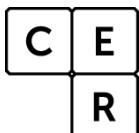
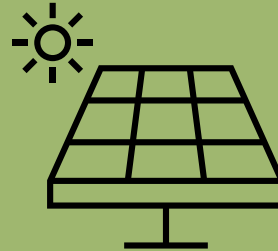
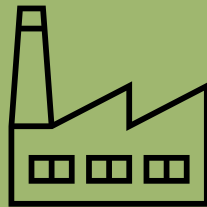
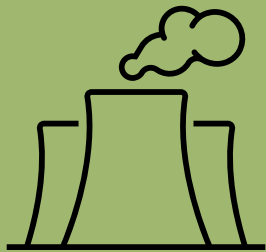


Estimating emissions and energy from wastewater handling (domestic and commercial) and (industrial) guideline

July 2023





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Definitions and abbreviations

Term	Meaning
ANZSIC	Australian New Zealand Standard Industrial Classification
BOD	Biological oxygen demand
CH₄	Methane
CO₂	Carbon dioxide
COD	Chemical oxygen demand
EERS	Emissions and Energy Reporting System
EF	Emission factor
Facility	Has the meaning given by section 9 of the NGER Act. For more information on defining a facility under the NGER scheme, see What is a Facility ¹ .
Group	Consists of the controlling corporation and may include the controlling corporation's subsidiaries. Note: refer to guideline on 'Registration as a controlling corporation' ¹ for assistance in defining your group for NGER reporting purposes.
MCF	Methane correction factor
N₂O	Nitrous oxide
NGER	National Greenhouse and Energy Reporting
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
NGER Measurement Determination	National Greenhouse and Energy Reporting (Measurement) Determination 2008
NGER Regulations	National Greenhouse and Energy Reporting Regulations 2008
Safeguard Mechanism	The Australian Government's mechanism to contribute to the achievement of Australia's greenhouse gas emissions reduction targets. See the Safeguard Mechanism for more information ² .

Please refer to Division 2 of the NGER Act, 1.03 of the NGER Regulations and Division 1.1.2 of the NGER Measurement Determination for defined terms in NGER legislation.

¹ <https://www.cleanenergyregulator.gov.au/NGER/Reporting-cycle/Assess-your-obligations/Reporting-thresholds%23n3-1>

² <https://www.cleanenergyregulator.gov.au/NGER/The-safeguard-mechanism>



Disclaimer

This guideline has been developed by the Clean Energy Regulator (CER) to assist entities to comply with their reporting obligations under the [National Greenhouse and Energy Reporting Act 2007](#)³ (NGER Act) and associated legislation.

This guideline only applies to the 2022–23 NGER reporting year and should be read in conjunction with the NGER Act, [National Greenhouse and Energy Regulations 2008](#)⁴ (NGER Regulations), and [National Greenhouse and Energy Reporting \(Measurement\) Determination 2008](#)⁵ (NGER Measurement Determination), as in force for this reporting period. These laws and their interpretation are subject to change, which may affect the accuracy of the information contained in the guideline.

The guidance provided in this document is not exhaustive, nor does it consider all circumstances applicable to all entities. This guidance is not intended to comprehensively deal with its subject area, and it is not a substitute for independent legal advice. Although entities are not bound to follow the guidance provided in this document, they must ensure they meet their obligations under the [National Greenhouse and Energy Reporting \(NGER\) scheme](#)⁶ at all times. CER encourages all users of this guidance to seek independent legal advice before taking any action or decision based on this guidance.

CER and the Australian Government will not be liable for any loss or damage from any cause (including negligence) whether arising directly, incidentally, or as consequential loss, out of or in connection with, any use of this guideline or reliance on it, for any purpose.

If an entity chooses to meet their obligations under the NGER scheme in a manner that is inconsistent with the guidance provided in this document, CER, or an independent auditor, may require the entity to demonstrate that they are compliant with requirements of the NGER Act, NGER Regulations, and/or the NGER Measurement Determination. Entities are responsible for determining their obligations under the law and for applying the law to their individual circumstances.

