

Non-Domestic Renewable Heat Incentive (RHI)

Guidance: Fuel Measurement and Sampling (FMS) (Version 2.3)

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Non-Domestic



Publication date: 23 May 2018

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Overview

This document provides applicants and participants using biomass and biogas, and producing biomethane for injection with information on the fuel measurement and sampling (FMS) procedures necessary to determine the renewable output eligible for RHI periodic support payments.

It also provides guidance to participants who are self-reporting for the purpose of demonstrating compliance with the sustainability requirements that came into force on 5 October 2015.

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1. Introduction

The common terminology used within this document is explained in this introductory chapter. It also outlines what a Fuel Measurement and Sampling (FMS) regime is and which applicants it applies to.

- 1.1. This document provides applicants with biomass, biogas and waste plants, and biomethane producers with information regarding the eligibility criteria regarding fuels for certain types of installations under the Renewable Heat Incentive (RHI) scheme, and guidance on how to meet the necessary Fuel Measurement and Sampling (FMS) requirements. An outline of data submission and supporting information requirements are also included.
- 1.2. This document cannot anticipate every scenario which may arise. Where a scenario arises which is not addressed in this guidance, we will adopt an approach consistent with the relevant legislation.
- 1.3. This document is for guidance only. The onus is on the applicant to ensure that they are aware of the requirements of the RHI Regulations. It is not intended to provide comprehensive legal advice on how the regulations should be interpreted. Where necessary, applicants should seek their own technical or legal support.
- 1.4. This document refers to the Renewable Heat Incentive Scheme Regulations 2018¹. These are referred to as the 'RHI Regulations'.
- 1.5. Some areas of the legislation are prescriptive, others give us discretion. Where the legislation is prescriptive, this guidance is intended to help applicants understand what we require. Where the legislation gives us discretion, the document gives guidance as to how we will generally exercise that discretion. It also explains what we need, practically, from applicants, to enable them to meet these requirements.
- 1.6. Any queries in relation to our functions and duties under the RHI regulations should be emailed to our dedicated enquiries team on RHI.Enquiry@ofgem.gov.uk. The nature of the query should be clearly marked. For telephone enquiries, the RHI team can be contacted on 0300 003 2289.

Fuel Measurement and Sampling (FMS)

- 1.7. A FMS regime is the general term that we use to describe the agreement with applicants of suitable procedures for the measurement and sampling of their fuels. These are required in order to determine:
 - the quantity of fuel(s) used in a quarter;

¹ [RHI Scheme Regulations 2018](#)

- consignment classification of the fuel(s) used in a quarter for the purposes of sustainability;
- the management of mixed consignments;
- the energy content of the fuels(s) used in a quarter, and
- the energy content of any fossil fuel contamination present.

1.8. FMS procedures are required to ensure that:

- RHI payments are only issued for heat generated from renewable sources in a given quarter, and
- Applicants have established appropriate procedures to report against their sustainability requirements
- The amount of eligible heat is determined according to the energy content attributable to the fossil and non-fossil-derived fraction of each of the fuels used in a particular quarter to generate heat. It is due to this calculation that applicants of certain installation types need to propose and agree an FMS regime with Ofgem, describing how they will determine the values required for the calculation of RHI payments.

When to submit FMS procedures

1.9. Applicants and participants should be aware of the following circumstances where an FMS questionnaire should be submitted or amended:

- Applying for accreditation (mandatory) or preliminary accreditation (optional);
- Applying for registration (mandatory) or preliminary registration (optional);
- We may request an amendment to an FMS where a new fuel or consignment is used at an existing accredited installation;
- An amended FMS is needed where a material change has been made onsite affecting the agreed procedures
- An amended FMS is needed when changes to the RHI regulations mean that the current agreed procedures are no longer adequate.

1.10. Table 1 outlines the installations that will be required to submit FMS procedures as part of the application.

Table 1: Circumstances under which the FMS questionnaire needs to be completed by an applicant.

Technology	Size	Where plant uses contaminated fuel, is FMS required?	Where fossil fuel is used for permitted ancillary purposes - is FMS required?	Demonstrating compliance with RHI sustainability requirements –is FMS required?
Solid biomass (except for CHP scenario below)	≤45kWth	N/A (not permitted)	N/A (not permitted)	Yes, if not using a BSL listed fuel (or other approved fuel)
	>45kWth and <1MWth	No	No ¹	Yes, if not using a BSL listed fuel (or other approved fuel)
	≥1MWth	Yes	Yes	Yes, if not using a BSL listed fuel (or other approved fuel)
Biogas - gasification or pyrolysis (except for CHP scenario below)	All	Yes	No	Yes
Biogas - anaerobic digestion (except for CHP scenario below)	All	No	No	Yes
Waste	All	Yes	Yes	No ²
Biomethane - gasification or pyrolysis*	All	Yes	N/A	Yes
Biomethane - anaerobic digestion*	All	Yes	N/A	Yes
CHP	All – where only certain combustion unit(s) are producing eligible heat	Yes	Yes	Yes ³

* Biomethane producers will be required to follow fuel measurement in all circumstances so that we can verify the energy content of the gas injected²

- 1.11. When applying, the agreement of FMS procedures is conducted as part of the accreditation or registration application review process. FMS procedures must be agreed before a full accreditation or registration can be granted. FMS procedures are optional for preliminary accreditations or registrations, but it may help to have assurance earlier on regarding your intended procedures.
- 1.12. Where fossil fuel is used which does not result in the generation of heat via liquid and/or steam you do not need to measure this as contributing to your fossil fuel use. For example, if fossil fuel is used for start-up or testing and does not contribute to heat being generated, this would not contribute to the fossil fuel proportion in the quarterly period. As part of the FMS questionnaire we will need to agree with applicants how to ensure that it does not contribute to the generation of heat (i.e. adding to the metered heat generation).

¹ You will be asked to provide information about your contamination levels in the application form.

² FMS procedures are not required as long as *all* of your consignments are waste.

