites that is no longer used in its primary function.	Waste

Material	Description	Classification
Diseased wood	Wood that has been felled due to damage from insect nests or blight which damages the tree and/or may spread disease to other trees/organisms and is of little value other than for energy	Forestry residue (unless from arboriculture)
End of life timber	Standing trees from plantations for non-timber products (suhc as coconut, rubber, palm trees) which have reached the end of their useful life	Agricultural residue
Fire damaged wood	Wood that has been damaged by fire and therefore has no other market than for energy.	Forestry residue (unless from arboriculture)
Leaves	Leaf matter arising directly from the forest as a result of harvesting or management activities	Forestry residue or arboricultural residue (depending on where the residue is generated)
Long rotation coppice	Plantation felled after a growing period of 15+ years and then replanted	Product
Non-sawmill lumber	Woody material that has been felled but does not meet the specifications for lumber for the sawmill due to its size or shape	Co-product
Post-consumer waste wood (Sometimes called recycled wood, eg pallets, packaging)	Woody material in a product that has been considered past its useful life by the consumer	Waste
Saw dust from felling	Saw dust produced during felling of trees	Forestry residue or arboricultural residue (depending on where the residue is generated)
Sawmill residue	Saw dust produced during the processing of wood at the sawmill	Processing residue However, some parties may say co-product if the value from this stream is material to ongoing profitability
Sawmill residue	Woody material produced during the processing of wood at the sawmill, may include small offcuts or also bark that has been stripped from the wood	Processing residue
Shavings	Wood shavings produced in the mill during timber processing	Processing residue
Short rotation coppice	Varieties of poplar and willow grown in wood plantations and managed through coppicing. Harvesting takes place every 2-5 years.	Product
Short rotation forestry	Tree plantations with short harvest rotations typically every 8-15 years. This can include agro-forestry (where trees are grown around or among crops or pastureland to optimise use of the land)	Product
Slab wood	An outsize piece cut from a log when squaring it for lumber. This takes place in the forest.	Forestry residue
Storm salvage wood	Wood from trees that have been uprooted or damaged during hurricanes or storms and is of little value other than for energy	Forestry residue or arboricultural residue (depending on where the residue is generated)
Stumps	The basal portion of a tree remaining after the rest has been removed	Forestry residue
Thinnings	Wood from a silvicultural operation where the main objective is to reduce the density of trees in a stand, improve the quality and growth of the remaining trees and produce a saleable product.	Co-product in the situation where alternative markets are available and the value of the thinnings is material to forest profitability. In other circumstances, forestry residue

Material	Description	Classification
Virgin Forestry	An area forested with virgin trees (ie non plantation) from which felled trees have been extracted.	Product
Woodchips from tops and branches	Typically comprised of chipped tops and limbs of trees that have been left behind following the harvesting of stem wood. This category should not include wood chips from stem wood or thinnings. May sometimes be called brash, which is the collective term for foliage, branches and tops of the tree.	Forestry residue
Wood residues from arboriculture	Biomaterial that is removed as part of tree surgery, management of municipal parks and verges of roads and railways. Also called arboricultural arisings	Arboricultural residue

Appendix 3 – Default values and standard input data

3.1. Table 15 sets out the default values of carbon intensities for solid biomass and biogas for use in the default value method as defined in the legislative framework.

3.2. Please note that the default value method cannot be used for installations with a TIC of 1MW and above.

3.3. Table 16 provides typical values that can be used by generators when calculating their GHG emissions as part of the actual value method. These values have been determined by BEIS and are pre-built into the Carbon Calculator.