³ <https://www.legislation.gov.au/Series/C2007A00175>

⁴ <https://www.legislation.gov.au/Series/F2008L0223>

⁵ <https://www.legislation.gov.au/Series/F2008L02309>

⁶ <http://www.cleanenergyregulator.gov.au/NGER/Pages/default.aspx>



2022–23 updates

Changes in this document for the 2022–23 reporting year:

- Minor stylistic and formatting changes have been made throughout this guidance document
- Page 3: Definitions added for 'CO₂' and 'Facility', and the 'Safeguard Mechanism' definition was updated.

1. Purpose of this guideline

Handlers of domestic, commercial, and industrial wastewater have reporting obligations under the NGER Act, the NGER Regulations and the NGER Measurement Determination.

It is important that the reporting of information related to greenhouse gas emissions, energy consumption and energy production of corporations is accurate. The information is used to:

- inform government policy formulation and the Australian public
- meet Australia's international reporting obligations
- assist Commonwealth, state and territory government programs and activities
- ensure, under the Safeguard Mechanism, that net covered emissions of greenhouse gases from the operation of a designated large facility do not exceed the baseline applicable to the facility.

This guideline is intended to assist wastewater managers to estimate and report emissions from wastewater handling.

It also provides guidance on the use of industry estimation practices. This guideline must be read in conjunction with Chapter 5 of the NGER Measurement Determination.

1.1 Focus of this guideline

The NGER Measurement Determination and the NGER Regulations contain the specific requirements and methods for estimation and reporting of emissions and energy from wastewater handling (domestic and commercial) and wastewater handling (industrial). This guidance will assist reporting entities in the appropriate use and application of these methods.

There are 3 methods and criteria for calculating direct (scope 1) greenhouse biogas emissions from domestic, commercial, and industrial wastewater handling in Chapter 5 of the NGER Measurement Determination:

- Method 1 (default method) – based on national average estimates
- Method 2 (facility specific method) – uses industry practices for sampling and Australian or equivalent standards for analysis
- Method 3 (facility specific method) – uses Australian or equivalent standards for both sampling and analysis.

This guidance has been developed to assist those using the NGER Wastewater (Domestic and Commercial) Calculator and NGER Wastewater (Industrial) Calculator (as applicable). These calculators were developed by CER, as described at [sections 3.2](#) and [4.2](#) of this guideline.



2. Good practice reporting of wastewater handling

Wastewater handlers must keep records of the activities across their group.

Registered corporations must apply the principles set out in section 1.13 of the NGER Measurement Determination to all estimates of emissions, energy production and energy consumption. Those principles and how they apply to reporting for wastewater handling are set out below.

Table 1 – General principles for NGER reporting for wastewater handling.

General estimation principles	Implication for wastewater handling in NGER reporting
<p>Transparency</p> <p>Emission estimates must be documented and verifiable</p>	<ul style="list-style-type: none"> All key decisions and assumptions made to prepare NGER reporting must be documented and updated each year, in a ‘Basis of preparation’ document or procedure. All data must be recorded in a form that can be easily audited. This includes all data resulting from sampling undertaken to support estimates of wastewater biogas flared. All data, and documentation of any assumptions applied to the data and the calculations must be retained in accordance with the record-keeping requirements for 5 years from the end of the financial year in which the relevant activity took place.
<p>Comparability</p> <p>Estimates using a particular method and produced by a registered corporation in an industry sector must be comparable with emission estimates produced by similar corporations in that industry sector using the same method and be consistent with the emission estimates published by the Department of Climate Change, Energy, the Environment and Water in the Australia’s National Greenhouse Accounts</p>	<ul style="list-style-type: none"> Appropriately using the rules and requirements of the NGER Measurement Determination will achieve this for most activity data and emissions estimates in wastewater handling. Unspecified industry estimation practices are acceptable for some components of Method 1 if they meet the other requirements of section 1.13 of the Measurement Determination – for example, ‘Transparency’ and ‘Accuracy’.
<p>Accuracy</p> <p>Having regard to the availability of reasonable resources by a registered corporation and the requirements of the NGER Determination, uncertainties in emissions and energy estimates must be minimised, and any estimates must be neither over nor underestimates of the true values at a 95% confidence level</p>	<ul style="list-style-type: none"> Sampling, e.g. for methane content, must be performed for a duration and at a frequency to enable reliable estimates. Estimates must be neutral without bias <ul style="list-style-type: none"> understating emissions when compared to the likely true value is not allowed overstating emissions when compared to the likely true value, for example, use of a ‘conservative’ value to compensate for uncertainty in the estimation method is not allowed. Reporters must apply reasonable effort and resources to minimise uncertainty associated with emissions and energy estimates.



