Bioenergy Criteria

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Climate Bonds Standard and Certification Scheme



Climate Bonds INITIATIVE

Prepared by the Climate Bonds Initiative

Climate Bonds Initiative

Bioenergy Criteria

Climate Bonds Standard and Certification Scheme

Final Criteria Document

NOTE: *These Criteria can be used to certify use-of-proceeds instruments, assets, entities and SLD per the Climate Bonds Standard*

Climate Bond Certified

Revision	Date	Summary of Changes
2	07 March 2026	Provisions for new default methane values for standard and best-practice scenarios to be included in life-cycle analysis (LCA) GHG calculations. Feedstock biomass eligibility based on robust sustainability requirements. The sustainability criterion for the biomass feedstock has been split from the adaptation and resilience requirement for the sake of clarity. Inclusion of facilities for electricity generation from biomass withing the scope of the Criteria. Establishment of a temporal trajectory for GHG emission savings, reaching close to 0 in 2050. Clarification of the definition given for aligned product/asset, biomass, biomass-based fuel, bioenergy, eligible project/asset, certified project/asset, bioenergy biomass-based fuel, intermediate biomass energy product.
1.3	1 Aug 2022	Clarification that Bioenergy 'Storage' is within the scope as supporting infrastructure – i.e., providing the Bioenergy meets the overarching criteria (with Storage included in LCAs). Addition of Supporting Infrastructure section (section 3.4) which was previously absent
1.2	23 Mar 2021	Feedstock certification best practise standards list updated to included CBI Agriculture criteria following analysis that it meets requirements in Appendix 2. Removal of indication that a part 2 might be developed (that could have been for woody biomass feedstocks). This will not now be done.
1.1	28 Jul 2020	Issue for Public Consultation Swap 'bioenergy' to 'electricity' in table 2
1	Jul 2019	Publication of first criteria

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Acronyms

ASC-MSC Aquaculture Stewardship Council – Marine Stewardships Council

CHP Combined Heat and Power

CORSIA Carbon Offsetting and Reduction Scheme for International Aviation

gCO_2e grams of equivalent carbon dioxide

FSC Forest Stewardship Council

FSS Food Security Standard

GHG Greenhouse gases

iLUC Indirect Land Use Change

ISCC International Sustainability and Carbon Certification

JAS Japanese Agricultural Standard

LDAR Leakage, Detection and Repair

LCA Life Cycle Analysis

LHV Low Heating Value

MJ Mega Joules

RMP Remaining Methane Potential

RSB Roundtable on Sustainable Biomaterials

SBP Sustainable Biomass Programme

Definitions

Additional production: The principle that the biomass production was made possible specifically through improved agricultural techniques or the use of land that was not previously producing food/feed, ensuring that the bioenergy demand does not divert exiting food supplies.

Aligned product/asset: A product/asset that meets the different requirements developed in the Criteria.

Applicant: The term or name for any potential bond issuer, or non-financial corporate entity, that might seek Certification under the Bioenergy Criteria.

Bioenergy: Renewable energy derived from biomass.[1]

Bioenergy commodity: An energy commodity through the combustion of a biomass-based fuel.

Bioenergy company: Entities integrated across the bioenergy value chain, specifically engaged in the direct production of bioenergy through the operation of specialized plants, or involved in the industrial processing and upgrading of biomass into energy carriers (e.g., biofuels, biogas, and pellets).

Bioenergy product: A product that provides energy derived from biomass, including electricity, heat, cooling and biomass-based fuels in solid, liquid, or gaseous form.

Biomass: Material of biological origin, excluding material embedded in geological formations and transformed into fossil.[2]

Biomass-based fuel: Consumable products derived from raw biomass that can be used in a variety of energy applications, such as electricity generation, heat and cooling production, and transportation. Biomass-based fuels can be solid, liquid and gaseous (see Annex I for non-exhaustive list).

Certified project/asset: An eligible project/asset that has demonstrated compliance with the specific requirements set out in the criteria and therefore has been approved for certification.

Certified entity: The entity or part thereof which is being certified under the Climate Bonds Standard. Currently, entity Certification is limited to non-financial entities or segregated segments thereof, for which the Climate Bonds Initiative has Climate Bonds Standard Sector Criteria for entity Certification.

Climate Bond Certification: Allows the applicant to use the Climate Bond Certification mark in relation to that bond. Climate Bond Certification is provided once the independent Climate Bonds Standard Board (CBSB) is satisfied the bond complies with the CBS.

Climate Bonds Initiative (Climate Bonds): An investor-focused not-for-profit organisation, promoting large-scale investments that will deliver a global low-carbon and climate resilient economy. Climate Bonds seeks to develop mechanisms to better align the interests of investors, industry, and government to catalyse investments at a speed and scale sufficient to avoid dangerous climate change.

Climate Bonds Standard (CBS): A screening tool for investors and governments that allows them to identify green bonds, the proceeds of which are being used to deliver climate change solutions. This may be through climate mitigation impact and/or climate adaptation or resilience. The CBS is made up of two parts: the parent standard (CBS v4.3) and a suite of sector-specific eligibility criteria. The parent standard covers the Certification process and pre-and post-issuance requirements for all Certified bonds, regardless of the nature of the capital projects. The Sector Criteria detail specific requirements for assets identified as falling under that specific sector. The latest version of the CBS is published on the Climate Bonds website.

Climate Bonds Standard Board (CBSB): A board of independent members that collectively represents USD34tn of assets under management. The CBSB is responsible for approving (i) revisions to the CBS, including the adoption of additional Sector Criteria; (ii) approved verifiers; and (iii) applications for Certification of a bond under the CBS. The CBSB is constituted, appointed, and supported in line with the governance arrangements and processes as published on the Climate Bonds website.

Climate change: A change in global or regional climate patterns attributed to the increased levels of CO_2 in the atmosphere, produced mainly by the combustion of fossil fuels.

Climate goals: Objectives that aim to reduce greenhouse gas (GHG) emissions to limit the global temperature increase to 2°C or preferably 1.5°C above pre-industrial levels.

Climate mitigation: Rules and principles containing thresholds , benchmarks, and milestones for sector activities whose objective is the reduction of the harmful effects of GHG emissions.

Climate mitigation performance targets: The performance targets that define the measurable climate mitigation performance to be achieved.

Climate resilience and adaptation: Measures or assessments related to protecting communities or ecosystems from the effects of climate change. Adaptation refers to protection, while resilience is the ability to adapt and recover from the impacts of climate change.

Climate targets: Thresholds established by scientists and policymakers in plans to combat climate change.

CO_2 equivalent: A unit to measure the effect of all greenhouse gases according to their global warming potential that expresses the warming effect of each GHG over a set period of time (usually 100 years) in comparison to CO_2. Thus, an amount of a GHG can be expressed by the amount of CO_2 that will have the equivalent warming effect over 100 years.

Decarbonisation pathways: Transformation processes, strategies, or instructions to be implemented in the energy sector aiming to reduce emissions and the use of fossil fuels. They involve measures such as shifting the energy mix, increasing energy efficiency, utilising the circular economy, or managing demand for energy.

Decarbonise: Move away from energy systems that produce carbon dioxide and other GHG emissions and remove the amount of gaseous carbon compounds in the atmosphere.

Eligible project/asset: Project/assets within the scope of these Criteria.

Emission intensity: Volume of emissions per unit of a representative factor in the assessed sector, which in the bioenergy sector is MJ generated, so the emissions intensity is the grams of CO_2e per MJ: gCO_2e/MJ.

Emissions target: Thresholds that scientists set for the quantity of emissions to be aligned with the Paris Climate Agreement.

Energy commodity: Refers to the final energy output delivered to the end-user, specifically electricity, heating, or cooling.

Food and feed crops: Starch-rich crops, sugar crops or oil crops produced on agricultural land as a main crop excluding residues, waste or ligno-cellulosic material and intermediate crops, such as catch crops and cover crops, provided that the use of such intermediate crops does not trigger demand for additional land.

Fossil gas: A hydrocarbon fuel, mostly composed of methane produced from the decay of organic material over millions of years.

Green bond: A bond where the proceeds are allocated to environmental projects or expenditures. The term generally refers to bonds that have been marketed as green. In theory, green bonds proceeds could be used for a wide variety of environmental projects or expenditures, but in practice they have generally been earmarked for climate change projects.

Industry Working Group (IWG): A group of key organisations that are potential applicants, verifiers and investors convened by Climate Bonds. The IWG provides feedback on the draft Sector Criteria developed by the Technical Working Group (TWG) before they are released for public consultation.

Intermediate biomass energy products: Semi-processed biomass-derived energy carriers that have undergone an initial conversion, pre-treatment, or upgrading step, but require further processing or refining before becoming final biomass-based fuels. Typical examples are biomass-derived oils from pyrolysis or hydrothermal liquefaction, solid bio-intermediates such as torrefied biomass, intermediate alcohols or syngas.

Investment period: The interval between a bond issue and its maturity date; otherwise known as the bond tenor.