Table 15: Solid biomass and biogas default carbon intensities

Biomass production pathway	**Default carbon intensity (CI) [gCO2eq/MJ feedstock]**
Bagasse briquettes where the process to produce the bagasse briquettes was fuelled by wood	17
Bagasse bales	20
Palm kernel	27
Rice husk briquettes	28
Biogas produced from wheat, where the whole plant was used to produce the biogas	21
Wheat straw	2
Biogas produced from straw	21
Biogas produced from organic maize, where the whole plant was used to produce the biogas	19

Table 16: Typical values provided in the Carbon Calculator

Factor	**Value**
Global warming potentials	
CO_2	1 gCO_2eq / g
CH_4	23 gCO_2eq / g
N_2O	296 gCO_2eq / g
Agricultural inputs GHG emission coefficients	
N-fertiliser (kg N)	4567.8 gCO_2eq/kg
P_2O5-fertiliser (kg P_2O5)	1176.0 gCO_2eq/kg
K_2O-fertiliser (kg K_2O)	635.6 gCO_2eq/kg
CaO-fertiliser (kg CaO)	89.6 gCO_2eq/kg
Pesticides	13894.6 gCO_2eq/kg
Seeds- rapeseed	794.0 gCO_2eq/kg
Seeds- soy bean	0.0 gCO_2eq/kg
Seeds- sugarbeet	3820.5 gCO_2eq/kg
Seeds- sugarcane	4.9 gCO_2eq/kg
Seeds- sunflower	794 gCO_2eq/kg
Seeds- wheat	289.9 gCO_2eq/kg
Short rotation coppice cuttings	0.0 [kg CO_2eq / cutting]

Short rotation coppice setts	0.0 [kg CO_2eq / sett]
Emissions due to transport of filter mud cake	0.0 [kg CO_2eq / kg filter mud cake]
Emissions due to transport of vinasse	0.0 [kg CO_2eq / kg vinasse]
Manganese	0.8 [kg CO_2eq / kg Mn]
Rhizomes	0.3 [kg CO_2eq / kg rhizome]
Forage maize seeds	0.3 [kg CO_2eq / kg seeds]
Urea silage additive	9.8 [kg CO_2eq / kg additive]
Propionic acid silage additive	1.3 [kg CO_2eq / L additive]
Digestate	0.0 [kg CO_2eq / kg digestate]
Farm yard manure	0.0 [kg CO_2eq / kg FYM]
Fuels GHG emission coefficients	
Natural gas (4000 km, Russian NG quality)	66.20 gCO_2eq/MJ
Natural gas (4000 km, EU Mix quality)	67.59 gCO_2eq/MJ
Diesel	87.64 gCO_2eq/MJ
HFO	84.98 gCO_2eq/MJ
HFO for maritime transport	87.20 gCO_2eq/MJ
Methanol	99.57 gCO_2eq/MJ
Hard coal	111.28 gCO_2eq/MJ
Lignite	116.98 gCO_2eq/MJ
Wheat straw	1.80 gCO_2eq/MJ
Electricity GHG emission coefficients	
Electricity EU mix MV	127.65 gCO_2eq/MJ
Electricity EU mix LV	129.19 gCO_2eq/MJ
North America	145 gCO_2eq/MJ
Latin America	55 gCO_2eq/MJ
Russia	237 gCO_2eq/MJ
Conversion inputs GHG emission coefficients	
n-Hexane	80.53 gCO_2eq/MJ
Hydrogen (for HVO)	94.35 gCO_2eq/MJ
Phosphoric acid (H_3PO_4)	3040.6 gCO_2eq/kg
Fuller's earth	199.8 gCO_2eq/kg
Hydrochloric acid (HCl)	1375.4 gCO_2eq/kg
Sodium carbonate (Na_2CO_3)	1267.6 gCO_2eq/kg
Sodium hydroxide (NaOH)	764.4 gCO_2eq/kg
Potassium hydroxide (KOH)	626.1 gCO_2eq/kg
Pure CaO for processes	1099.9 gCO_2eq/kg
Sulphuric acid (H_2SO_4)	268.8 gCO_2eq/kg
Ammonia	2554.7 gCO_2eq/kg
Cycle-hexane	723.0 gCO_2eq/kg
Lubricants	947.0 gCO_2eq/kg
Emissions from steam production (per MJ steam or heat)	
CH_4 and N_2O emissions from NG boiler	0.39 gCO_2eq/MJ