³ Unless you fall within the exception stipulated by regulation 36B(3) where you are meeting the RO sustainability criteria

- 1.13. If your installation is a combined heat and power (CHP) installation and only certain combustion unit(s) are producing eligible heat, an agreed FMS procedure will always be required, even if the relevant combustion units do not use contaminated or ancillary fossil fuel. This is because the energy content of total fuel used on the installation across all plants and energy content of fuel used in the combustion units producing eligible heat needs to be measured. These measurements will be used to calculate the eligible proportion of the heat output and associated RHI payments.

Format of FMS procedures – ‘FMS Questionnaire’

- 1.14. The proposed FMS procedures must be provided on the Microsoft Word template supplied by us, which is available on our website to download (‘Fuel Measurement and Sampling Questionnaire’, FMSQ). This template will then need to be converted to a Portable Document Format (PDF) before it can be uploaded to the RHI Register in the FMS Submission section. Depending on your specific circumstances different sections of the FMS questionnaire will need to be completed. For more information on this please refer to chapter 2 of this document.
- 1.15. If you are an existing participant and intend to self-report on the sustainability requirements which came into force on 5 October 2015, please email the completed questionnaire to rhi.biomass-sustainability@ofgem.gov.uk as soon as possible.
- 1.16. The exception to this is if you are accredited on the Renewables Obligation (RO) and have completed their FMS questionnaire. In this case you may upload the RO FMS questionnaire in place of the RHI FMS template. However, we may request supplementary information from you regarding your fuel measurement and sampling procedures.

Agreement of FMS: case-by-case approach

- 1.17. 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 plant. However before agreeing FMS procedures, we must be satisfied that the approach you are proposing is capable of adequately demonstrating ongoing compliance with the fuel requirements as set out in the regulations.
- 1.18. The onus for the production of suitable FMS procedures lies with the applicant. However, Ofgem can look at any source of information that may be used to determine the fossil-derived content within the fuel (whether or not this information has been provided by the operator).

Simplified FMS procedures for ancillary fossil fuels

- 1.19. If you propose to use only biomass and ancillary fossil fuel (with no contaminated biomass fuel), we will consider proposals to only measure the ancillary fossil fuel

used at the plant, and compare the energy content of the fossil fuel to the heat generated (making the conservative assumption that the boiler operates at 100 per cent efficiency). For example, if 500kWh of fossil fuel was used for start-up purposes, and the total heat output generated by the biomass plant was 10,000kWh, then we could agree that the fossil fuel percentage of all the fuel used in the period was five per cent. Although this assumption is conservative, it may reduce the difficulty and complexity of measuring biomass and fossil fuels. Alternatively you may use the standard FMS approach.

- 1.20. The simplified FMS approach cannot be used for CHP installations where only certain combustion units are producing eligible heat.
- 1.21. Applicants and participants who are self-reporting for the purpose of demonstrating compliance with the sustainability requirements will need to complete an FMS questionnaire at the application stage in order to define the consignments that they will report against each quarter. They will have to do so irrespective of whether they will be using contaminated biomass, waste or fossil fuels for ancillary purposes in their installation.

Quarterly FMS measurement: carry-over of fuel-stocks

- 1.22. Measuring the weight of biomass used in a quarterly period is required as part of calculating RHI payments. This means that the weight of any stocks carried over from the previous quarter must be measured in the quarter of use. This information will also be required for the biogas installations (anaerobic digestion) and biomethane plants that are subject to feedstock requirements. Further information on feedstock requirements can be found in volume 2, chapter 4.
- 1.23. A strict interpretation of the requirement to account accurately for the weight of biomass used within a quarter would 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 after the end of the quarterly period (in line with meter readings).
- 1.24. We encourage participants to take weight measurements of stock carried over from one quarterly period to the next at the same time each quarterly period so that the qualifying percentage (proportion of heat used that came from renewable sources) can be measured accurately.
- 1.25. 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, 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.

Fuel/consignment management in the RHI register

- 1.26. In addition to submitting the FMS questionnaire, applicants will be required to submit the name and type of fuel(s) and or consignment(s) they are planning to use in their RHI installation. This is done through the Ofgem RHI Register. We will review these against the FMS questionnaire you have provided and, as appropriate, agree these for use in the installation. Where energy from waste, waste is defined under the RHI Regulations as having the meaning given in section 75(2) of the Environmental Protection Act 1990³ so you should refer to the categories defined there where possible.
- 1.27. The fuels and/or consignments submitted should mirror what has been provided on the FMS questionnaire. Where a new fuel/consignment is to be used by the plant (e.g. the plant is proposing to use a fuel sourced from a different country to existing fuels), you may need to provide a revised FMS questionnaire with the new fuel/consignment being used, or any new procedures required. Details of the new fuel/consignment should also be uploaded to the Ofgem RHI Register for us to review.
- 1.28. We advise you to seek agreement of fuels before using them to avoid any future problems if we have concerns over the suitability of the FMS procedures for that fuel.

Submitting quarterly fuel data

- 1.29. If you are required to submit fuel data each quarterly period for the purpose of assessing the renewable content of your fuel(s), you will need to submit this alongside your quarterly meter readings. The same one month submission deadline applies for this data. This fuel data includes the quantity (e.g. in tonnes) of each fuel combusted and the contamination percentage and GCV of each of these fuels.
- 1.30. There is no requirement for participants of such installations to submit documentary evidence of this on a quarterly basis, though evidence must be retained as it may be requested by the Authority, and/or required for audit purposes. For more information about the documentation participants must keep please refer to Chapter 4 of the RHI Guidance Volume 2: Ongoing Obligations and Payments.
- 1.31. Where relevant, sustainability information should also be provided at the same time for each consignment of fuel used to demonstrate you meet the RHI sustainability criteria. Please see our [Sustainability Self-Reporting Guidance](#) for further details on this.

Alternative proposals for measurement methodologies

- 1.32. As an alternative or supplementary approach to the measurement and sampling of input fuels used by an installation, you can propose that any fossil fuel component of fuel used can be measured by analysing any gases or other substances that are

³ EPA 1990 at <http://www.legislation.gov.uk/ukpga/1990/43/section/75>

created as part of the combustion process. This will typically be analysis of the flue gases resulting from combustion.