Life-cycle emissions assessment: A methodology for estimating or quantifying environmental emissions associated with all the stages of the life cycle of a product, from the initial design phase to disposal or recycling.

Mitigation technologies: Actions within technological processes implemented to reduce and curb GHG emissions.

Negative emissions: Processes in which more CO_2 is removed and stored from the atmosphere than added to it, so the final GHG emissions balance is negative. It can be achieved by natural processes or a variety of technological solutions. Negative emissions are necessary to meet the Paris Agreement.

Net gain in productivity: The measurable increase in total biomass and food/feed output from a specific land area compared to traditional single-crop systems. This surplus justifies the use of the secondary crop for energy purpose without creating a supply deficit in the food market.

Net-zero emissions: A situation where global GHG emissions from human activity are in balance with their removal or negative emissions. To achieve this situation, human-caused emissions should be reduced as close to zero as possible.

Net-zero targets: Commitments adopted by countries or companies to achieve net-zero emissions by a specified year.

Non-food agricultural biomass: Agricultural biomass that is not classified as food and feed crops according to the definition provided below. Examples can be seen in Table 8.

Non-fossil renewable gaseous and liquid fuels: Fuels produced using energy from other renewable energy sources.

Parent company/group: A company is considered a parent company of another entity (a subsidiary) if it exercises control over the subsidiary. The terms control and subsidiary have the meaning assigned to them under International Financial Reporting Standard 10 (IFRS 10). A parent group consists of the parent company and all the companies that the parent company exercises control over. Where the applicant does not belong to a group of companies, the term parent company applies to the applicant.

Paris Agreement: A legally binding international treaty on climate change adopted by 196 parties. Its overarching goal is to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

Pathways: Science-based trajectories for different sectors indicating the way to achieve targets related to relevant indicators. In the bioenergy sector, these trajectories generally refer to the emission intensity of the biomass-based product.

Productive intensification system: A farming framework or regional zoning strategy (such as Brazil's ZAE) that optimizes land use to increase total agricultural output per hectare. This is typically achieved by introducing a secondary bioenergy crop without reducing the volume or displacing the production of the main food/feed crop.

Sequential cropping (or Double cropping): The agricultural practice of cultivating and harvesting two or more different crops in succession on the exact same delineated physical plot of land within a single agricultural year (12-month cycle).

Scope of emissions: Scope 1, 2 and 3 are terms devised by the GHG Protocol to categorise the different sources of GHG emissions an organisation creates in its own operations, and in its wider value chain.

Standards Criteria: Established principles to evaluate processes, assets, or entities aiming to achieve benchmarks, targets, or goals.

Stemwood: Forest biomass consisting of the main stem of a tree that meets the quality and size specifications to be merchantable as sawtimber or for industrial wood products in local markets.

Sustainability-linked debt (SLD): Any debt instrument for which the financial and structural characteristics can vary depending on whether the issuer achieves predefined sustainability/ESG objectives. Such objectives are measured through predefined key performance indicators (KPIs) and assessed against predefined performance targets. Proceeds of SLD are intended to be used for general purposes.

Technical Working Group (TWG): A group of recognised experts from academia, international agencies, industry, and NGOs convened by Climate Bonds. The TWG develops the Sector Criteria, which are detailed technical criteria for the eligibility of projects and assets as well as guidance on the tracking of eligibility status during the term of the bond. Their draft recommendations are refined through engagement with finance industry experts in convened industry working groups (see below) and through public consultation. Final approval of Sector Criteria is given by the CBSB.

Transition targets: Thresholds, benchmarks, and milestones based on key assumptions and dependencies used by scientists and policymakers to develop a plan to achieve climate targets.

Waste woody biomass: Forest biomass derived from forest management or harvesting operations that is not classified as stemwood.[3]

1 Introduction

1.1 The Climate Bonds Standard

Investor demand for climate bonds is strong and is expected to increase in line with the delivery of quality products into the market. As of Q3 2025, Climate Bonds Initiative (Climate Bonds) has recorded an aligned cumulative volume of USD6.5 tn green, social, sustainability, and sustainability-linked (SGG+) debt, which continues on an upward trajectory with ongoing diversification in the types of debt issued. To support this growth, standards, assurance, and certification are essential to demonstrate credibility, which improves confidence and transparency.

The Climate Bonds Standard and Certification Scheme is an easy-to-use screening tool that provides a clear signal to investors and intermediaries on the climate integrity of Certified Climate Bonds.

At the core of the Standard is a suite of sector-specific eligibility Criteria, each of which sets climate change benchmarks for that sector. These are used to screen debt instruments, assets and/or entities, so that only those with climate integrity, either through their contribution to climate mitigation, and/or to adaptation and resilience to climate change, will be Certified.

These sector-specific Criteria are determined through a multi-stakeholder engagement process, including a technical working group (TWG) and an industrial working group (IWG), convened and managed by Climate Bonds, and are subject to public consultation. Finally, they are reviewed and approved by the Climate Bonds Standard Board (CBSB).

The Climate Bonds Standard and Certification Scheme is supported by the overarching Climate Bonds Standard which sets out the cross-sectoral as well as sector-specific Criteria all Certified instruments, assets, and entities must meet.[4]

1.2 Environmental scope of the Bioenergy Criteria

Certification requirements address:

- sustainable biomass feedstock; and
- climate change mitigation; and
- climate adaptation and resilience.

1.3 What can be Certified under the Bioenergy Criteria

Subject to meeting the Criteria, the following can be Certified under use of proceeds (UoP) Certification:

- UoP instruments financing facilities (or retrofitting of facilities) producing intermediate biomass energy products.[5]
- UoP instruments financing facilities (or retrofitting of facilities) producing biomass-based fuels for use in transport, heat or cooling production, electricity generation, or co-generation of heat and power (CHP)
- UoP instruments financing facilities (or retrofitting of facilities) for heat and cooling production, electricity generation or co-generation of heat and power (CHP) from biomass-based fuels.
- UoP bond instruments financing supporting infrastructure attached to an eligible asset.

The following can be Certified under Asset Certification (physical asset, the facility):

- Facilities producing intermediate biomass energy products.
- Facilities producing biomass-based fuels for use in transport, heat or cooling production, electricity generation, or co-generation of heat and power (CHP).
- Facilities for heat and cooling production, electricity generation or co-generation of heat and power (CHP) from biomass-based fuels.

The following entities (bioenergy companies) and sustainability-linked debt (SLD) issued by those entities can be Certified under entity's Certification:

- Companies involved in the production of bioenergy products (e.g. operators of bioenergy plants across one or multiple sites).

- Companies engaged in the processing and upgrading of biomass into bioenergy carriers (e.g. pellets, biogas, biofuels).

The Climate Bonds Standard (CBS) provides any cross-sectoral requirements for UoP, SLD, Asset or Entity Certification which must be met in addition to the specific requirements described in this document.[6]

Applicants to the CBS must provide information to demonstrate compliance with the Criteria, which is validated by third-party verifiers in the assurance process.

1.4 Documents supporting the criteria

Bioenergy-specific information to support applicants and verifiers is available at Bioenergy Climate Bonds Initiative website as follows: [7]

- *Bioenergy Criteria Background Paper* detailing how the criteria were chosen;
- *Bioenergy Criteria. Sustainable Biomass Feedstock- Applying for recognition as an approved proxy;*
- *Bioenergy Criteria Frequently Asked Questions* (FAQs);
- *Bioenergy Criteria Public Consultation Feedback and Responses Summary.*

In addition, the following cross-cutting information to support applicants and verifiers is available as follows:

- The Climate Bonds Standard contains the requirements of the overarching CBS. [8]
- For more information on Climate Bonds and the Climate Bonds Standard and Certification Scheme, see climate bonds website.[9]

1.5 Revisions to the criteria

These criteria will be reviewed by the TWG on a regular basis, taking into account the deals that are printed in the early stages, and any developments in improved methodologies and data that can increase the climate integrity of future deals. As a result, the criteria are likely to be refined over time, as more information becomes available. **Certification will not be withdrawn retroactively from bonds Certified under earlier versions of the Criteria.**

1.6 Acknowledgements

Climate Bonds gratefully acknowledges the technical working group (TWG) and industry working group (IWG) members who provided their time and expertise during the development of these criteria. The full list of members is provided in Annex V.

Special thanks are given to ***Dr Ana Díaz Vazquez***, Global Energy Transition Lead at Climate Bonds, ***Dr Bernabé Alonso Fariñas***, the bioenergy technical lead, and ***Francisco Moreno Castro,*** Energy Analyst at Climate Bonds, for coordinating the development of the Criteria through the TWG.

2 Eligible projects, assets and companies. Scope of the criteria.

Table 1 presents projects and assets that can be included in a Certified Climate Bond under UoP Certification subject to meeting the Bioenergy Criteria described in Section 3. Examples are provided for illustrative purposes and do not represent an exhaustive list of all possible eligible assets and projects.