CH_4 and N_2O emissions from NG CHP	0.00 gCO_2eq/MJ
CH_4 and N_2O emissions from Lignite CHP	3.79 gCO_2eq/MJ
CH_4 and N_2O emissions from Straw CHP	0.00 gCO_2eq/MJ
CH_4 and N_2O emissions from NG gas engine	1.23 gCO_2eq/MJ
Electricity production (reference for credit calculation)	
Electricity (NG CCGT)	124.42 gCO_2eq/MJ
Electricity (Lignite ST)	287.67 gCO_2eq/MJ
Electricity (Straw ST)	5.71 gCO_2eq/MJ
Density	
Diesel	832 kg/m^3
Gasoline	745 kg/m^3
HFO	970 kg/m^3
HFO for maritime transport	970 kg/m^3
Ethanol	794 kg/m^3
Methanol	793 kg/m^3
FAME	890 kg/m^3
Syn diesel (BtL)	780 kg/m^3
HVO	780 kg/m^3
Lower Heating Values	
Manure	10 MJ/kg
Methane	50 MJ/kg
Diesel	43.1 MJ/kg
Gasoline	43.2 MJ/kg
HFO	40.5 MJ/kg
HFO for maritime transport	40.5 MJ/kg
Ethanol	26.81 MJ/kg
Methanol	19.9 MJ/kg
FAME	37.2 MJ/kg
Syn diesel (BtL)	44.0 MJ/kg
HVO	44.0 MJ/kg
PVO	36.0 MJ/kg
Hard coal	26.5 MJ/kg
Lignite	9.2 MJ/kg
Corn	18.5 MJ/kg
FFB	24.0 MJ/kg
Rapeseed	26.4 MJ/kg
Soybeans	23.5 MJ/kg
Sugar beet	16.3 MJ/kg
Sugar cane	19.6 MJ/kg
Sunflower seed	26.4 MJ/kg
Wheat	17.0 MJ/kg
Waste vegetable / animal oil	37.1 MJ/kg
Bio Oil (by-product FAME from waste oil)	21.8 MJ/kg
Crude vegetable oil	36.0 MJ/kg
DDGS (10 wt% moisture)	16.0 MJ/kg
Glycerol	16.0 MJ/kg
Palm kernel meal	17.0 MJ/kg
Palm oil	37.0 MJ/kg
Rapeseed meal	18.7 MJ/kg