General estimation principles	Implication for wastewater handling in NGER reporting
<p>Completeness</p> <p>Subject to any applicable reporting thresholds, all emission sources identified in section 1.10 of the NGER Measurement Determination, and production and consumption of all fuels and energy commodities listed in Schedule 1 of the NGER Regulations, must be accounted for</p>	<ul style="list-style-type: none">• All typical emission source types for wastewater handling are identified in the NGER Measurement Determination.• A key issue is identifying the reporting boundary and documenting all emissions and energy sources that the registered corporation or liable entity must report, and those that must be separately reported by contractors. See guidelines on Defining a facility⁷ and Operation control⁸ for more information.

An executive officer must approve the report's submission to CER, confirming that it has been prepared in accordance with the NGER legislation, including that the general principles have been appropriately applied.

It is up to the reporting entity to prepare the NGER report and to determine what reporting processes and controls are deemed appropriate to achieve transparency, comparability, completeness and accuracy. However, formalised and repeatable processes are expected. A few observations for wastewater NGER reporting are worth mentioning in this regard:

- Individuals responsible for NGER report compilation do not necessarily control the data – for wastewater facilities, NGER reporting responsibility may be delegated to a person with little control over the data required to prepare the report. Whilst this may be appropriate for report compilation purposes, it may be difficult for a person physically removed from wastewater operations to confirm whether data is complete and accurate.
- Formalising reliance on data processes – existing measurement processes controlled by parties external to the liable entity may be suitable to rely upon for NGER reporting. For example, data on wastewater biogas quantities combusted and flared, and methane content, may be derived from another party such as the wastewater biogas manager.

It is good practice to appoint individual 'data owners' who conduct checking and validation of specific data used for NGER reporting who are formally accountable for ensuring the specific data is complete and accurate. Executive officers often rely on the work of others when they provide confirmation that the general principles have been appropriately applied, hence it is prudent to have data owners sign-off on the completeness and accuracy of the annual data for which they are accountable. Where possible, it can also include 'sense-checks' on total amounts to be reported in the NGER report to underlying to underlying systems – for example the tonnages or kilolitres of wastewater entering and leaving a facility compared to previous years.

⁷ <http://www.cleanenergyregulator.gov.au/DocumentAssets/Pages/NGER-Defining-facilities.aspx>

⁸ <http://www.cleanenergyregulator.gov.au/DocumentAssets/Pages/Operational-control-supplementary-guideline.aspx>



3. Estimating emissions from wastewater handling (domestic and commercial)

3.1 Sources of emissions

Domestic or commercial wastewater refers to liquid wastes and sludge (including but not limited to human waste) from housing or commercial premises. Handling of domestic and commercial wastewater generates emissions through treatment in wastewater collection and treatment systems, or discharge into surface waters. More specifically, the emissions are generated from:

- decomposition of organic material
- nitrification and denitrification processes
- flaring of sludge biogas.

A summary of the available methods used to calculate emissions generated by wastewater handling (domestic and commercial) from the NGER Measurement Determination is provided below.

Table 2.1: Summary of available methods by emissions of gas type - emissions from wastewater handling (domestic and commercial).