Table 1. Scope of the criteria. UoP Certification

Project/Asset type	Example Use of Proceeds Certification	Mitigation criteria	Sustainable biomass feedstock criteria	Adaptation and resilience criteria
Facilities producing intermediate biomass energy products	Biomass conditioning facilities such as those for drying or densifying the feedstock for transportation. Pretreatment facilities such as those for thermochemical liquefaction, pyrolysis and gasification.	Sub-section 3.1.1	Section 3.2	Section 3.3
Facilities producing biomass-based fuels for use in transport, heat or cooling production, electricity generation, or co-generation of heat and power (CHP)*	Biodiesel plants via transesterification of vegetable oils or animal fats. Bioethanol distilleries. Biogas upgrading facilities to biomethane. SAF production plants via hydro-processed esters and fatty acids (HEFA), Fischer-Tropsch synthesis or alcohol-to-jet (ATJ) technologies. Pellet production plants from agricultural residues for direct combustion in heat/electricity or CHP.	Sub-section 3.1.2 (Table 5)		
Facilities for heat/cooling production, electricity generation or co-generation of heat and power (CHP) from biomass-based fuels	CHP plants for simultaneous electricity and heat generation from solid biomass fuels. Anaerobic digestion CHP plants to produce electricity and heat from biogas. Combined Cycle Power Plant (CCPP) burning biomethane produced off-site. District heating plants using solid biomass-based fuel.	Sub-Section 3.1.2 (Table 6)		
	Traditional biomass assets or projects, such as a three-stone fire for heating and cooking in the residential sector.	Not eligible		
Supporting assets/infrastructure	Dedicated transmission lines from an eligible bioenergy facility to the grid Any equipment, infrastructure attached to an eligible asset, including storage infrastructure	Automatically eligible		

* They may also co-produce biomass-based products for non-energy use (such as food and feed ingredients, chemicals, materials and minerals), when > 50% biomass-based products produced for energy use, referred to the energy content of the final products.

Table 2 presents assets that can be included in a Certified Climate Bond under Asset Certification subject to meeting the Bioenergy Criteria described in Chapter 3. Examples are provided for illustrative purposes and do not represent an exhaustive list of all possible eligible assets and projects.

Table 2. Scope of the Criteria. Asset Certification

Asset type	Example Asset Certification	Mitigation criteria	Sustainable biomass feedstock criteria	Adaptation and resilience criteria
Facilities producing intermediate biomass energy products	Biomass conditioning facilities such as those for drying or densifying the raw material for transportation. Pretreatment facilities such as those for thermochemical liquefaction, pyrolysis and gasification.	Sub-section 3.1.1	Section 3.2	Section 3.3
Facilities producing biomass-based fuels for use in transport, heat or cooling production, electricity generation, or co-generation of heat and power (CHP)*	Biodiesel plants via transesterification of vegetable oils or animal fats. Bioethanol distilleries. Biogas upgrading facilities to biomethane. SAF production plants via hydro-processed esters and fatty acids (HEFA), Fischer-Tropsch synthesis or alcohol-to-jet (ATJ) technologies. Pellet production plants from agricultural residues for direct combustion in heat/electricity or CHP.	Sub-section 3.1.2 (Table 5)		
Facilities for heat/cooling production, electricity generation or co-generation of heat and power (CHP) from biomass-based fuels	CHP plants for simultaneous electricity and heat generation from solid biomass fuels. Anaerobic digestion CHP plants to produce electricity and heat from biogas. Combined Cycle Power Plant (CCPP) burning biomethane produced off-site. District heating plants using solid biomass-based fuel.	Sub-section 3.1.2 (Table 6)		
	Traditional biomass assets or projects, such as a three-stone fire for heating and cooking in the residential sector.	Not eligible		

* They may also co-produce biomass-based products for non-energy use (such as food and feed ingredients, chemicals, materials and minerals), when > 50% biomass-based products produced for energy use, referred to the energy content of the final products.

Asset Certification category corresponding to the classification of the physical asset as certifiable provided that the criteria detailed in Chapter 3 are met. The certification is valid for one year.

Table 3 presents companies that can be included in a Certified Climate Bond under Entity Certification subject to meeting the Bioenergy Criteria described in Chapter 3. Examples are provided for illustrative purposes and do not represent an exhaustive list of all possible eligible companies.

Table 3. Scope of the Criteria. Entity Certification

Companies	Examples	Entity's Certification Criteria
Companies involved in the production of bioenergy	Operators of bioenergy plants across one or multiple sites.	Section 3.4
Companies engaged in the processing and upgrading of biomass into bioenergy carriers.	Operators that produce pellets, biogas, biofuels.	

2.1 Alignment with other sector criteria.

The following activities are not covered by the Bioenergy Criteria, which are addressed by other Climate Bonds Criteria detailed in Table 4.

Vehicles used to transport biomass or biomass-based fuels or that run on these fuels are covered by the Climate Bonds Land Transport Criteria and Climate Bonds Shipping Criteria, and are therefore outside the scope.[10,11]

Biomass-based fuel or energy products from municipal waste are addressed in the Climate Bonds Waste Management Criteria with the exception of used cooking oil (UCO). UCO is an eligible biomass source for these criteria and classified as processing waste and residues biomass (see Table 8).

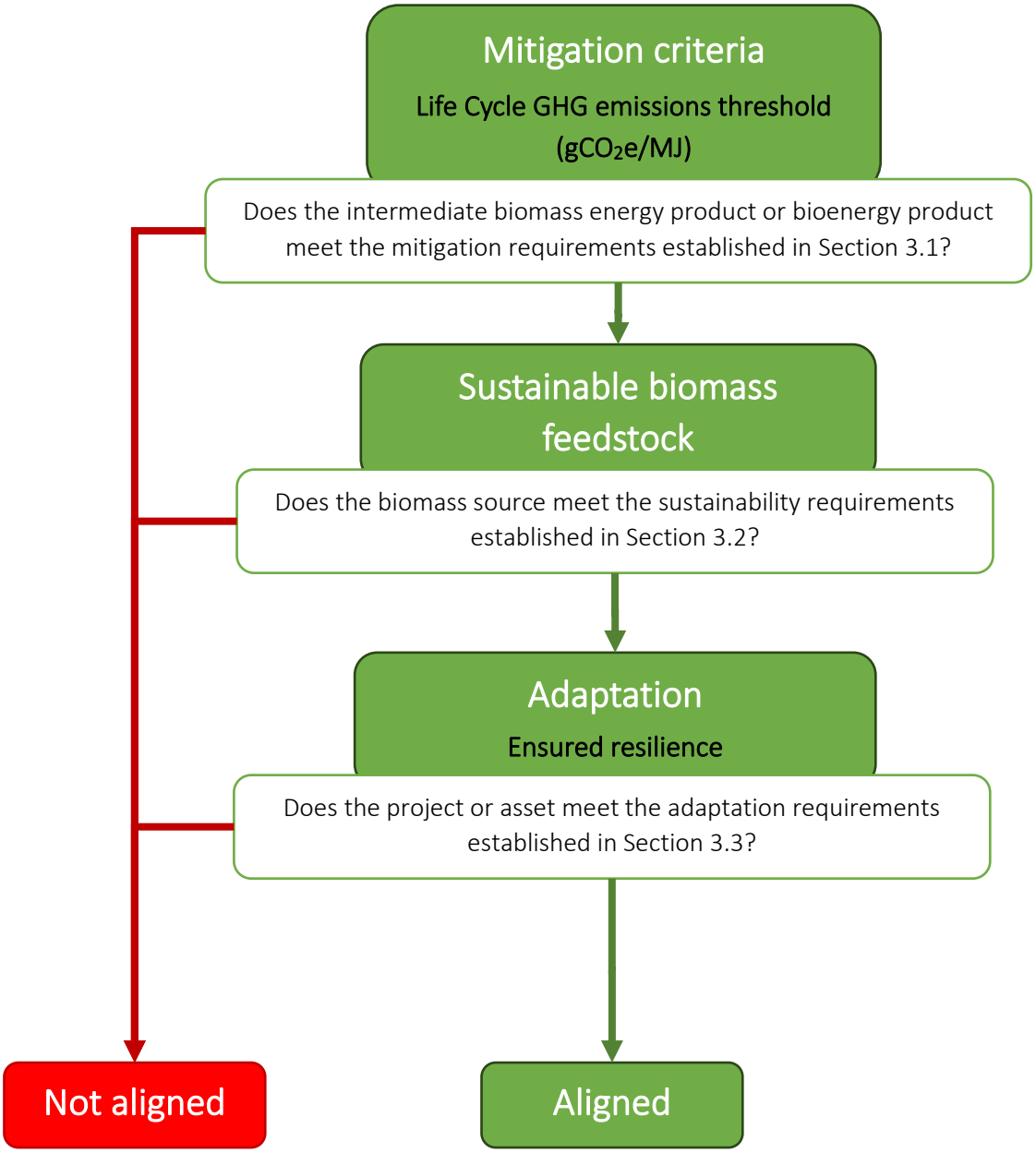
Table 4. Assets or projects partially or wholly covered by other Sector Criteria.