Soybean oil	36.6 MJ/kg
Soy bean meal	-
Sugar beet pulp	15.6 MJ/kg
Sugar beet slops	15.6 MJ/kg
Wheat straw	17.2 MJ/kg
n-hexane	45.1 MJ/kg
Wood @ 50% moisture content	8.4 MJ/kg
Wood @ 25% moisture content	13.8 MJ/kg
Wood @ 15% moisture content	16.0 MJ/kg
Wood @ 10% moisture content	17.0 MJ/kg
Bagasse @ 50% moisture content	11.8 MJ/kg
Bagasse pellets (10% moisture content)	15.1 MJ/kg
Olive cake	19.3 MJ/kg
Grass at 10% MC	14.4 MJ/kg
Grass at 15% MC	13.6 MJ/kg
Grass at 25% MC	11.9 MJ/kg
Charcoal	30.0 MJ/kg
RDF	15.5 MJ/kg
Biological fraction of MSW	5.8 MJ/kg
Straw @ 15% moisture content	15.2 MJ/kg
Biogas (52% methane)	21 MJ/Nm^3
Biomethane	34 MJ/Nm^3
Methane	36 MJ/Nm^3
Fuel efficiencies	
Truck for dry product (Diesel)	0.81 MJ/t.km
Truck for liquids (Diesel)	0.87 MJ/t.km
Truck for FFB transport (Diesel)	2.24 MJ/t.km
Tanker truck MB2318 for vinasse transport	2.16 MJ/t.km
Tanker truck with water cannons for vinasse transport	0.94 MJ/t.km
Dumpster truck MB2213 for filter mud transport	3.60 MJ/t.km
Ocean bulk carrier (Fuel oil)	0.20 MJ/t.km
Ship /product tanker 50kt (Fuel oil)	0.12 MJ/t.km
Local (10 km) pipeline	0 MJ/t.km
Rail (Electric, MV)	0.21 MJ/t.km
Transport exhaust gas emissions	
Truck for dry product (Diesel)	0.0034 gCH_4/t.km
Truck for dry product (Diesel)	0.0000 gN_2O/t.km
Truck for liquids (Diesel)	0.0036 gCH_4/t.km
Truck for liquids (Diesel)	0.0000 gN_2O/t.km
Truck for FFB transport (Diesel)	0.0002 gCH_4/t.km
Truck for FFB transport (Diesel)	0.0000 gN_2O/t.km
Tanker truck MB2318 for vinasse transport	0.000 gCH_4/t.km
Tanker truck MB2318 for vinasse transport	0.000 gN_2O/t.km
Tanker truck with water cannons for vinasse transport	0 gCH_4/t.km
Tanker truck with water cannons for vinasse transport	0 gN_2O/t.km
Dumpster truck MB2213 for filter mud transport	0 gCH_4/t.km
Dumpster truck MB2213 for filter mud transport	0 gN_2O/t.km
Ocean bulk carrier (Fuel oil)	0 gCH_4/t.km
Ocean bulk carrier (Fuel oil)	0.0007 gN_2O/t.km

Ship /product tanker 50kt (Fuel oil)	0 gCH_4/t.km
Ship /product tanker 50kt (Fuel oil)	0 gN_2O/t.km
Local (10 km) pipeline	0 gCH_4/t.km
Local (10 km) pipeline	0 gN_2O/t.km
Rail (Electric, MV)	0 gCH_4/t.km
Rail (Electric, MV)	0 gN_2O/t.km

Table 17: IPCC Default Values for calculation of soil N2O emissions

Factor	**Value**
IPCC default values for calculation of soil N2O emissions	
Direct N_2O emission factor (calculated from IPCC references given in italics below)	4.65 kg CO_2eq / kg N
Indirect N_2O emission factor from inorganic fertiliser (calculated from IPCC references given in italics below)	1.51 kg CO_2eq / kg N
Indirect N_2O emission factor from organic fertiliser (calculated from IPCC references given in italics below)	1.98 kg CO_2eq / kg N
IPCC Tier 1 default emission factor for N additions from mineral fertilisers, organic amendments and crop residues, and N mineralised form mineral soil as a result of loss of soil carbon	0.01 [kg N_2O-N / (kg N)]
IPCC Tier 1 default emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces	0.0100 [kg N_2O-N / (kg NH_3-N + NOx-N volatilised)]
IPCC Tier 1 default fraction of AN fertiliser that volatilises as NH3 and NOx	0.1000 [(kg NH_3-N + NOx-N) / kg N applied]
IPCC Tier 1 default fraction of urea that volatilises an NH3 and NOx	0.2000 [(kg NH_3-N + NOx-N) / kg N applied]
IPCC Tier 1 default emission factor for N2O emissions from N leaching and runoff	0.0075 [kg N_2O-N / (kg N leached and runoff)]
IPCC Tier 1 default fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff	0.3000 [kg N / kg N additions]
N_2O emissions / N_2O-N emissions	1.5714 [kg N_2O / kg N_2O-N]
IPCC Tier 1 default fraction of organic fertiliser that volatilises as NH_3 and NOx	0.2000 [(kg NH_3-N + NOx-N) / kg N applied]
Nitrogen content of digestate	2.1000 [kg N / t]
Nitrogen content in farm yard manure	6.5000 [kg N / t]

Appendix 4 – Land use change calculations

4.1. This section sets out how to calculate emissions due to land use change. The EC transparency platform has published an annotated example of these emissions calculations.[64]

4.2. Equation 1 is taken directly from the RED GHG calculation methodology.[65] Equations 2-5 are from the EC decision[66] regarding guidelines for the calculation of land carbon stocks. The EC decision was published to establish the rules for calculating land carbon stocks, for both the reference land use (CS_R) and the actual land use (CS_A). Please refer to the EC decision for further information on the similarities required when establishing the extent of an area for which the land carbon stocks are to be calculated.