	CO ₂	CH ₄	N ₂ O
Method 1	NA	Section 5.25	Section 5.31
Method 2	NA	Section 5.26	Section 5.32
Method 3	NA	Section 5.30	Section 5.36

NA = Not available

Table 3.2: Summary of available methods by emissions of gas type - emissions as a result of methane flared from the operation of the facility (estimated for each gas type).

	CO ₂	CH ₄	N ₂ O
Method 1	NA	Section 5.37	Section 5.37
Method 2	NA	Section 5.38	Section 5.38
Method 3	NA	Section 5.39	Section 5.39

NA = Not available



3.2 Wastewater (Domestic and Commercial) Calculator

CER has developed a Microsoft Excel based [Wastewater \(Domestic and Commercial\) Calculator](#)⁹ to assist wastewater handlers to report emissions data relating to these activities. CER recommends that reporters use it to assist with ensuring that reporting requirements are met. The Wastewater (Domestic and Commercial) Calculator calculates the total emissions from wastewater handling facilities based on Chemical Oxygen Demand (COD) or Biochemical Oxygen Demand (BOD) for methane and nitrogen content of materials entering and leaving a facility. The emissions calculations are in accordance with the relevant equations and factors set out in Part 5.3 of the NGER Measurement Determination.

The Wastewater (Domestic and Commercial) Calculator allows users to input activity data in editable fields and does not allow users to edit equations and factors that are required by the NGER Measurement Determination. The calculator assists wastewater handlers to calculate and report current emissions. The calculator tabulates the information provided and results from calculations undertaken, in a form that can be manually entered into the Emissions and Energy Reporting System (EERS).

The Wastewater (Domestic and Commercial) Calculator is reviewed and updated as necessary to remain consistent with the NGER Measurement Determination. It is important to ensure correct versions of the NGER Measurement Determination and the latest version of the Wastewater (Domestic and Commercial) Calculator are used for each reporting year.

3.3 Methane emissions from wastewater handling (domestic and commercial)

Section 5.25 of the NGER Measurement Determination sets out Method 1 for estimating methane emissions from wastewater handling (domestic and commercial).

Method 1 for wastewater handling is consistent with the methods used for Australia's National Greenhouse Accounts, except in certain circumstances specified below.

Total greenhouse gas emissions from domestic and commercial wastewater are the sum of emissions from wastewater treatment and sludge treatment. The total quantity of wastewater treated depends on the size of the population that is generating the wastewater.

Method 1 does not require data on COD or BOD estimates of on-site wastewater and sludge.

Section 5.25 (3) of the NGER Measurement Determination provides that an alternative approach to the estimated quantity of methane should apply to facilities:

- that capture methane generated by the wastewater handling.
- where the estimates of the quantity of methane captured for combustion (either at the facility or elsewhere) or flaring exceed 75% of the estimated emissions generated from the wastewater from the facility according to the application of the methane generation model.

This approach applies to facilities that capture methane generated from the wastewater handling and where the estimates of the quantity of captured methane exceed 75% of the estimated emissions generated by the landfill according to the application of the FOD model.