Activities related to the Bioenergy value chain	Requirements in other Climate Bonds Standards	Climate Bonds Criteria
Vehicles used to transport biomass or biomass-based fuels, or that run on these fuels.	Land Transport criteria do not allow vehicles running on biofuels.	Climate Bonds Land Transport Criteria
	Shipping criteria establish a GHG threshold for tailpipe emissions.	Climate Bonds Shipping Criteria
Facilities producing intermediate biomass energy product or bioenergy products from municipal waste. With the exception of used cooking oil (UCO)	Waste Management Criteria includes production of biogas/biomethane throughout anaerobic digestion of municipal waste. Waste Management Criteria also includes heat/cooling production, electricity generation or co-generation of heat and power (CHP) produced from municipal waste-derived biofuels.	Climate Bonds Waste Management Criteria

3 Climate Bonds bioenergy requirements

Figure 1 illustrates the structure of the Criteria, which consists of three components.

Figure 1. Bioenergy Criteria decision tree



Source: Climate Bonds Initiative

3.1 Mitigation

3.1.1 Mitigation component for intermediate biomass energy products

Facilities producing intermediate biomass energy products shall disclose the GHG emissions associated with the intermediate product following the methodology described in Sub-section 3.1.3, adapting the scope of the life cycle analysis (LCA) to a cradle-to-gate boundary.

3.1.2 Greenhouse gas thresholds for bioenergy products

Mitigation thresholds are shown in Table 5 and Table 6, which specify admissible maximum life cycle GHG emissions.

Table 5. Emissions intensity threshold for biomass-based fuels (gCO_2e per MJ of energy content).

LCA GHG emissions threshold for biomass-based fuels		
Energy sector	Year	LCA GHG emissions threshold (gCO_2e/MJ of biomass-based fuel energy content)
Road	2025	47
	2030	37.6
	2040	18.8
	2050	Close to 0*
Shipping	2025	32.9
	2030	28.8
	2040	18.8
	2050	Close to 0*
Aviation	2025	44.5
	2030	35.6
	2040	17.8
	2050	Close to 0*
Heat/cooling production (in brackets values for proven coal substitution)	2025	12.8 (19.8)
	2030	9.6 (14.9)
	2040	3.2 (5)
	2050	Close to 0*
Electricity generation	2025	14.6
	2030	11.0
	2040	3.7
	2050	Close to 0*
Cogeneration	2025	19.2
	2030	14.4
	2040	4.8
	2050	Close to 0*

* See Box 1 below

Box 1. Specifications for 'close to zero' targets

By 2050, the certified product must achieve a 'close to zero' status, defined as reduction in GHG emissions of at least 95% compared to the applicable fossil fuel comparator, which is detailed in the Bioenergy Background document.

When the GHG reduction is less than 100%, it is demonstrated that the remaining emissions (representing ≤ 5% of the fossil reference) are 'technically unavoidable' given the current state of the art. This means that the residual emissions originate exclusively from the following:

a. Upstream embodied emissions. GHG emissions associated with the extraction of raw materials, the manufacture of infrastructure (CAPEX), or essential transport where zero-emissions alternative are not commercially available.
b. Unavoidable process emissions. Minimal fugitive emissions or biogenic N_2O emissions that persist despite the implementation of best available techniques (BAT) recognised by relevant industrial standards (e.g., EU Industrial Emissions Directive or IPCC Guidelines).

Table 6. Emissions intensity threshold for heat/cooling, electricity and cogeneration produced from biomass-based fuels (gCO_2e per MJ of final energy commodity).

LCA GHG emissions threshold for heat/cooling, electricity and co-generation produced from biomass-based fuels.		
Bioenergy products	Year	LCA GHG emissions threshold (gCO_2e/MJ of final bioenergy commodity)
Heat/cooling	2025	16
	2030	12
	2040	4
	2050	Close to 0*
Electricity	2025	36.6 (131.76 gCO_2e/kWh)
	2030	27.45 (98.82 gCO_2e/kWh)
	2040	9.15 (32.94 gCO_2e/kWh)
	2050	Close to 0*
Cogeneration	2025	16 (heat)/36.6 (electricity)
	2030	12/27.45
	2040	4/9.15
	2050	Close to 0*

*See Box 1 above.

For facilities producing biomass-based products for both energy and non-energy purposes (such as food and feed ingredients, pharmaceuticals, chemicals, materials and minerals), issuers are required to allocate GHG emissions based on their energy content (energy allocation). For such facilities, only those biomass-based products for energy purpose needs to meet the GHG emissions thresholds detailed in Table 5 and Table 6 above. There are no additional GHG emissions thresholds for biomass-based products for non-energy use. However, users of these Criteria are reminded that, if biomass-based products for energy use account for less than 50% of the energy content of the final products, then the facility is not eligible under this Climate Bonds Criteria.

3.1.3 GHG emissions accounting methodologies.

To demonstrate they meet these thresholds, issuers are required to conduct a LCA of GHG emissions. The scope of the LCA shall include:

- Feedstock production;
- Feedstock processing;
- Biomass-based fuel production;
- Biomass-based fuel storage and blending;
- Intermediate and final transport steps: transportation of feedstock to processing facilities, and transportation of biomass-based fuel to the point of consumption;
- Use of the biomass-based fuel (CO_2 emissions are considered zero in this stage).

Issuers are required to use one of the five tools in Table 7 below for GHG emissions calculation. When applicable, guidelines described in Annex II must be integrated in the calculation for methane emissions of the biogas and biomethane value chain.

Table 7. Endorsed GHG calculation tools

Name	Criteria	Origin
BIOGRACE II[12]	Biomass for electricity, heating and cooling	EU
RSB GHG Calculator[13]	Liquid biofuels	International
UK Solid and Gaseous Biomass Carbon Calculator[14]	Solid biomass and biogas used for heat and electricity generation	UK
GREET[15]	Alternative fuels in transport	US
RenovaCalc[16]	Ethanol, biodiesel, aviation biokerosene and biogas from waste	Brazil

Recent studies have demonstrated that important sources of methane emissions are not included in methodologies and for those that are accounted for, default values are lower than real values. The criteria indicate a methodology to include methane emissions in the calculation of LCA GHG emissions. [17] See Annex II.

3.1.3.1 Demonstration of compliance.

The LCA GHG emissions threshold declines over time. A linear trajectory must be assumed for time periods between the dates and thresholds provided in Table 5 and Table 6.

The issuer has three options for meeting the criteria during the term of the debt instrument.

Option A – Calculate the average emissions threshold over the term of Certification and demonstrate that the facility meets the average threshold at the time of Certification.

Example. Option A: A 15-year bond starting in 2025 for electricity generation

- 2025 threshold: 36.6 gCO_2e/MJ;
- 2040 threshold: 9.15 gCO_2e/MJ;
- Average emissions threshold: $\frac{36.6+9.15}{2} = 22.975$ gCO_2e/MJ.

Electricity generated at the time of certification must meet the 22.975 gCO_2e/MJ emissions intensity threshold.

Option B – Meet the threshold at the time of Certification and commit to a 3-yearly assessment by an approved verifier for the duration of the Certification period. Each assessment must confirm that the facility meets the updated, lower emissions intensity threshold in effect at that time. If, during any 3-yearly verification, the issuer fails to demonstrate compliance with the emissions intensity threshold, Certification will be removed.

Option C – Meet the threshold at the time of Certification, at the halfway point of the debt instrument's term, and one year before the end of the term, both assessed by an approved verifier. If, within the duration of the Certification period, the issuer fails to demonstrate compliance with the emissions intensity threshold in effect at that time, Certification will be withdrawn.

Example. Option C: A 10-year bond for heat production starting in 2025

- 2025 threshold: 12.8 gCO_2e/MJ;
- 2030 threshold: 9.6 gCO_2e/MJ;

2034 threshold: 7.04 gCO_2e/MJ (a linear trajectory must be assumed for time periods between the dates and thresholds provided in Table 5 and Table 6).

Option D – For Asset Certification the issuer must meet the threshold corresponding to the year of the certification, following a linear trajectory for the years between the dates and thresholds indicated in Table 5 and Table 6.

Note: Regardless of the option chosen, the issuer must disclose the GHG emissions intensity annually to verify that targets are being met.

3.2 Sustainable biomass feedstock criteria

These criteria establish the sustainability requirements for biomass feedstock sources.

3.2.1 Biomass feedstock classification

Biomass feedstocks within the scope of the criteria are aggregated into four categories, based on their characteristics. See Table 8.