2. Conditions and instructions for completing FMS procedures

This chapter outlines the key principles behind fuel measurement and sampling (FMS) and the conditions under which applicants must complete FMS procedures as part of their RHI application.

- 2.1. Certain applicants must complete and submit FMS procedures to Ofgem for agreement as outlined in Table 1 in chapter 1 of this document. If you fall into one or more of the categories listed below you will need to complete an FMS questionnaire:
 - (1) Waste;
 - (2) Contaminated biomass;
 - (3) Use of fossil-fuels for permitted ancillary purposes
 - (4) Self-report for the purpose of demonstrating compliance with the sustainability requirements;
 - (5) Biomethane producers
- 2.2. This chapter has been broken down into the five categories listed directly above. Each category provides the reasons why FMS procedures are required, and guidance on the expectations of these procedures.

Contaminated solid biomass

- 2.3. The following applies to applicants making an RHI application for solid biomass installations, or for a biogas installation that uses pyrolysis and/or gasification, where fuel has been contaminated with fossil fuels (e.g. wood which has been painted, varnished etc.), or for installations that produce biomethane for injection.
- 2.4. The RHI regulations state that participants using contaminated solid biomass must ensure the proportion of solid biomass in their fuel is at least 90 per cent by energy content in each quarterly period (i.e. the fossil fuel component must be less than or equal to 10 per cent).
- 2.5. The measurement and sampling procedures used determine the proportion per quarter must be described by the applicant in the FMS questionnaire submitted to us and agreed with us at the application stage.

- 2.6. As the 10 per cent or under requirement applies to a quarterly period, individual deliveries of fuels can be above 10 per cent contamination by energy content. So a contaminated wood fuel above 10 per cent contamination could be used, as long as the total contamination for the quarter was under 10 percent.

Solid biomass plants of capacity ≤ 45 kWth

- 2.7. The RHI regulations do not permit plants of 45kWth and under to use biomass contaminated with fossil fuel at the plant (i.e. in the same boiler). It will therefore be a condition of accreditation that these biomass plants must use 100 per cent biomass fuels. As such, FMS procedures are not applicable to installations of this capacity.

Solid biomass of capacity >45 kWth and <1 MWth⁴

- 2.8. Those applying for solid biomass installations with capacity between 45kWth and 1MWth that use contained biomass and/or ancillary fossil fuels are not required to complete FMS procedures. However, they will need to outline at the application stage how they can be assured that the contamination and/or ancillary fossil fuels per quarter will not exceed 10% by energy content. They should keep evidence to support this claim. This evidence may be requested by us during a site audit.

Solid biomass of capacity ≥ 1 MWth⁵

- 2.9. Those applying for solid biomass installations with capacity 1MWth and above using contaminated biomass must quantify the energy content of that contamination per quarter (as a percentage of the energy content of all the fuels used in a quarter). An FMS questionnaire is required to describe the procedures that will allow this to be quantified.
- 2.10. As with ancillary fossil fuel use (described below), the RHI regulations require that the percentage of fossil fuel contamination be used to determine the appropriate deduction to be made to RHI payments.

CHP plants

- 2.11. A specific requirement for CHP installations accredited after 28 May 2014 where only the heat generated by certain combustion units is eligible for accreditation under the RHI, is that the 10 per cent limit applies to contamination of the fuels in the eligible combustion unit(s).

Biogas and biomethane produced by anaerobic digestion (AD)

- 2.12. As per the RHI Regulations, the permitted feedstocks for AD plants are:

⁴RHI Scheme Regulation 2018, Part 4, Chapter 1, Regulation 39.

⁵RHI Scheme Regulation 2018, Part 4, Chapter 1, Regulation 38.

- solid biomass,
- solid waste, and
- liquid waste.

2.13. For AD plants, the regulations do not require deductions to be made to RHI payments due to contamination because it is assumed that for any feedstock contaminated with fossil fuel (e.g. food waste which contains plastic food packaging), the fossil fuel element does not digest and therefore contribute to the calorific value of the biogas.

2.14. We therefore do not require the contamination of the feedstock to be measured through agreed FMS procedures.

Biogas and biomethane produced by gasification or pyrolysis

2.15. For gasification and pyrolysis plants, the solid biomass feedstock would need to meet the 10 per cent or under contamination by energy content limit per quarter.

2.16. Where an applicant has declared that the installation will use feedstock contaminated with fossil fuel, they will need to submit an FMS questionnaire. This is to ensure compliance with the contamination criteria and that the correct RHI payments are made.

All technology types – sustainability

2.17. Where installations are only using fuel(s) that are 100 per cent biomass, i.e. where there is no fossil fuel contamination, and no fossil fuel is being used, but the applicant intends to self-report for the purpose of sustainability reporting, only the sustainability section of the FMS questionnaire needs to be completed.

Ancillary fuels

2.18. Where the use of fossil fuel for the specific ancillary purposes is required by the installation, up to 10 per cent of the energy content of all the fuels (biomass and fossil) used by that installation during one quarter can be from fossil fuel for ancillary purposes. For more information on permitted ancillary purposes please refer to chapter 9 of the RHI Guidance Volume 1 document.

2.19. The exception to this is for CHP installations where only the heat generated by certain combustion units is eligible for support. In this case the 10 per cent limit of ancillary fossil fuel is in relation to the energy content of all the fuels used in the eligible combustion unit(s), rather than across the whole installation. Where the energy content is above this level, the participant would be in breach of their ongoing obligations.

Solid biomass plants of capacity ≤ 45 kWth

- 2.20. The RHI regulations do not provide for solid biomass plants of this capacity to use fossil fuels for any purpose, including ancillary fuel. As such, operators of installations within this capacity range will not be required to complete and submit FMS procedures.