⁹ <http://www.cleanenergyregulator.gov.au/NGER/Forms-and-resources/Calculators>



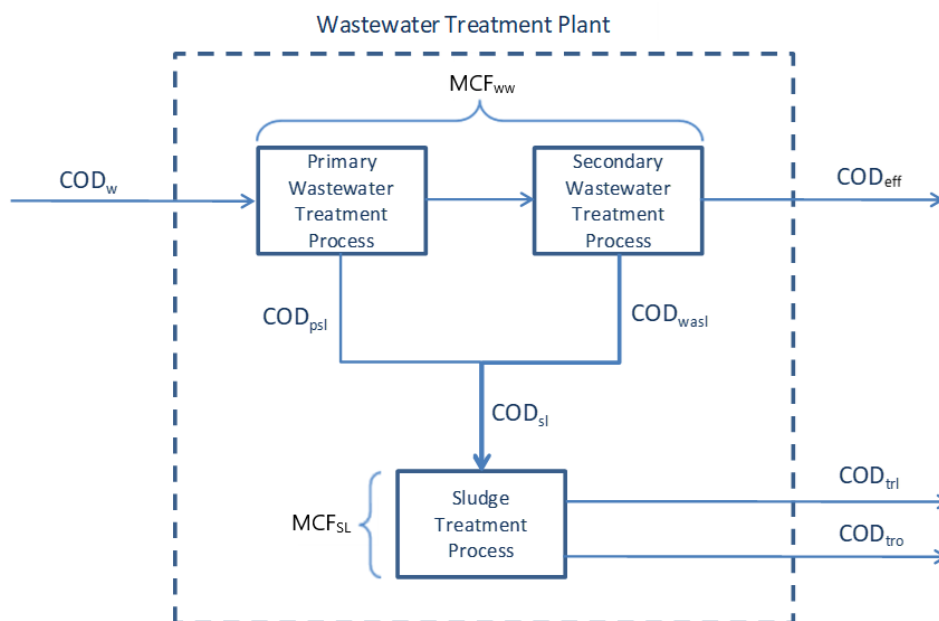
If the 75% threshold is exceeded (that is, if the quantity of methane captured, transferred offsite or flared exceeds 75% of the estimated methane generated at the landfill), then the emissions would be estimated as $[1/0.75]$ multiplied by the quantity of methane captured. This essentially applies a maximum capture rate of 75%.

The intent of the equation in 5.25 (5) of the NGER Measurement Determination is to estimate the theoretical quantity of methane generated at the plant, based on a simple COD mass balance. The equation is divided into 2 parts.

The first part is a simple COD mass balance over the main wastewater treatment processes, that is, 'liquid train' primary and secondary treatment. The second part is a simple COD mass balance over the sludge treatment processes, for example, anaerobic digesters, lagoons and dewatering.

Each COD mass balance determines how much COD is consumed in the treatment process by converting it to a gas. Multiplying by the maximum methane generation emission factor calculates how much CH_4 would be generated if all the COD consumed is converted to CH_4 . Then, multiplying by the process-specific methane correction factor (MCF_{ww} or MCF_{sl}) calculates the expected fraction of methane emissions for that process. The methane correction factors are the fractions of COD anaerobically treated by the plant. Methane is only generated through anaerobic treatment of the COD and emissions estimates are corrected to eliminate any COD that is not anaerobically treated.

Figure 1: Wastewater treatment plant.



Division 5.3.3 of the NGER Measurement Determination sets out Method 2 for the estimation of methane emissions from wastewater handling, which requires estimates of COD concentrations in wastewater estimated using sampling undertaken in accordance with section 5.27 and analysis conducted in accordance with section 5.28, which allows the use of certain listed Australian or international standards or an equivalent standard. It is likely that many facilities collect this data routinely for existing regulatory reasons.

Section 5.30 of the NGER Measurement Determination sets out Method 3 for the estimation of methane emissions from wastewater handling, which is the same as Method 2, except that the wastewater must be sampled in accordance with AS/NZS 5667.10:1998 or an equivalent Australian or international standard.



3.4 Nitrous oxide emissions from wastewater handling (domestic and commercial)

Section 5.31 of the NGER Measurement Determination sets out Method 1 for the estimation of nitrous oxide emissions.

Sections 5.32 to 5.35 of the NGER Measurement Determination set out Method 2 for the estimation of nitrous oxide emissions from wastewater handling. Method 2 requires the sampling and analysis of nitrogen quantities in the wastewater and sludge in accordance with sections 5.33 to 5.35 and in accordance with the listed Australian or international standards in section 5.34 or an equivalent standard. It is likely that many facilities collect this data routinely for regulatory reasons.

Section 5.36 of the NGER Determination sets out Method 3 for the estimation of nitrous oxide emissions from wastewater handling. Method 3 is very similar to Method 2, except that:

- the sampling of the wastewater must be undertaken in accordance with AS:NZS 5667.10:1998 or an equivalent Australian or international standard
- the sampling of the sludge must be undertaken in accordance with ISO 5667-13:1997 or an equivalent Australian or international standard.