4.3. The same method should be applied for the calculation of emission savings from soil carbon accumulation via improved agricultural practices. All calculations in this section refer to direct land use changes. Generators do not need to report against, or include in their carbon intensity calculations, emissions from indirect land use change.

4.4. Land use change related emissions should be calculated based on the difference in carbon stocks of the land between its current and previous use (on 1 January 2008), as shown in Equation 1.

Equation 1: Land use change emission

$$e_l = \frac{3.664}{20P}\,(CS_R - CS_A) - e_B$$

Where:

e_l is the annualised GHG emissions due to land use change (measured as mass of CO2eq per unit energy)

CS_R is the carbon stock associated with the reference land use (ie the land use in January 2008 or 20 years before the feedstock was obtained, whichever the later) (measured as mass of carbon per unit area, including both solid and vegetation)

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

P is the productivity of the crop (measured as energy per unit per year)

e_B is a bonus of 29gCO2eq/MJ if the bioliquid feedstock is obtained from restored degraded land under the conditions set out in the paragraphs below

4.5. The EC decision defines the calculation of the carbon stocks as:

[64] http://ec.europa.eu/energy/renewables/biofuels/doc/2010_bsc_example_land_carbon_calculation.pdf
[65] Annex V, Part C, Para 7.
[66] 2010/335/EU - Commission Decision of 10th June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC – available on the EC Transparency Platform.

Equation 1: Carbon stock

$$CS_i = (SOC + C_{VEG}) \times A$$

Where:

CS_i is carbon stock of the area associated with the land use i (measured as mass of carbon per unit area, including both soil and vegetation)

SOC is the soil organic carbon (measured as mass of carbon per hectare)

C_{VEG} is the above and below ground vegetation carbon stock (measured as mass of carbon per hectare)

A is the factor scaling to the area concerned (measured as hectares per unit area**)**

4.6. The key part of the land use change calculation is therefore an estimation of the change in carbon stocks. This is based on the difference between the carbon stock now and the carbon stock either in January 2008 or 20 years before the feedstock was obtained, whichever is later.

4.7. Carbon stock estimates are based on:

- previous land use
- climate and in some cases ecological zone
- soil type
- soil management (for both previous and new land use)
- soil input (for both previous and new land use).

4.8. The location and nature of the land use change must be known by the generator reporting land use change. When the change is known, it is possible to use the look-up tables in the EC decision for the different parameters listed above to estimate the change in carbon stock.

- climate, ecological zone and soil type can be taken from maps and data provided in the EC decision and on the EU Transparency Platform
- soil management (whether full-till, reduced-till or no-till) and soil inputs (low, medium, high-with manure, and high–without manure) are factors that would need to be reported by the generator reporting that land use change has taken place.

4.9. There are two land types (settlements[67] and degraded land) for which the carbon stock has not yet been defined in the existing EC decision. In the absence of specified carbon stock for settlements, we advise that the carbon

[67] Based on the 2006 IPCC Guidelines for National GHG inventories (Vol. 4), a settlement includes all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories.

stock of the settlement should be measured. We also advise measuring that the carbon stock of any land claimed to be degraded land.

Soil organic carbon

4.10. Generators may use several methods to determine soil organic carbon, including measurements.[68] As far as the methods are not based on measurements, they should take into account climate, soil type, land cover, land management and inputs.