Table 8. Biomass feedstock source classification

Biomass feedstock type		Examples
Agricultural Biomass *Biomass produced from agriculture*	Food and Feed Crops	Food and feed agricultural crops, such as corn or wheat
	Non-food agricultural biomass	Non-food agricultural crops cultivated in agricultural land, such as energy crops
		In-field agricultural residues, originating from the cultivation of food or feed crops, such as cereal straw, rice straw, stalks, nutshell, bagasse (classified as processing residue if generated during processing); fruit tree cuttings and vineyard pruning
		Agro-livestock waste and residues such as animal manure, slurry, and organic bedding material
		Aquaculture and fisheries waste and residues such as mortalities, aquatic sludge or ponds sediments
		Algae if cultivated in land ponds
Forestry biomass *Only waste woody biomass is eligible as a feedstock.*		Harvested grass
		Branches and other waste from forest harvesting. (not including residues from related industries or processing)
		Salvage trees, end of life trees and trees removed for nature conservation purposes
		Feedstock coming from necessary management activities, aiming to ensure pre-commercial thinning operations or carried out in accordance with national law or wildfire prevention in high-risk areas
		Short-rotation (3-15 years) techniques crops including poplar, willow, eucalyptus, gum trees or perennial grasses
Processing waste and residues biomass *Waste and residues other than agricultural, aquacultural, fisheries and forestry residues*		Non-field agricultural residues, originating from the primary processing of a food crop in a factory such as rice husk, maize cob, nutshell and husks, peels, fruit seeds, bagasse, coffee husk, cocoa pods (classified as agricultural crops residue if directly generated by agriculture)
		Animal byproducts generated by slaughterhouses or other operations, and animal fats generated in a rendering process
		Other agrifood industry waste or residues such as brewery sludge and brewer's spent grain, grape marcs and wine lees, or solid waste and wastewater from dairy industry
		Waste/residues from forest-based industries such as black and brown liquor from cellulose industry or paper sludge
		Crude glycerol from biodiesel production
		Bio-genic fraction of end-of-life tires
		Used cooking oil (UCO)
		Captured bio-genic CO_2
Aquatic biomass *Cultivated or harvested water-based plants or algae, and associated derivatives, different from those cultivated in land ponds*		Microalgae (Chlorella, Scenedesmus, Nannochloropsis, Dunaliella)
		Cyanobacteria, often called "blue-green algae" (Spirulina, Synechocystis)
		Macroalgae, also called seaweeds (Kelp, Gracilaria, Ulva, Porphyra)
		Aquatic vascular plants (Duckweed, Water hyacinth, Cattail)

3.2.2 Sustainability principles and criteria

Biomass feedstock shall meet the sustainability requirement defined as a compendium of criteria, which are grouped in principles that aim to assess all the material topics for the environment, local people, and communities.

The identified principles and criteria for each type of biomass feedstock defined above (Table 8) are detailed in the Climate Bonds Bioenergy Criteria Background Paper in Section 3.2.

3.2.2.1 Demonstration of compliance

To meet the criteria, the issuer must demonstrate compliance with the following:

- General requirements (applicable to all biomass types)
  - The source feedstocks are certified under one of the pre-accepted certification schemes depending on the type of biomass (see subsections 3.2.4 to 3.2.7). Certification of all source feedstock is maintained for the full term of the bond; and
  - Where specific criteria, such as those related to iLUC, food security or socio-economic impacts are applicable but not covered by the chosen certification scheme, the alternative options provided below are used.
- Additional requirement for the biogas/biomethane value chain
  - The feedstock storage best practices detailed in Annex III are adhered to.

Every two years, Climate Bonds will check whether there are other certification schemes that should be included in the list of pre-approved certification standards for compliance with best practices (Table 9, Table 10, Table 11 and Table 12)

Note: For the inclusion of new certification scheme as a proxy, follow the procedure detailed in the separate document: *Climate Bonds Bioenergy Criteria. Applying for recognition as an approved proxy.*

3.2.3 Agricultural biomass from food/feed crops

Agricultural biomass from food and feed crops could pose a potential iLUC risk and problems for food security. Therefore, the food and feed crops feedstock must meet:

- Certification according to one of the schemes included in Table 9; and
- Unless the production has resulted in a direct land-use change, the issuer must also meet iLUC risk criteria detailed below in point 3.2.3.1; and
- The issuer must also meet food security criteria detailed below in point 3.2.3.2;

Table 9. Pre-accepted certification schemes for food/feed-crop agricultural biomass feedstock

Scheme	Complete name	iLUC risk management	Food security
ISCC-EU	International Sustainability and Carbon Certification	Included as an additional module*	Included
ISCC-CORSIA	International Sustainability and Carbon Certification	Included**	Included
ISCC-PLUS	International Sustainability and Carbon Certification	Not included	Included
RSB	Roundtable on Sustainable Biomass	Included as an additional module*	Included
RBB-CORSIA	Roundtable on Sustainable Biomass	Included**	Included
ClassNK-CORSIA	Class NK	Included**	Included
ClassNK	Class NK	Not included	Included
BetterBiomass	Better Biomass	Not included	Included
GGL	Green Gold Label	Not included	Not included
SBP	Sustainable Biomass Programme	Not included	Not included
Better Cotton	Better Cotton Initiative	Not included	Not included
2BSvs	Biomass Biofuel Sustainability Voluntary Scheme	Not included	Not included
RSPO	Roundtable on Sustainable Palm Oil	Not included	Not included
BonSucro	BonSucro	Not included	Not included
RTRS	Roundtable on Sustainable Soy Association	Not included	Not included

* Explicit low-iLUC risk certification: The certification scheme includes a specific or additional farm-level verifiable module to certify 'Low iLUC-risk' biomass.

** Macro-penalty integration: The certification scheme applies a standardized, official iLUC penalty factor (measured in gCO_2e/MJ) to the total Greenhouse Gas (GHG) emission calculation

3.2.3.1 iLUC risk management criteria

The issuer shall meet iLUC risk management criteria following one the following options:

OPTION A: Explicit low-iLUC risk certification

The certification scheme includes a specific or additional farm-level verifiable module to certify "Low iLUC-risk" biomass (see third column in Table 9).

OPTION B: Macro-penalty integration

The certification scheme includes a specific or additional module which applies a standardized, official iLUC penalty factor (measured in gCO_2e/MJ) to the total greenhouse gas (GHG) emission calculation (see third column in Table 9). The biomass is accepted if the final GHG savings meet or exceed the required sustainability threshold despite the inclusion of the applied iLUC penalty. (e.g. CORSIA approved certification schemes); or

OPTION C: Regional or National Productive Intensification Systems

Compliance is met if the feedstock is produced within a *Productive Intensification System* officially recognized by local or national authorities (e.g., Brazil's Agro-ecological Zoning - ZAE). This approach validates the biomass as an "*additional production*" output provided it fulfils the following conditions to mitigate indirect land-use change:

1. Recent Implementation (20-Year Window): The intensification practice (e.g., introduction of *sequential cropping*) must have been implemented on the specific plot no earlier than 20 years prior to the certification assessment.

2. Non-Displacement: The producer must demonstrate that the supply of biomass for bioenergy does not result in a diversion of existing food/feed products. Compliance is verified by ensuring that the current food/feed output remains at least equal to the 3-year historical baseline (average production) of the farm prior to the start of the bioenergy supply.

When farm-level data is not available to demonstrate recent implementation and non-displacement requirements, regional datasets from official sources are accepted as complementary evidence.

3.2.3.2 Food security criteria

The issuer shall meet food security criteria following one the following options:

OPTION A: Food security risk certification

The certification scheme includes a specific or additional and verifiable module at the farm level to check for the absence of food safety risks (see last column of Table 9).

OPTION B: Additional food security certification

The issuer provides a Food Security Standards (FSS) Certification.

OPTION C: Regional assessment

The feedstock is deemed to have no food security risk if cultivated in regions with:

- Global Hunger Index (GHI) < 10; or
- 10 < GHI < 20 and Prevalence of undernourishment (PoU, FAO) < 5%.

3.2.4 Non-food agricultural biomass

Non-food agricultural biomass could pose problems for food security where cultivation replaces/displaces previous food/feed crop production on the same land. Therefore, non-food agricultural biomass must meet:

- Certification according to one of the schemes included in Table 10; and
- Where cultivation replaces/displaces previous food/feed crop production on the same land, the issuer must also meet food security criteria detailed in point 3.2.4.1.

Table 10. Pre-accepted certification schemes for non-food agricultural biomass feedstock

Scheme	Complete name	Food security
ISCC-EU	International Sustainability and Carbon Certification	Included
ISCC-CORSIA	International Sustainability and Carbon Certification	Included
ISCC-PLUS	International Sustainability and Carbon Certification	Included
RSB	RoundTable on Sustainable Biomass	Included
RBB-CORSIA	RoundTable on Sustainable Biomass	Included
ClassNK-CORSIA	Class NK	Included
ClassNK	Class NK	Included
BettterBiomass	Better Biomass	Included
Better Cotton	Better Cotton Initiative	Included
SBP	Sustainable Biomass Programme	Not included
GGL	Green Gold Label	Not included
2BSvs	Biomass Biofuel Sustainability Voluntary Scheme	Not included

3.2.4.1 Food security criteria

The issuer shall meet food security criteria following one of the following options:

OPTION A: Food security risk certification

The certification scheme includes a specific and verifiable module at the farm level to check for the absence of food safety risks (see last column of Table 10).

OPTION B: Additional food security certification

The issuer provides a Food Security Standards (FSS) Certification.

OPTION C: Regional assessment

The feedstock is deemed to have no food security risk if cultivated in regions with:

- Global Hunger Index (GHI) < 10; or
- 10 < GHI < 20 and Prevalence of undernourishment (PoU, FAO) < 5%.