3.5 Wastewater handling (domestic and commercial) - Flaring

Sections 5.37 to 5.39 of the NGER Measurement Determination set out Methods 1, 2 and 3 for the flaring of gas. Method 1 is derived from the methods used for Australia's National Greenhouse Accounts. Methods 2 and 3 rely on the sampling and analysis of the gas to estimate its composition to more accurately estimate the quantity of methane flared.

Method 2 requires that the sludge biogas be sampled and analysed in accordance with Subdivision 2.3.3.2 of the NGER Measurement Determination, and Method 3 requires that the sludge biogas be sampled and analysed in accordance with Division 2.3.4 of the NGER Measurement Determination. Both Methods 2 and 3 require compliance with the measuring requirements in Division 2.3.6 of the NGER Measurement Determination.

4. Estimating emissions from wastewater handling (industrial)

4.1 Sources of emissions

Industrial wastewater refers to liquid wastes and sludge resulting from the production of industrial commodities, listed in column 1 of an item of the table in subsection 5.42(8) of the NGER Measurement Determination, and listed below in [section 4.3](#) of this document.

Emissions from wastewater handling (industrial) result from the decomposition of organic material and the flaring of sludge biogas, resulting from the handling of industrial wastewater through treatment in wastewater collection and treatment systems.

A summary of the available methods used to calculate emissions generated by wastewater handling (industrial) for the NGER Measurement Determination is provided below.



Table 4.1: Summary of available methods, by emissions of gas type - emissions from wastewater handling (industrial).

	CO ₂	CH ₄	N ₂ O
Method 1	NA	Section 5.42	NO
Method 2	NA	Section 5.43	NO
Method 3	NA	Section 5.47	NO
Method 4	NA	NA	NO

NA = Not available. NO = Not occurring.

Table 3.2: Summary of available methods, by emissions of gas type - emissions as a result of methane flared from the operation of the facility (estimated for each gas type)¹⁰.

	CO ₂	CH ₄	N ₂ O
Method 1	NA	Section 5.48	Section 5.48
Method 2	NA	Section 5.49	Section 5.49
Method 3	NA	Section 5.50	Section 5.50
Method 4	NA	NA	NA

NA = Not available.

4.2 Wastewater (Industrial) Calculator

CER has developed a Microsoft Excel based [Wastewater \(Industrial\) Calculator](#)¹¹ to assist wastewater handlers to report emissions data relating to industrial wastewater activities. The Wastewater (Industrial) Calculator calculates the total emissions from Wastewater Handling Facilities based on COD or BOD for CH₄ and Nitrogen Content of materials entering and leaving a facility. The emissions calculations are in accordance with the relevant equations and factors set out in Part 5.4 of the NGER Measurement Determination.

The calculator allows users to input activity data in editable fields and does not allow users to edit equations and factors that are required by the NGER Measurement Determination. It assists wastewater handlers to calculate and report current emissions. The calculator tabulates all the information provided, and results from calculations undertaken, in a form that can be manually entered into EERS.

The Wastewater (Industrial) Calculator is reviewed and updated as necessary to remain consistent with the NGER Measurement Determination. It is important to ensure correct versions of the NGER Measurement Determination and the latest version of the calculator are used for each reporting year.

¹⁰ Note: the same method must be used for each gas type.

¹¹ <http://www.cleanenergyregulator.gov.au/NGER/Forms-and-resources/Calculators>



4.3 Emissions of Methane released from wastewater handling (industrial)

Section 5.42 of the NGER Measurement Determination sets out Method 1 for methane emissions from industrial wastewater handling. It is intended that this method applies to industries producing the following commodities under the applicable ANZSIC codes:

- dairy products (ANZSIC code 113)
- pulp, paper, and paperboard (ANZSIC code 1510)
- meat and poultry (ANZSIC codes 1111 and 1112)
- organic chemicals (ANZSIC codes 18 and 19)
- raw sugar¹² (ANZSIC code 1181)
- beer (ANZSIC code 1212)
- wine and Other Alcoholic Beverages (ANZSIC code 1214)
- fruit and vegetables (ANZSIC code 1140).