4.11. As a default method, the following equation can be used:

Equation 1: Soil organic carbon

$$SOC = SOC_{ST} \times F_{LU} \times F_{MG} \times F_I$$

Where:

SOC is soil organic carbon (measured as mass of carbon per hectare)

SOC_{ST} is the standard soil organic carbon in the 0 – 30 cm topsoil layer (measured as mass of carbon per hectare)

F_{LU} is the land use factor reflecting the difference in soil organic carbon associated with the type of land use compared to the standard soil organic carbon (no unit)

F_{MG} is the land use factor reflecting the difference in soil organic carbon associated with the principle management practice compared to the standard soil organic carbon (no unit)

F_I is the land use factor reflecting the difference in soil organic carbon associated with different levels of carbon input to soil compared to the standard soil organic carbon (no unit)

4.12. SOC_{ST} can be located in the EC decision depending on climate region and soil type. The climate region can be determined from the climate region data layers available on the EC transparency platform.69 The soil type can be determined by following the flow diagram on page 12 of the EC decision or following the soil type data layers also available from the transparency platform.

4.13. F_{LU}, F_{MG} and F_I can be located in Tables 2 to 8 of the EC decision depending on climate region, land use, land management and input.

4.14. If a generator does not report a land use change but wishes the carbon intensity calculation to take into consideration an increase in soil carbon

[68] Soil organic carbon levels can traditionally be measured using mass loss on ignition or wet oxidation. However, newer techniques are being developed, which can either be carried out in the field or remotely (near infrared reflectance spectrometry, remote hyperspectral sensing).
[69] The climate region and soil type data layers are available online from http://eusoils.jrc.ec.europa.eu/projects/RenewableEnergy/

resulting from improved agricultural practices, the same calculations are performed but only F_{MG} or F_I will change between CS_R and CS_A.

Organic soils (histosols)

4.15. There is no default method available for determining the soil organic carbon (SOC) value of organic soils. The method used by parties should however take into account the entire depth of the organic soil layer as well as climate, land cover and land management and input. An appropriate method could be to measure the SOC of the soil.

4.16. Where carbon stock affected by soil drainage is concerned, losses of carbon following drainage shall be taken into account by appropriate methods, potentially based on annual losses of carbon following drainage.

Above and below ground vegetation carbon stock

4.17. For some vegetation types, CVEG can be directly read in Tables 9 to 18 of the EC decision.

4.18. If a look-up value is not available, vegetation carbon stock should be determined using the following equation:

$$C_{VEG} = C_{BM} + C_{DOM}$$

4.19. This takes into account both above and below ground carbon stock in living stock (C_{BM}) and above and below ground carbon stock in dead organic matter (C_{DOM}). See Equations 4a-d for calculating C_{BM} and C_{DOM}. For C_{DOM} the value of 0 may be used, except in the case of forest land (excluding forest plantations) with more than 30% canopy cover.

Equations 2a, b, c and d: Above and below ground carbon stock in living stock

$$C_{BM} = C_{AGB} + C_{BGB} \quad [a]$$

Where:

$$C_{AGB} = B_{AGB} \times CF_B \quad [b]$$

And:

$$C_{BGB} = B_{BGB} \times CF_B \quad [c]$$

Or

$$C_{BGB} = C_{AGB} \times R \quad [d]$$

Where:

C_{BM} is the above and below ground carbon stock in living biomass (measured as mass of carbon per hectare)

C_{AGB} is the above ground carbon stock in living biomass (measured as mass of carbon per hectare)

C_{BGB} is the below ground carbon stock in living biomass (measured as mass of carbon per hectare)

B_{AGB} is the weight of above ground living biomass (measured as mass of carbon per hectare)

B_{BGB} is the weight of below ground living biomass (measured as mass of carbon per hectare)

C_{FB} is the carbon fraction of dry matter in living biomass (measured as mass of carbon per hectare)

R is the ratio of below ground carbon stock in living biomass to above ground carbon stock in living biomass