3.2.5 Forestry biomass

Only waste woody biomass is accepted as a feedstock to produce biomass-based fuels or bioenergy products. Waste woody biomass examples can be found in Table 8.

To be included as eligible feedstock, waste woody biomass must come from forest or sources certified by one the certification schemes listed in Table 11.

Table 11. Pre-accepted certification schemes for forestry biomass feedstock

Scheme	Complete name
ISCC-EU	International Sustainability and Carbon Certification
FCS	Forest Stewardship Council
SBP	Sustainable Biomass Programme
GGL	Green Gold Label

3.2.6 Process waste and residues biomass

Process waste and residues are only required to meet the socio-economic criteria described in point 3.2.6.1.

3.2.6.1 Socio-economic impacts criteria

The issuer must declare their commitment to the International Labour Organisation (ILO) core labour standards.

3.2.7 Aquatic biomass

Aquatic biomass, examples of which are provided in Table 8, must meet the following two criteria:

- Certification according to one of the schemes included in Table 12; and
- The issuer must also meet socio-economic impacts criteria detailed below in point 3.2.7.1

Table 12. Pre-accepted certification schemes for aquatic biomass feedstock

Scheme	Complete name	Socio-economic criteria
ASC-MSC	Aquaculture Stewardship Council – Marine Stewardship Council	Included
MarineTrust	Marine Ingredients Responsibly Supplied	Included
JAS	Japanese Agricultural Standard	Not included*

*For those certification schemes pre-accepted for aquatic biomass that don't include any socio-economic criteria, the following is required.

3.2.7.1 Socio-economic impacts criteria

The issuer shall meet socio-economic impacts criteria following one of these two options:

OPTION A: Socio-economic impacts certification

The certification schemes include a specific and verifiable module assessing socio-economic impacts (see last column of Table 12)

OPTION B: Commitment to the International Labour Organisation (ILO) core labour standards

The issuer must declare their commitment to the ILO core labour standards.

3.3 Adaptation and Resilience criteria

This section describes the Adaptation and Resilience (A&R) component of the eligibility criteria, which ensure the project/asset is fully resilient to the impact of climate change and can continue to provide the bioenergy product under future climate conditions. To demonstrate compliance, all facilities must satisfy the requirements of the checklist detailed below in Table 13.

The checklist is a tool to verify that the applicant has implemented sufficient processes and plans in the design, planning and decommissioning phases of the facility/facilities to ensure that the operation and construction of the facility/facilities minimises environmental harm and the facility is appropriately adaptive and resilient to climate change and supports the adaptation and resilience of others stakeholders in the surrounding system, if applicable.

All elements of the checklist must be addressed, and appropriate evidence provided that these requirements are being met or are not applicable in respect of the specific facility linked to Certification. It is expected that the applicant's evidence will encompass a range of assessment and impact reports and associated data, including but not limited to those reports required to meet national and local licensing and approval processes. This might include Development Consent Orders, planning regulations adhered to, Environmental Impacts Assessments, Vulnerability Assessments and associated Adaptation Plans.

It is the applicant's responsibility to provide the relevant information to the verifier. Verifiers must include this information in the scope of verification.

For each question in the scorecard:

- A 'yes' indicates sufficient proof given.
- A 'no' indicates insufficient proof.
- In case of a 'n/a', please justify why the question in not applicable.

Table 13. Adaptation and Resilience criteria for facilities producing biomass-based fuels or bioenergy products.

No.	Adaptation and resilience checklist for facilities producing biomass-based fuels or bioenergy products.	Proof Given	Overall Assessment
		For verifier to complete	
1.	**Section 1: Clear boundaries and critical interdependencies between the production facility and the system it operates within are identified.**		
1.1	Boundaries of the infrastructure are defined using: 1. a listing of all assets and activities associated with the use of the bond proceeds, 2. a map of their location, and 3. identification of the expected operational life of the activity, asset or project.		
1.2	Critical interdependencies between the infrastructure and the system within which it operates are identified. Identification of these interdependencies should consider the potential for adverse impacts arising from, but not limited to: 1. The effects of supply disruption or interruption on dependent electricity users or populations; 2. Exacerbation of wildfires; 3. Relationships of the asset/activity to surrounding water bodies and water courses; 4. Relationships of the asset/project to residential neighbourhoods surrounding the plant; 5. Damage or reduction in value of neighbouring property due to boundary structures at risk of falling during storm events; 6. Reduction in value of neighbourhood property due to pollution caused by the chemical facilities, due to extreme weather events (e.g., release of toxic chemicals due to failure in safety systems in case of extreme weather events); 7. Reduction in biodiversity or High Conservation Value habitat;[18] 8. Relationships of the asset/project to nearby flood zones; 9. Fire and other practices that affect air quality; 10. Appropriation of land or economic assets from nearby vulnerable groups;[19]		
2.	**Section 2: An assessment has been undertaken to identify the key physical climate hazards to which the production facility will be exposed and vulnerable to over its operating life**		
2.1	Key physical climate risks and indicators of these risks are identified based on: a) a range of climate hazards, and b) information about risks in the current local context, including reference to any previously identified relevant hazard zones, e.g., flood zones. In order to be confident that assets and activities are robust and flexible in the face of climate change uncertainties, it is essential that the climate risks being assessed and addressed cover those that are of greatest relevance to the production of biomass-based fuels or bioenergy products. • Is there a good understanding of the risks facing the facility today? In five years? In ten years? • Are risks defined and detailed? • Are risk areas for hazardous materials identified?[20] • Was a hazard assessment conducted to identify toxic, flammable, volatile and reactive chemicals? [21,22] • Is there an accident management plan in place? • Time horizon is set according to the severity of the risks. Higher risk locations: shorter time (every 5 years). Lower risk locations: Longer time (every 10 years). • Where accurate assessments of climate variability for specific locations are not possible, use worst-case scenarios. The potential impacts that must be considered in the risk assessment include the ones described in the following sections (2.2-2.9):[23]		
2.2	**Temperature rise and heat waves** 1. Potential increase in temperature may result in expansion and stress of plant, pipework and fittings. 2. There could be an increase in dust emissions from the site. 3. There could be an increase in odour from the site.		

No.	Adaptation and resilience checklist for facilities producing biomass-based fuels or bioenergy products.	Proof Given	Overall Assessment
		For verifier to complete	
	4. Increase in fugitive or diffuse emissions from the site. 5. Increase in pollution. 6. Increase in water consumed for cooling purposes. 7. Increase in energy consumption due to added pumping of cooling water around site. 8. Limited cooling, which implies that throughputs could need to be reduced or processes shut down 9. Volatile chemicals can exceed their temperature range during transportation		
2.3	**Extreme cold weather** 1. Failure of trace heating systems: a) Freezing of cooling water, resulting in blockages - particularly on long pipelines and storage in exposed areas. b) Process failures. 2. Pipework ruptures, affecting: Boiler condensate, process water, cooling water, effluent systems, this in turn may lead to process interruption. 3. Failure of pH control due to caustic systems solidifying (such as effluent treatment). 4. Catalytic processes can be affected, reducing performance. 5. Freezing of coolant lines, equipment, and chemical reaction vessel resulting in rising reaction temperature and pressure. 6. Frozen onsite roadways may restrict access for staff and emergency vehicles. 7. Lack of water for fire suppression. 8. Damage to site infrastructure from snow-loading over extended periods.		
2.4	**Daily extreme rainfall** 1. Flooding could lead to increased site surface water and flash flooding. 2. The site may experience reduced access or egress due to site flooding. 3. Stored substances can react with water or be contaminated. 4. Uncontrolled chemical reactions, for example due to shut down of refrigeration systems as a consequence of power outages and lack of backup facilities. 5. Emergency relief systems, which work at atmospheric discharge pressure can be affected due to the static head of water. 6. Process equipment running hot materials can be affected by thermal stress.		
2.5	**Season rainfall increase** 1. Overland flow or groundwater flooding. 2. Flooding and associated impacts, as previously identified.		
2.6	**Sea level rise** If located near the coast a site could experience increased: 1. Risk of flooding and associated impacts, as previously identified. 2. Corrosion due to increase in saltwater spray. 3. Reduction of useful life of assets due to frequent exposure to salty water.		
2.7	**Drier seasons** 1. Potential increased use or reliance on mains water for dust suppression and cleaning. 2. Potential for increase in dust emissions from the site.		
2.8	**Decreased river flow** 1. Reduced dilution available in receiving watercourse for discharge of effluent, resulting in increased pollution.		
2.9	**Wildfires** 1. Severe damage on buildings, process equipment and industrial infrastructure. 2. Release of toxic pollutants. 3. Volatile organic solvents with low flash points can exacerbate the fire risk. 4. Explosions.		