Solid biomass plants of capacity >45kWth and <1MWth, and biogas

- 2.21. Applicants using either biogas or solid biomass in this capacity range must ensure that the energy content derived from fossil fuels used for ancillary purposes does not exceed 10 per cent of the energy content of all fuels used.
- 2.22. Applicants must provide information and evidence in their application which gives assurance that this limit will not be exceeded.
- 2.23. As RHI payment calculations are not affected by this ancillary fossil fuel use for installations of this capacity range, the exact percentage of energy content derived from fossil fuels is not required. This means FMS procedures will not need to be completed for ancillary fossil fuel use.

Solid biomass of capacity \geq 1MWth

- 2.24. Applicants using solid biomass in this capacity range who use fossil-derived fuel for permitted ancillary purposes must complete and submit FMS procedures in addition to keeping records of fuel purchases.
- 2.25. As required by the RHI regulations, the energy content of the ancillary fossil fuel used in plants with capacity of 1MWth or above will be deducted pro-rata from the payment calculation made (as a total of the energy content of all fuels) as required by the RHI regulations.

CHP plants

- 2.26. For CHP installations where only the heat produced by certain combustion units is eligible, the energy content of the ancillary fossil fuel will be deducted pro-rata from the payment calculation (as a total of the energy content of all fuels used in the eligible combustion units) as required by the RHI regulations.

Plants using solid biomass contained waste

- 2.27. Energy content of the ancillary fossil fuel used in plants of this technology type will be deducted from the payment calculation as a total of the energy content of all fuels as required by the regulations.

Sustainability requirements – GB only, not NI

- 2.28. Sustainability criteria have been in place for installations using biomass and biogas, and those producing biomethane for injection from 5 October 2015 necessitating that participants of the RHI scheme must use fuels that meet the sustainability criteria to

continue to receive RHI payments. Please note that these sustainability requirements are **not** applicable to installations based in Northern Ireland.

- 2.29. The sustainability criteria consider the land from which the biomass is sourced, and the life-cycle greenhouse gas (GHG) emissions associated with the production and use of that biomass. Detailed information on the criteria can be found in our [Sustainability Self-Reporting Guidance](#).
- 2.30. From 5 October 2015, participants of the RHI scheme who are self-reporting for the purposes of demonstrating compliance with the sustainability requirements, must report against the sustainability criteria for each consignment of fuel used in each quarter.
- 2.31. Consignments of fuels are to be defined by the applicant and agreed with Ofgem via an FMS questionnaire. The approach for managing mixed consignments must also be agreed where applicable as part of the FMS procedures.
- 2.32. Once consignments have been agreed, applicants will be able to report on the sustainability of each consignment, each quarter. This reporting process will be through the RHI register in parallel with the submission of periodic data.
- 2.33. Please note participants who do not, or will not use contaminated fuels, waste fuels or fossil-fuels for permitted ancillary purposes, but are self-reporting against the sustainability criteria, should only complete the Sustainability section of the FMS questionnaire.
- 2.34. Any consignments classified as waste will be considered to be sustainable. A participant using such fuels will still be required to report quarterly on the quantity, GCV and fossil fuel content (where appropriate) of the fuels.

Reporting by consignment

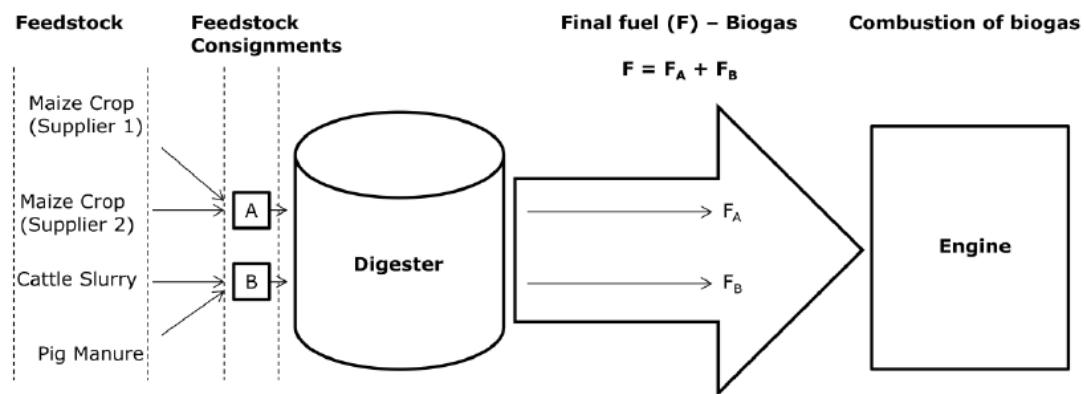
- 2.35. As part of the FMS process, we require applicants to consider whether they are using multiple consignments, and whether there is any mixing of these consignments at the installation site or in the supply chain, including mixing with any fossil fuel.
- 2.36. In determining what constitutes a consignment, factors, considered as the 'sustainability characteristics' of the fuel must be considered. For further information on sustainability characteristics see our Sustainability Guidance document.
- 2.37. Reporting on the sustainability for each consignment of fuel per quarter is mandatory and as such, where consignments are mixed, a system is needed to track individual consignments and the associated sustainability information.
- 2.38. Where consignments have been mixed, we recommend that a mass balance system is used to account for the consignments being added to the mix, and consignments being used per quarter.

- 2.39. Should an applicant wish to use a system other than mass balance to track consignments and associated sustainability information, they will need to outline the suitability of the alternative system, particularly where mixing of consignments with fossil fuel and/or consignments that are contaminated with fossil fuel takes place. This is important as Ofgem can only issue RHI payments on generation occurring from renewable sources for certain types of installations.

Reporting by consignment - Biogas and Biomethane

- 2.40. For biogas and biomethane installations, sustainability characteristics are passed from the feedstock to the final fuel (biogas or biomethane). Therefore, a consignment of final fuel is derived from a feedstock consignment. A feedstock consignment consists of any feedstocks that have identical sustainability characteristics.
- 2.41. In Figure 1 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 those feedstock (pig manure and cattle slurry) which are considered to be sustainable.