4.20. The values for Equation 4a-d are determined as follows:

- For cropland, perennial crops and forest plantations, the value of B_{AGB} shall be the average weight of the above ground living biomass during the production cycle
- For CFB the value of 0.47 may be used
- For cropland, perennial crops and forest plantations, the value of BBGB shall be the average weight of the above ground living biomass during the production cycle
- R can be read in Tables 11 to 18 of the EC decision

Equation 3a, b and c: Above and below ground carbon stock in dead organic matter

$$C_{DOM} = C_{DW} + C_{LI} \quad [a]$$

Where:

$$C_{DW} = DOM_{DW} \times CF_{DW} \quad [b]$$

And

$$C_{LI} = DOM_{LI} \times CF_{LI} \quad [c]$$

Where:

C_{DOM} is the above and below ground carbon stock in dead organic matter (measured as mass of carbon per hectare)

C_{DW} is the carbon stock in dead wood pool (measured as mass of carbon per hectare)

C_{LI} is the carbon stock in litter (measured as mass of carbon per hectare)

DOM_{DW} is the weight of dead wood pool (measured as mass of carbon per hectare)

CF_{DW} is the carbon fraction of dry matter in dead wood pool (measured as mass of carbon per hectare)

DOM_{LI} is the weight of litter (measured as mass of carbon per hectare)

CF_{LI} is the carbon fraction of dry matter in litter (measured as mass of carbon per hectare)

4.21. These values for Equations 5a to c are determined as follows:

- For CFDW the value of 0.5 may be used
- For CF_{LI} the value of 0.4 may be used

Appendix 5 – Example templates for mass balance chain of custody records

5.1. This appendix provides two tables with examples of mass balance records that parties in the supply chain could use. The examples mention several steps in the supply chain. In reality, however, there may be other steps in addition to these.

Table 18: Example of an output record from a farm supplying certified rapeseed to crusher

Consignment no.	Transaction date	Receiving Company	Product	Quantity (tonnes)	Country of origin	NUTS 2 compliant region	Voluntary Scheme	Land Use on 1 January 2008	Crop yield (t/ha)[70]	Nitrogen fertiliser (kg/ha)
22001	16-1-2011	C1	Rapeseed	1,000	UK	Y	LEAF	Cropland - non protected	30	180

Table 19: Example of an input record from a rapeseed crusher. This crusher receives certified rapeseed from farms F1 and F2.

Consignment no.	Transaction date	Supplying Company	Product	Quantity (tonnes)	Country of origin	NUTS 2 compliant region	Voluntary Scheme	Land Use on 1 January 2008	Carbon intensity (g CO2e/MJ)
22001	16-1-2011	F1	Rapeseed	1,000	UK	Y	LEAF	Cropland - non protected	30
22002	16-1-2011	F2	Rapeseed	1,000	UK	Y	LEAF	Cropland - non protected	30

Table 20: Example record of crusher conversion factor

Conversion parameters	Rapeseed to rapeseed oil

[70] Farmers/plantation owners can also report on carbon intensity but the key data are crop yield and use of nitrogen fertiliser.

Input	Rapeseed
Output	Rapeseed oil
Unit	kg rapeseed oil / kg rapeseed
Value	0.40
Valid from	1-1-2011
Valid until	1-6-2011

Table 21: Example of an output record from a crusher. This crusher supplies operator of an eligible installation 'G' with rapeseed oil.

Consignment no.	Transaction date	Receiving	Product	Feedstock	Quantity (tonnes)	Country of origin	NUTS 2 compliant	Voluntary Scheme	Land Use on 1 January 2008	Carbon intensity (g CO2e/MJ)	Bonus degraded land	Factor soil carbon accumulation	Installation in operation on 23
23001	20-1-2011	G	Rapeseed oil	Rapeseed	400	UK	Y	LEAF	Cropland - non protected	32	N	N	Y
23002	20-1-2011	G	Rapeseed oil	Rapeseed	800	UK	Y	LEAF	Cropland - non protected	36	N	N	Y

Table 22: Example of an input record from a generator of an eligible installation. This generator receives palm oil based HVO from bioliquid producers B1 and B2.