No.	Adaptation and resilience checklist for facilities producing biomass-based fuels or bioenergy products.	Proof Given	Overall Assessment
		For verifier to complete	
	5. Pipelines for transporting oil and gas, fuel storage facilities, external floating roof tanks for combustible liquids can spread the fire. 6. Supply chain disruption.		
3.	**Section 3: The measures that have or will be taken to address those risks, mitigate them to a level such that the production plant is suitable to climate change conditions over its operational life have been identified and planned if not yet undertaken.**		
3.1	The following **are examples** of risk management activities that bond Applicant might consider, or that might be adopted as part of regulations (e.g., codes and standards).[24] This list is not exhaustive and bond applicant should fully assess the mitigation measures that are relevant to the climate risks and impacts identified in the risk assessment. Measures depend on the specific and local conditions of an asset.		
3.2	**Temperature rise and heat waves** 1. Identify temperature limits that could impact your processes and workers. 2. Regular inspection and preventative maintenance of plant and equipment. 3. Regular site cleaning and use of dust suppression systems. 4. Appropriate odour abatement is in place and maintained effectively. 5. Appropriate odour management plan is in place. 6. Make sure an appropriate fugitive or diffuse emissions plan is in place. 7. Water can be cleaned and recirculated for reuse on site. 8. Alternative cooling systems. 9. Assess how efficient the current cooling system is, and to propose upgrades or modifications where necessary.		
3.3	**Extreme cold weather** 1. Identify temperature limits that could impact your processes and workers. 2. Regularly inspect and maintain insulation, particularly on pipework and equipment in exposed areas of the site. 3. Consider added insulation on pipework containing water review operating procedures to make sure pipework is not left full of static water when not in use identify any potential dead-legs where static water may be held up. 4. Reviewing the capability of caustic systems to remain liquid at expected colder temperatures. 5. Regularly inspect and maintain roadways during winter and remove any standing water. 6. Make sure grit is available to treat road surfaces. 7. Review the design of structures to withstand increased loadings.		
3.4	**Daily extreme rainfall** 1. Suitable measures are in place for the management of expected surface water and flood waters a. Drainage systems are inspected and maintained. b. External areas where wastes are handled or stored are provided with contained drainage. c. The site drainage system and effluent treatment plant has sufficient storage or treatment capacity. 2. Make sure there are suitable alternative transport routes to and from the site.		
3.5	**Season rainfall increase** 1. Make sure suitable measures are in place for the management of anticipated overland flow or groundwater flooding. 2. Prepare flood plan including: a. Risk assessment of process equipment and services at greatest risk from flooding. b. Provision of emergency pumps to remove floodwater and identification of lowest risk location for discharge of floodwaters. c. Protection of control and electrical systems d. Identification and protection of flat bottom tanks at risk of floating in floodwater		

No.	Adaptation and resilience checklist for facilities producing biomass-based fuels or bioenergy products.	Proof Given	Overall Assessment
		For verifier to complete	
	3. Ensure backup power, capable of functioning during extreme weather events and guarantee the stability and safety of the stored chemicals.		
3.6	**Sea level rise** 1. Prepare flood plan including: a. Risk assessment of process equipment and services at greatest risk from flooding b. Provision of emergency pumps to remove floodwater and identification of lowest risk location for discharge of floodwaters c. Protection of control and electrical systems d. Identification and protection of flat bottom tanks at risk of floating in floodwater 2. Prevent corrosion. Measures could include making sure that plant or equipment prone to corrosion are: a. Protected, such as by being painted with resistant coating b. Regularly inspected and maintained		
3.7	**Drier seasons** 1. Measures are in place to review and minimise water use and to maximise collection and use of rainfall a. Mains water capacity is adequate, taking into account reduced availability of rainwater for activities such as dust suppression and cleaning 2. Potential for increase in dust emissions from the site.		
3.8	**Decreased river flow** 1. Review the environmental risk assessment for discharge to water from on-site effluent treatment 2. Check existing environmental risk assessment to make sure low river flow used in assessment remains valid - if not, discuss with Environment Agency (local site inspector and water quality team) and carry out an updated environmental risk assessment		
3.9	**Wildfires** 1. Implement active fire prevention measures such as fire detector, gas detector, design of sprinkler systems, use of line detectors, design of deluge systems, design of gaseous extinguishing systems[29] 2. Implement passive fire protection measures, like permanent inertisation of warehouses, support for pipe racks, fireproofing cabling, use of fire resistance cable coating, protection of tank farms 3. Storage protection measures such as distancing to avoid fires from spreading within an industrial complex 4. Wildland and vegetation management		
4.	**Section 4: The facilities do no harm to the climate resilience of the defined system they operate within, as indicated by the boundaries of and critical interdependencies with that system as identified in item 1 in this checklist.**		
4.1	The facilities themselves do not pose significant risk of harm to the system they are located within or others' natural, social, or financial assets according to the principle of best available evidence during the investment period, taking into account the boundaries and critical interdependencies as defined in item 1 in this checklist. 1. The effects of supply disruption or interruption on dependent electricity users or populations; 2. Exacerbation of wildfires; 3. Relationships of the asset/activity to surrounding water bodies and water courses; 4. Relationships of the asset/project to residential neighbourhoods surrounding the plant; 5. Damage or reduction in value of neighbouring property due to boundary structures at risk of falling during storm events; 6. Reduction in value of neighbourhood property due to pollution caused by the chemical facilities, due to extreme weather events (e.g., release of toxic chemicals due to failure in safety systems in case of extreme weather events); 7. Reduction in biodiversity or High Conservation Value habitat;[25] 8. Relationships of the asset/project to nearby flood zones;		

No.	Adaptation and resilience checklist for facilities producing biomass-based fuels or bioenergy products.	Proof Given	Overall Assessment
		For verifier to complete	
	9. Fire and other practices that affect air quality; 10. Appropriation of land or economic assets from nearby vulnerable groups.[26]		
5.	**Section 5: There will be ongoing monitoring and evaluation of the relevance of the risks and resilience measures and related adjustments to those measures will be taken as needed.**		
5.1	Indicators for risks identified under item 2 in this checklist are provided. • Risk thresholds/trigger levels, for which new adaptation actions are set, are monitored.[27]		
5.2	Indicators for risk mitigation measures identified under item 3 in this checklist are provided. • Determine whether planned outputs and outcomes from adaptation actions have been achieved.[28]		
5.3	Applicants have a viable plan to annually monitor and evaluate: Climate risks thresholds/triggers, climate resilience performance, and appropriateness of climate resilience measure(s) and to adjust as necessary to address evolving climate risks.		

3.4 Entity and Sustainability-Linked Debt Certification

Entities (Bioenergy companies) and sustainability-linked debt (SLD) issued by those entities can be Certified under these Criteria following the overarching Climate Bonds Standard (CBS). [29]

The Bioenergy Criteria detailed in this section can be used to Certify:

- A whole entity (in the case, a bioenergy company, or part of the company producing biomass-based fuels or bioenergy products. See Table 14
- Sustainability-linked debt instruments (SLD) issued by an entity dedicated to the production of biomass-based fuels or bioenergy products. See Table 15

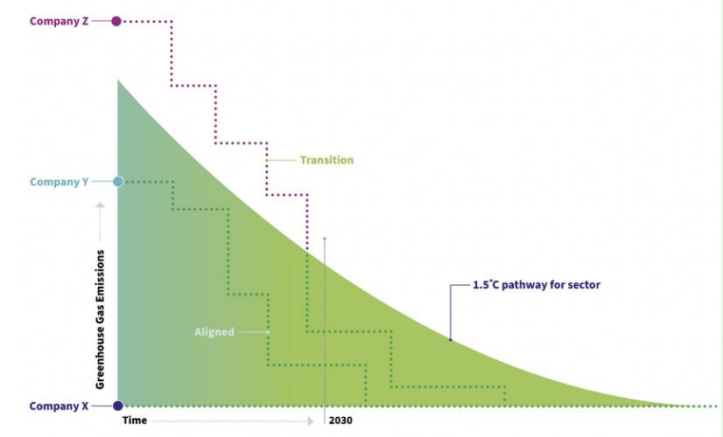
Certification requires compliance with the Climate Bonds Standard Bioenergy Criteria (explained in the sections above). Two levels of Entity Certification are available, depending on when the climate mitigation performance targets align with the Climate Bonds Standard and these Bioenergy Criteria.

See also the Climate Bonds Standard for the cross-sectoral requirements for Entity Certification and SLD Certification relating to transition plans, disclosure for the Certified entity, and requirements relating to the parent group. These cross-sectoral requirements must be met in addition to the specific requirements described here.[30]

Box 2: Two levels of Entity Certification

Two levels of Entity Certification are available, depending on when the Climate Mitigation Performance Targets align with 1.5 degree.

1. Level 1 – "Aligned": The Climate Mitigation Performance Targets align with the Sector Criteria at the time of Certification and thereafter until the date the Climate Mitigation Performance Targets represent net zero emissions or 2050, whichever is sooner,
2. Level 2 – "Transition": The Climate Mitigation Performance Targets do not align with the sector Criteria at the time of Certification but align by 31st December 2030 and thereafter until the date the Climate Mitigation Performance Targets represent net zero emissions or 2050, whichever is sooner.



Source: Climate Bonds

3.4.1 Entity Certification

Table 14. Entity Certification Requirements.