Figure 1: Example of how to apportion biogas derived from multiple feedstock consignments.



- 2.42. The resulting final fuel (F), in this case biogas, can then be apportioned according to the consignments of Consignment A and Consignment B.
- 2.43. Applicants/participants can use Ofgem’s Biogas Apportioning Tool to apportion their resultant biogas. The tool requires the user to input the mass (dry or wet) of each feedstock 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 is available on the Ofgem website.
- 2.44. The Biogas Apportioning Tool can also be used by biogas installations (anaerobic digestion) and biomethane plants that are subject to feedstock restrictions. Further

information on feedstock requirements can be found in NDRHI Guidance volume 2, chapter 4. .

- 2.45. Applicants are welcome to propose an alternative method to apportion their biogas, and will need to demonstrate its suitability.

Reporting by consignment on biomass pellets

- 2.46. We recognise that biomass pellets can be made from multiple types of biomass with differing sustainability characteristics; we will work with applicants during the FMS review process to develop appropriate procedures to report on a consignment basis.
- 2.47. Reporting by consignment is key to ensuring the correct information is supplied to Ofgem for fuels used by participants at their RHI installations. It is recognised that materials may be added to pellets to act as binding agents or to reduce the emissions of dust, carbon dioxide, methane or nitrous oxide.
- 2.48. The RHI Regulations state that if this material constitutes up to two per cent, by weight, of solid biomass material, it will be considered to have zero GHG emissions. Therefore this material does not require a separate reporting procedure for sustainability purposes and will not be required to have a separate entry on the RHI Register.
- 2.49. Applicants/participants are required to declare (through their FMS questionnaire) the percentage contribution, by weight, of the binder to the biomass pellets.
- 2.50. Additional information will need to be submitted to support this statement. This can be in the form of a fuel specification, contract or letter, on headed paper, from the fuel supplier. The percentage contribution must be stated explicitly on whichever form of evidence is submitted.
- 2.51. Where the binder is greater than two per cent by weight of solid biomass material, applicants will need to report separately on the sustainability characteristics of the binder and will require a separate entry on the RHI Register. This will be based on the whole contribution of the binder and not just that over two per cent. We recognise that the percentage contribution of binders to the fuel are typically low therefore, if appropriate information is provided to demonstrate the maximum possible contribution, by weight of the binder to the fuel, along with the corresponding GCV of the binder – this information can form the basis of FMS procedures for this particular consignment of pellet binder. These values will be those used as entries on the Register, to report the binder as a 'separate fuel'. If applicants cannot provide supporting information about the binder's contribution (mass and GCV) to the fuel, these values will need to be determined by measuring and sampling.

Biomethane producers

- 2.52. Biomethane producers will have to implement a FMS regime in order to determine:
- the quantity of feedstocks used in a quarter;

- consignment classification of the feedstock(s) used in a quarter for the purposes of sustainability and where applicable, feedstock requirements (see ND RHI Guidance volume 2, chapter 4 for further information on feedstock requirements);
- the management of mixed consignments;
- the energy content of the feedstock(s) used in a quarter;
- the energy content of any fossil fuel contamination present in the feedstock(s) used;
- the energy content and volume of biomethane injected;
- the energy content of the ingredients added as part of the biomethane production process, and
- any relevant heat supplied to the biogas/biomethane production process (please refer to chapter 6 of the RHI Guidance Volume 2 document).

2.53. RHI periodic support payments can only be made on the renewable content of feedstock used to produce the final fuel. As such, any contamination of feedstock used to produce the biogas will need to be accounted for through FMS procedures.

There is a separate questionnaire for biomethane producers available on the Ofgem website⁶.

Solid biomass in waste⁷

- 2.54. The following applies to applications for an installation using solid biomass contained in waste.
- 2.55. RHI payments cannot be issued for heat generation attributable to non-renewable waste.
- 2.56. Applicants who intend to use waste must ensure the proportion of solid biomass in that waste is at least 10 per cent in each quarterly period (i.e. the fossil fuel component of the waste must be less than, or equal to 90 per cent). This must be done by quantifying the fossil fuel proportion of the waste fuel they burn by its percentage contribution by energy content in any given quarter.
- 2.57. Applicants using solid biomass contained in waste must complete Ofgem's FMS questionnaire describing the measurement and sampling methodology they intend to use to determine the fossil fuel proportion of the waste they use.
- 2.58. While applicants and participants can explore a range of options when designing their FMS procedures, they must bear in mind the key relevant requirement of the regulations, namely that the fossil fuel proportion in a waste stream must be determined according to the energy content of the fuel.

⁶ <https://www.ofgem.gov.uk/publications-and-updates/fuel-measurement-and-sampling-questionnaire>

⁷ RHI Scheme Regulation 2018, Part 4, Chapter 1, Regulation 37.

- 2.59. In certain circumstances, when determining the proportion of solid biomass contained in waste, Ofgem may have regard to any information (where or not produced to it by the participant) if, in Ofgem's opinion, that information indicates what the proportion of the energy content of the waste is composed of fossil fuel.
- 2.60. Installation using using solid biomass contained in waste, it has the option to use literature-based evidence to demonstrate that the fossil fuel content of the stream is unlikely to exceed 50 per cent (and as such the renewable energy content of the waste stream is at least 50 per cent).
- 2.61. Only relevant and up-to-date data produced from an allocating body, waste disposal authority or waste collection authority, is suitable for this purpose. Evidence of direct sampling carried out at an installation can also be used. If such evidence is provided, and considered acceptable by us, the renewable content of the municipal waste can be deemed at 50 per cent in each quarterly period.
- 2.62. In practice, this allows applicants to base their FMS procedures approach on the submission of published data, rather than conducting regular measurements and sampling.
- 2.63. Where the MSW has been processed before use, this may have materially increased the proportion of fossil-derived materials within it. An applicant can opt to separate and remove certain parts of a MSW stream prior to using the remaining fuel for heat generation or an applicant may decide to remove certain materials that are likely to have a high biomass content so that these materials can be recycled.
- 2.64. Where processing has taken place, we would look firstly for the applicant to provide an explanation of the process. We would then look to the applicant to demonstrate that, in spite of the process taking place, the fossil fuel proportion of the waste is still unlikely to exceed 50 per cent.
- 2.65. In cases where part of the waste stream has been removed for recycling purposes, we would ask the applicant to calculate the energy content attributable to the biomass portion of the removed fraction as a percentage of the total energy content of the waste stream prior to processing.
- 2.66. Relevant supporting evidence will need to be kept regarding the waste processing regime, for example, Waste Transfer notes or other documentation relating to waste streams which are separated and removed for recycling. We may request these at any time for audit purposes.