ANZSIC codes and descriptions of the activities included under each code can be found on the [Australian Bureau of Statistics](#)¹³ website.

As for domestic and commercial wastewater handling facilities, Method 1 for industrial wastewater handling is based on Australia's [National Greenhouse Accounts](#)¹⁴ methods, except in specific circumstances.

While default MCF values are provided under Method 1, it is also possible to use a site-specific MCF value based on the type of wastewater treatment system employed in the industrial plant. To assist in the MCF selection process, a table provided in Section 5.42(8) of the NGER Measurement Determination provides default values of COD for several commodities and industries. The NGER Wastewater (Industrial) Calculator contains these default values for use in calculations and allows inputting of site-specific values.

Sections 5.43 to 5.46 of the NGER Measurement Determination set out the requirements for Method 2 for estimating methane released from industrial wastewater handling. Method 2 requires that wastewater be sampled in accordance with the general sampling requirements set out in section 5.44 of the NGER Measurement Determination, and analysed for COD and BOD in accordance with the standards listed in subsections 5.45(1) and (2) respectively, or an equivalent Australian or international standard, with this sampling and analysis to take place on at least a monthly basis.

Section 5.47 of the NGER Measurement Determination sets out Method 3 for estimating methane released from industrial wastewater handling. Method 3 is the same as Method 2, save that wastewater must be sampled in accordance with AS/NZS 5667.10:1998 or an equivalent Australian or international standard.

¹² Note the definition of raw sugar is as follows:

'Raw sugar' has the meaning given by Chapter 17, Section IV, Schedule 3 of the *Customs Tariff Act 1995*. The following is an excerpt from Chapter 17, Section IV, Schedule 3 of the *Customs Tariff Act 1995*: "'raw sugar' means sugar whose content of sucrose by weight, in the dry state, corresponds to a polarimeter reading of less than 99.55."

¹³ www.abs.gov.au

¹⁴ <https://www.dceew.gov.au/climate-change/publications/national-greenhouse-accounts-factors-2022>



4.4 Wastewater handling (industrial) - Flaring

Sections 5.48 to 5.50 of the NGER Measurement Determination set out Methods 1, 2 and 3 for the flaring of methane in sludge biogas. Method 1 is derived from the methods used for Australia's National Greenhouse Accounts. Methods 2 and 3 rely on the sampling and analysis of the fuel to estimate the gas composition of the fuel in order to estimate the quantity of methane flared more accurately.

Method 2 requires that the sludge biogas be sampled and analysed in accordance with Subdivision 2.3.3.2 of the NGER Measurement Determination, and Method 3 requires that the sludge biogas be sampled and analysed in accordance with Division 2.3.4 of the NGER Measurement Determination. Both Methods 2 and 3 require compliance with the measuring requirements in Division 2.3.6 of the NGER Measurement Determination.

More information and references

This guideline has been developed by CER for use by wastewater facility handlers and wastewater biogas managers, to assist in the consistent accounting and reporting of greenhouse gas emissions, energy consumption and energy production using the NGER legislation.

More information

For more information, please contact CER.

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Phone: 1300 553 542 within Australia

Web: www.cleanenergyregulator.gov.au

References

National Greenhouse and Energy Reporting Act 2007 (NGER Act)

National Greenhouse and Energy Reporting Regulations 2008 (NGER Regulations)

National Greenhouse and Energy Reporting (Measurement) Determination 2008 (NGER Measurement Determination)

See [Guidelines¹⁵](#) for more information on:

- defining a facility
- operational control
- measurement criteria
- reporting energy production and consumption
- reporting uncertainty.

¹⁵ <https://www.cleanenergyregulator.gov.au/NGER/Forms-and-resources/Guidelines>