Consignment no.	Transaction date	Supplying Company	Bioliquid type	Feedstock	Production process	Quantity (tonnes)	Country of origin	NUTS 2 compliant region	Voluntary Scheme	Land Use on 1 January 2008	Carbon intensity (g CO2e/MJ)	Bonus degraded land	Factor soil carbon accumulation	Installation in operation on 23 January 2008

33001	20-1-2011	B1	HVO	CPO	Methane capture	900	Indonesia		RSPO	Cropland - non protected	29	N	N	Y
33002	20-1-2011	B2	HVO	CPO	-	300	Malaysia	-	RSPO	Cropland - non protected	62	N	N	Y

Appendix 6 - Glossary

AD means anaerobic digestion - a technology that uses the breakdown of organic material in the absence of oxygen to produce biogas.

BEIS means the Department of Business Energy and Industrial Strategy.

BS means British Standard.

CEN means the European Committee for Standardization.

CHP means Combined heat and power – a generating technology that produces electricity and heat at the same time.

CO_{2eq} means Carbon dioxide equivalent - a measure used to compare the emissions from various greenhouse gases based upon their global warming potential.

DECC means the Department of Energy and Climate Change – the department that is now BEIS.

DEFRA means the Department of Environment, Farming and Rural Affairs.

EC means the European Commission.

EN means European Norm or a European Standard – a standard that is recognised by a European standards body.

EU means the European Union.

Export Tariff means any tariff offered by any licensee for electricity exported to the grid.

FIT means the Feed-In-Tariff, the scheme designed to promote the uptake of small-scale renewable and low-carbon electricity generation technologies that closed to new applicants on 1 April 2019.

FMS means Fuel Measurement and Sampling – the procedures for the measurement and sampling of the fuels an AD generator intends to use.

FSC means Forest Stewardship Council.

GHG means greenhouse gas.

ISAE means International Standard on Assurance Engagements.

ISO means International Organisation for Standardization.

KG means kilogram.

Mandatory SEG Licensee means a person who is a holder of a licence under section 6(1)(d) of the Electricity Act 1989 which, as at 31 December before the start of each SEG Year, either: (a) supplies electricity to at least 150,000 domestic customers; or (b) together with its affiliates jointly supplies electricity to at least 150,000 domestic customers.

MJ means Megajoule.

NUTS means Nomenclature of Territorial Units for Statistics.

RED means the Renewable Energy Directive (2009/28/EC).

RHI means the Renewable Heat Incentive – a UK financial incentive to promote the use of renewable heat.

RO means Renewables Obligation – a support mechanism for large-scale renewable electricity projects in the UK.

RTFO means Renewable Transport Fuels Obligation – a government policy to reduce GHG emissions from road transport in the UK.

SEG means Smart Export Guarantee.

SEG arrangements means the arrangements for delivering the smart export guarantee introduced in accordance with sections 41 to 43 EA08, as set out in Standard Condition 57 of the Electricity Supply Licence (including this Schedule A) and the SEG Order.

SEG generator means a person (a) entitled to seek payment in respect of an Eligible Installation from a SEG licensee, and (b) who has accepted the SEG licensee's offer of a tariff offered in accordance with the SEG arrangements.

SEG licensee means the collective term for mandatory SEG licensees and voluntary SEG licensees.

SEG Order means the Smart Export Guarantee Order 2019 (including any amendments to that Order).

SEG payments means the payments made to an installation that a SEG licensee has confirmed is eligible for payments under a SEG Export Tariff.

SEG compliant tariff/SEG tariff means the tariff, consisting of SEG payments, offered to a SEG generator in accordance with the SEG arrangements. The tariff must offer an above zero pence rate per kilowatt hour at all times in order to be compliant.

Voluntary SEG licensee means a person who is a holder of a licence under section 6(1)(d) of the Electricity Act 1989 which is not a mandatory SEG licensee and which voluntarily elects to participate in making SEG payments under the SEG arrangements.