Table 2: Example methodology for plants seeking to demonstrate that the fossil fuel content of a MSW stream is not likely to exceed 50 per cent:

Stage	Description
1	Extract a representative sample of the waste and identify the percentage contribution by weight of each of the primary categories within the stream, using a reliable data source to compile a list of primary categories.
2	Draw upon a reliable data source to apply an estimated GCV value to each primary category.
3	Multiply the weight and GCV values obtained for each primary category together.
4	Divide the value obtained at Stage 3 by the sum of the values obtained at Stage 3 and then multiply the resulting value by 100 for each fuel.
5	Draw upon a reliable data source to apply a biodegradable content to each of the primary categories within the fuel.
6	Multiply the values obtained at Stage 4 by the value obtained at Stage 5 for each primary category and sum the resulting value for each primary category to generate the overall qualifying percentage of the stream.

Table 3: MSW stream methodology example:

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Primary category	% contribution by weight	Gross calorific value (GCV)	Weight X GCV	% by GCV	Biodegradable content	Qualifying %
Paper + card	30	12.5	375	25.2	1	25.2
Textiles	70	15.9	1113	74.8	0.5	37.4
Totals	100	-	1488	100	-	62.6

- 2.67. Applicants must deduct the qualifying percentage (%) shown in table 3 from the total percentage attributable to biomass prior to processing. This calculation will provide applicants with the revised total percentage energy content attributable to biomass within the waste stream post-processing.
- 2.68. In order to verify the proportion of solid biomass contained in MSW, the regulations allow us to request that operators either provide a sample of MSW used in an accredited installation or implement a sampling regime. The regulations also give us the discretion to take account of sampling conducted on any gas or other substance produced as a result of the fuel being used. We may also request a sampling regime as part of our auditing procedures. For further information on auditing please refer to chapter 14 of RHI guidance volume 2.
- 2.69. We can exercise our right to require sampling at any time but we will generally ask applicants to implement sampling in the following scenarios:
- 2.70. Where applicants have not been able to provide sufficient data-based evidence to demonstrate that the fossil fuel content of a municipal waste stream (before or after it has undergone any process) is not likely to exceed 50 per cent
- 2.71. Where applicants wish to agree an FMS procedure for a municipal waste stream in the belief the fossil fuel content of the stream is less than 50 per cent. Please see table 3 for an example methodology which you may wish to use.

3. Measuring and sampling fuels

This chapter provides an indication of the types of procedures that applicants may need to put in place, and describe in their FMS questionnaire.

Weight measurements

3.1. The following tables provide examples of how you may wish to weigh your fuel:

Table 5: Example of weight measurement using a weighbridge

Question	Answer
When is the weight measurement taken?	At installation on delivery
How is the weight measurement taken?	By totalising weighbridge deliveries
How often is the weight measurement taken?	Every delivery
How is fuel carried over from one quarter to the next accounted for?	Stocks run down at quarter end
Are any industry standards met?	<p>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.</p> <p>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.</p>
How is accuracy ensured?	<p>Weighbridges will normally achieve an accuracy of +/- 0.5% of the load. Participants 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 from a Chief Trading Standards Officer.</p> <p>Although the weighbridge at a heat installation is unlikely to be 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.</p>

Table 6: Example of weight measurement using a weighbridge and stock calculation

Question	Answer
When is the weight measurement taken?	At installation on delivery and stock calculation at quarter end.
How is the weight measurement taken?	By totalising weighbridge deliveries and performing a stock calculation at the end of each quarter.
How often is the weight measurement taken?	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?	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?	<p>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.</p> <p>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.</p>
How is accuracy ensured?	<p>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.</p> <p>Participants 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 from a Chief Trading Standards Officer.</p> <p>Although the weighbridge at a heat installation is unlikely to be 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.</p>

Table 7: Example of weight measurement using a weighing belt

Question	Answer
When is the weight measurement taken?	Immediately prior to combustion
How is the weight measurement taken?	Directly from a weighing belt
How often is the weight measurement taken?	Throughout the burn
Is any method of verification used?	Total weighbridge delivery figures and stock level calculation at the end of each quarter (if applicable).

Accuracy of weight measurements

- 3.2. Belt weighing devices vary substantially in accuracy according to their principle of operation, construction and installation. The Organisation Internationale de Métrologie Légale (OIML) has classified those intended for commercial use into three classes as per the table below. Good practice is considered to be class 0.5.

Table 8: Accuracy of belt weighers

Class	Percentage of the mass of the totalized load for	
	Initial verification	In-service
0.5	0.25	0.5
1	0.5	1.0
2	1.0	2.0

- 3.3. There is an international recommendation from OIML that specifies the metrological and technical requirements for belt conveyor equipment. This provides standardised requirements and test procedures for evaluating this equipment in a uniform and traceable way.
- 3.4. The title of the international recommendation is: 'Continuous totalizing automatic weighing instruments (belt weighers). Part 1: Metrological and technical requirements – Tests. OIML R 50-1 Edition 1997 (E)'. Further information can be found at www.oiml.org. Please note regular calibration is an integral part of the quality assurance of all weighing devices. Where possible, inaccuracies from excessive tension or stiffness in the belt, irregular loading, or installation too close to non-weighing rollers should be avoided. Guidance for the calibration of stand-alone electronic weighing devices can be found on the OIML website.

Sampling fuels for energy content

- 3.5. This section outlines why fuel sampling is required, how frequently samples should be taken, and how we expect the results to be verified. This is in relation to where there is fossil fuel in use and the renewable proportion must be identified.
- 3.6. Sampling is required to identify the energy content of a fuel and must be both of sufficient quantity for analysis to be undertaken and representative of the fuel used in that quarter.
- 3.7. The approach that should generally be used when developing a robust sampling regime is to:
- take a series of incremental samples
 - combine these to form a composite sample
 - extract a representative sub-sample of the composite sample for analysis
 - While some factors that can affect the precision and accuracy of sampling are:

- the size of the sample relative to the whole
- the number of increments taken during the sampling period to produce a composite sample
- the method used to extract the sample
- the location of sample extraction. If the fuel is not sampled immediately before combustion, it is generally expected that the fuel sampled should be as representative as possible to what is combusted
- the method used to extract a sub-sample from the composite sample for subsequent analysis

Sampling frequency

- 3.8. To ensure that RHI payments are issued for the renewable proportion of fuel used in each quarter, the energy content reported within quarterly data submissions must relate to the fuel used in that quarter.
- 3.9. Where sampling is required, samples can be taken either from each delivery or from the fuel stream immediately prior to combustion. You may propose other sampling intervals, providing it can be demonstrated that this regularity is able to provide accurate and reliable results.
- 3.10. When considering how frequently to take samples, you should consider how consistent the GCV of your biomass fuel is, how many fuel sources you have and how much biomass you are using.

Weighted averaging

- 3.11. Good practice when calculating the average GCV of a number of composite samples is to use a weighted average.

Verification

- 3.12. When conducting sampling, you should consider how you might verify the results and may wish to consider using a second method of sampling analysis at the stage of agreeing FMS procedures.

Examples

- 3.13. The following tables provide examples of how you may wish to measure the energy content of your fuel:

Table 9: sampling fuels immediately prior to combustion

Question	Answer
How is the energy content measurement taken?	Increments are taken from the nearest possible point immediately prior to combustion.
How often are sample increments taken?	Depends on the material being burned and the number of deliveries
How is the sample prepared?	The overall size of the composite sample may be over 200kg, but the actual amount of material that is required for chemical analysis is usually less than five grams. Therefore it is necessary to obtain a representative sample of the composite sample that is suitable for chemical analysis. This can be achieved by using a combination of sample size reduction (using a suitable shredder) and sample splitting procedures to produce a finely powdered sample.
What steps are in place to ensure that the sample is representative of the whole?	<p>You should explain how sampling will be undertaken, which demonstrates that the sample taken is representative of the whole.</p> <p>The objective of any sample extraction procedure is to ensure that all particles have an equal chance of being included in the sample. This is particularly important when the material being sampled contains a wide range of particle sizes (such as chipped wood), as the finer sized particles will tend to settle towards the bottom of the material in a delivery vessel or in a stockpile, and towards the bottom of the flow of material on a conveyor.</p> <p>For a given accuracy, the required sample weight is directly proportional to the size of the largest particle in the mixture being sampled. This means that the weight of sample needed reduces as the particle size reduces, and thus the total size of a sample of sawdust will be smaller than that of a sample of woodchips.</p>
Is any method of verification used?	Previous quarter's results are used as a comparison.

Table 10: Energy content measurement from delivery vessels

Question	Answer
How is the energy content measurement taken?	Increments are taken manually from delivery vessels.
How often are sample increments taken?	Every delivery.
How is any fuel carried over from one quarter to the next accounted for?	Stocks run down at quarter end.
How is the sample prepared?	The overall size of the composite sample may be over 200kg, but the actual amount of material that is required for chemical analysis is usually less than five grams. Therefore it is necessary to obtain a representative sample of the composite sample that is suitable for chemical analysis. This can be achieved by using a combination of sample size reduction (using a suitable shredder) and sample splitting procedures to produce a finely powdered sample.
What steps are in place to ensure that the sample is representative of the whole?	<p>You should explain how sampling will be undertaken, which demonstrates that the sample taken is representative of the whole.</p> <p>The objective of any sample extraction procedure is to ensure that all particles have an equal chance of reporting to the sample. This is particularly important when the material being sampled contains a wide range of particle sizes (such as chipped wood), as the finer sized particles will tend to settle towards the bottom of the material in a delivery vessel or in a stockpile, and towards the bottom of the flow of material on a conveyor.</p> <p>For a given accuracy, the required sample weight is directly proportional to the size of the largest particle in the mixture being sampled. This means that the weight of sample needed reduces as the particle size reduces, and thus the total size of a sample of sawdust will be smaller than that of a sample of woodchips.</p>
Is any method of verification used?	Previous quarter's results are used as a comparison

Table 11: Energy content measurement from stockpile

Question	Answer
How is the energy content measurement taken?	Increments are taken manually from delivery vessels and from a stockpile.
How often are sample increments taken?	Every delivery and from stockpile at the beginning of each quarter.
How is any fuel carried over from one quarter to the next accounted for?	Stockpile sampled at the beginning of the quarter.
How is the sample prepared?	The overall size of the composite sample may be over 200kg, but the actual amount of material that is required for chemical analysis is usually less than five grams. Therefore it is necessary to obtain a representative sample of the composite sample that is suitable for chemical analysis. This can be achieved by using a combination of sample size reduction (using a suitable shredder) and sample splitting procedures to produce a finely powdered sample.
What steps are in place to ensure that the sample is representative of the whole?	<p>You should explain how sampling will be undertaken, which demonstrates that the sample taken is representative of the whole</p> <p>The objective of any sample extraction procedure is to ensure that all particles have an equal chance of reporting to the sample. This is particularly important when the material being sampled contains a wide range of particle sizes (such as chipped wood), as the finer sized particles will tend to settle towards the bottom of the material in a delivery vessel or in a stockpile, and towards the bottom of the flow of material on a conveyor.</p> <p>For a given accuracy, the required sample weight is directly proportional to the size of the largest particle in the mixture being sampled. This means that the weight of sample needed reduces as the particle size reduces, and thus the total size of a sample of sawdust will be smaller than that of a sample of woodchips.</p>
Is any method of verification used?	Previous quarter's results are used as a comparison.

4. Alternative methods for determining contamination of waste fuels

This chapter provides information on alternative methods for determining a contamination percentage for waste fuels.

- 4.1. If you are using waste or solid biomass contaminated with fossil fuel you may wish to consider using the CEN 343 group of industry standards to support development of your FMS procedures. CEN 343 is a set of standards covering many aspects of the production, handling and measurement of solid recovered fuels. The following are the standards you may need to comply with:
- 4.2. CEN/TS 15440: 2006 Solid recovered fuels - Method for the determination of biomass content, is a standard that provides methodologies for determining the biomass fraction of a representative waste sample.
- 4.3. CEN/TS 15440: 2006 includes two methods for determining the biomass percentage by energy: selective dissolution and manual sorting. The standard explains the process a laboratory should follow and the conditions under which the methods can be used.
- 4.4. You must ensure that you are using fuels that meet the conditions set out in the standard in order for a sampling regime based on this standard to be viewed as being reliable. For example, fuels must not contain substances for which the methods prescribed in the standards do not work, such as coal and charcoal.

The Selective Dissolution Method

- 4.5. This method relies on the fact that under the conditions specified in the standard biomass materials will dissolve and whatever is left undissolved will therefore be fossil derived. Since the dissolution method that can be used to directly determine the GCV of the biomass in the sample, it is preferential to the manual sorting method.

The Manual Sorting Method

- 4.6. In this method, a representative sample of the solid recovered fuel is sorted by hand into various sub-fractions e.g. plastics, paper/cardboard, wood and inert matter. These constituents are then dried to a constant weight and separated into biomass, non-biomass and inert categories.
- 4.7. The calorific value of the biomass content of the sample can now be determined through establishing the average net calorific value for each category on a dry basis. Manual sorting can also only be applied to waste materials over a certain particle size.

Potential for error

- 4.8. If you are seeking to utilise the selective dissolution and manual sampling methods outlined in CEN/TS 15440 you should bear in mind that these methodologies have several limitations (outlined in Annex G for the standard). For example, as regards selective dissolution operators will need to consider that the biodegradability of certain non-biomass materials eg coal or polyurethane plastics, may lead them to dissolve and therefore they would be considered biomass. A list of such materials is considered in the standard. Also, since the manual sorting method is to some extent reliant on estimation it is therefore prone to human error.

Use of the Selective Dissolution Method for waste wood fuels

- 4.9. The methods outlined in CEN/TS 15440 were primarily designed for use with waste fuels e.g. Solid Recovered Fuel (SRF). However, the selective dissolution method may be used to determine the fossil fuel derived contamination percentage of waste wood fuels e.g. those contaminated by small quantities of paint, varnish and adhesives. These fuels naturally have a higher biomass content than SRF or similar waste fuels.
- 4.10. Within Annex G of the standard it states that the reliability of the method may be compromised when used with fuels with very high biomass contents eg >95%. Therefore where waste wood fuels are utilised alongside the selective dissolution method we may seek to impose a minimum contamination level which will be assumed for the RHI payment. This will be considered on a case by case basis.

Re-release of the standard

- 4.11. We will monitor the re-release of CEN Standards and at such point as an updated version of CEN/TS 15440 is released this will be reviewed. We may then seek to alter our approach based on any developments in the standard as regards the addition of new methodologies or re-evaluation of those already included.

Carbon-14 (¹⁴C)

- 4.12. We are aware that this method could potentially be used for the determination of the biomass content of feedstocks, and are happy to discuss our current position⁸ as regards the use of this approach with interested applicants at the time of an application for accreditation or registration.

⁸ See 'Determination of biomass energy content of waste feedstock by post combustion analysis of flue gases: Carbon-14 technique proposal' at <http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/FuelledStations/Documents1/14C%20publicity.pdf>,

5. Industry standards

This chapter provides a list of industry standards what can be used and followed to support FMS plans and procedures.

- 5.1. We will ask as part of the Fuel Measurement and Sampling Questionnaire whether any of these industry standards will be followed:
- BS EN 303-5:1999 (Part 5) Heating boilers for solid fuels hand and automatically fired, nominal heat output of up to 300 kW - Terminology, requirements, testing and marking
 - BS EN 12809:2001 +A1:2004 Residential independent boilers fired by solid fuel - Nominal heat output up 50kW – Requirements and test methods
 - BS 7420:1991 Guide for determination of calorific value of solid, liquid and gaseous fuels (including definitions)
 - BS EN ISO 10012:2003 Measurement management systems. Requirements for measurement processes and measuring equipment
 - BS EN ISO 6974 –determines the composition of natural gas with defined uncertainty by gas chromatography
 - BS EN 14778: 2011 Solid bio fuels – sampling: methods for sampling
 - BS EN 14918:2009 Solid Bio fuels- Method for the determination of calorific value
 - BS EN 14961-1:2010 Solid Bio fuels – Fuel specifications and classes. General requirements.
 - BS EN 15440:2011 Solid Recovery fuels Method for the determination of biomass content
 - BS EN 14778:2011 Solid bio fuels Sampling
 - BS EN 14780:2011 Solid bio fuels – Methods for sample preparation
 - BS EN 15358:2011–Solid recovered fuels –quality management systems –particular requirements for their application to the production of solid recovered fuels
 - CEN 343 –A set of European draft standards which covers many aspects of the measurement, sampling and management of solid recovered fuels
 - Directive 2004/22/EC on measuring instruments applies to measurements of flue gas volume

- EN 14588 :2010 Solid bio fuels –Terminology, definitions and descriptions
- EN 14778 : 2011 Solid bio fuels –Sampling
- EN 15440: 2011 Solid recovered fuels – Methods for the determination of biomass content
- EN 15442 : 2011 Solid recovered fuels- Methods for Sampling.