Certification Level	Entity Certification Requirements
Level 1-Aligned	1. At the time of certification, the Certified Entity's bioenergy production facilities average emissions intensity meets the emissions thresholds (calculated on a weighted average basis) and their future Performance Targets to 2050 are projected to continue to meet those declining thresholds; and 2. At the time of certification, every single facility within the Certified Entity has a risk assessment in place that identifies the climate risks and the measures planned or implemented to manage or mitigate those risks (see Section 3.3) which is maintained during of Certification. 3. At the time of certification, all feedstocks used by the Certified Entity meet the sustainability requirements for feedstocks (see Section 3.2). Compliance shall be maintained for duration of Certification.
Level 2-Transition	1. The criteria are the same as for Level 1, except: The Certified Entity's bioenergy production facilities average emissions don not meet the emissions thresholds (calculated on a weighted average basis) at the time of certification, but the future Performance Targets align with those entity-level emissions thresholds by 30 December 2030 and will continue to meet them after that date.

3.4.2 SLD Certification

Table 15. SLD Certification Requirements.

Certification Level	SLD Certification Requirements
Level 1-Aligned	1. At the time of certification, the average emissions intensity of the bioenergy production to which the future Performance Targets of the debt are linked and the future Performance Targets for those facilities align with the emissions thresholds (calculated on a weighted average basis) from now through to 2050; and 2. At the time of certification, every single facility within the issuing entity has a risk assessment in place that identifies the climate risks and the measures planned or implemented to manage or mitigate those risks (see Section 3.3) which is maintained during of Certification. 3. At the time of certification, all feedstocks used by the issuing entity meet the sustainability requirements for feedstocks (see Section 3.2). Compliance shall be maintained for duration of Certification.
Level 2-Transition	1. The criteria are the same as for Level 1, except: At the time of certification, the average emissions intensity of the bioenergy production to which the future Performance Targets of the debt are linked and the future Performance Targets for those facilities align by 30 December 2030 and continue thereafter through to 2050.

Annex I. Non-exhaustive list of biomass-based fuels

Based on the physical state of a biomass-based fuel it can be classified as solid, liquid or gaseous. Table 16 presents a non-exhaustive list of biomass-based fuels sorted on this basis.

Table 16: Non exhaustive list of biomass-based fuels

Kind of biomass-based fuels	Examples
Solid biomass-based fuel	pellets, chips, briquettes, logs, and charcoal
Liquid biomass-based fuel	ethanol, biodiesel, renewable diesel and biojet fuel
Gaseous biomass-based fuel	biogas, biomethane and syngas

Source: adapted from IEA Bioenergy

Annex II. Methodology to include methane emissions in the calculation tools

Methane emissions are included in the LCA-based GHG calculation methodologies. However, fully accounting for fugitive methane emissions from biogas plants remains challenging. Some methodologies do not adequately capture operational emissions, leading to incomplete assessment. The European Commissions has shown that both the RED II default values and estimates commonly used in the literature tend to underestimate methane emissions from biogas and biomethane production.[31]

The criteria require the inclusion of emissions from the downstream stages of the biogas and biomethane value chain and proposes updated emissions factor for them.

Next stages of biogas/biomethane value chain shall be considered for methane emission:

- Feedstock management;
- Biogas/Biomethane plant;
  - Biogas processing,
  - Digestate management,
  - Raw biogas upgrading,
  - Biogas used in CHP;
- Distribution.

The Climate Bonds bioenergy emissions factors for the biogas/biomethane value chain are collected in Table 17.

Table 17. Updated emissions factors for biogas/biomethane value chain.

Updated default emissions factors for biogas/biomethane value chain stages and substages		
Value chain stage	Substage	Emissions factor values (% of the total methane production)
Feedstock management	Storage	0.0%
Plant	Biogas processing	5.0%
	Digestate management. Composting or storage	2.2% (silage) 2.5% (biowastes)[a] 10.0% (manure)
	Storage with RMP[b] measurement below the proposed default emission factor for standard digestate management	0.75·RMP
	Raw biogas upgrading	0.2[c] / 1.0[d]/ 3.0%
Plant. Biogas use in CHP	Slippage of methane in the exhaust gas	
Distribution	Piping, maintenance, leaks	1.5%

a. Including sewage sludge from industrial wastewater treatment plants (sludge from municipal wastewater treatment plants is excluded from this Climate Bonds Criteria).
b. Remaining methane potential.
c. Technologies certified by the provider or measured to have <0.2% of produced methane in the off-gas.
d. Technologies certified by the provider or measured to have <1% of produced methane in the off-gas.

However, when these default values are included in the LCA GHG calculation, they may prevent a facility from meeting the Criteria. For this reason, and in line with EU-funded initiatives and national programmes, the implementation of LDAR programmes has demonstrated positive results, helping to address unavoidable methane leaks and reduce overall emissions through the systematic application of best practices. The emissions factors associated with the best practices if methane emissions are not directly measured are shown in Table 18.

Table 18. Emissions factors associated to best practise in the biogas/biomethane value chain

Emissions factors associated to best practices in the biogas/biomethane value chain		
Value chain stage	Substage	Emissions factor values (% of the total methane production)
Feedstock management	Storage	0.0% + access to credits[a]
Plant	Biogas processing	0.5%
	Digestate management. Composting or storage	0.1%
	Storage with RMP[b] measurement below the proposed default emission factor for standard digestate management	0.25·RMP
	Raw biogas upgrading	0.0%
Plant. Biogas use in CHP	Slippage of methane in the exhaust gas	1.7%
Distribution	Piping, maintenance, leaks	0.0%

a. The application of good practices allows the application of credits for avoided emissions.
b. Remaining methane potential.

Climate Bonds Bioenergy Criteria propose three options for life cycle methane emissions accounting to be included in the LCA GHG emissions:

Option A – The use of actual values resulting from measurements and quantification of emissions made by an independent third-party.

Option B – The use of the default values given in Table 17 and Table 18. The use of a default values associated with best practices (Table 18) is conditional on the use of the corresponding "best practice" also given in Table 19.

The use of other default values for methane emissions in biogas or biomethane value chain is not a viable option, except for the credits coming from emissions savings for improved agricultural management (included in the LCA GHG emissions accounting).

Option C – The use of a mix of actual and default values. The use of default values is affected by the same rules described in option B.

Best practices detailed in Table 19 were extracted from the best practices reported by Joint Research Centre of the European Commission and the Danish Energy Agency. [32,33]

Table 19. Best practices in biogas and biomethane value chain

Stage	Substage/Process		Best practice
Feedstock management. *	Storage		Closed Systems
			Rapid Substrate Turnover
			Thermal Suppression
Biogas/Biomethane plant.	General requirement		Follow a certified voluntary leakage detection and repair (LDAR) program. The minimum requirements for this LDAR are listed in Annex IV.[34]
	Biogas processing		Automatically activated flare connected to all pressure release valves and venting systems
	Digestate management	Composting	The whole process is carried out in a fully enclosed and controlled environment. It includes actively aerated cells, direct mixing and cooling of digestate with the substrate immediately after it exits the air-tight section, and monitoring and measurement of methane content in the off-gas.
		Storage	Keeping the feedstock or digestate in an airtight environment (combined time in digester and closed digestate storage) for at least 50 + x days, where "50" represents the minimum retention time of 50 days and "x" is the number calculated as additional 2 days for each mass percent of non-manure-based feedstock (max 150 days).
		Storage with RMP measurement below the proposed default emission factor	The temperature inside the digestate storage remains below 20 °C during the whole storage period.
	Raw biogas upgrading		Off-gas oxidation: combustion of off-gas is performed; or
			No off-gas emitted: the CO2 separated from the biogas is captured and no off-gases are released.
Distribution	Piping, maintenance, leaks		Follow a certified voluntary leakage detection and repair (LDAR) program. The minimum requirements for this LDAR are listed in Annex IV.[35]

*Annex II describes the criteria for these best practices

Annex III. Criteria for compliance with best practices in the feedstock substage of the biogas/biomethane value chain

For biomass feedstock that can be naturally digested, namely, biomass feedstock to be used for biogas/biomethane:[36,37]

Table 20. Criteria for compliance with methane best practices

biomass	Description	Criteria
Closed Systems	Implementation of physically enclosed infrastructure (tanks and piping) to prevent the direct interface between substrate and atmosphere.	Design must ensure confinement via fixed covers or sealed piping. Systems should be configured to prevent operational venting (e.g., through gas-balancing lines or equivalent pressure-control measures).
Rapid Substrate Turnover	Operational protocol ensuring slurry is quickly moved to the foretank and quickly sent to processing.	Maximum Hydraulic Residence Time (HRT) in upstream stages < 24 hours. Storage must be managed or designed to ensure full discharge, avoiding the accumulation of stagnant sludge or sediments.
Thermal Suppression	Maintenance of substrates at low temperatures to inhibit the biological onset of methanogenesis.	Substrate temperature maintained < 20 °C during the upstream storage and handling phase.

Annex IV: Minimum requirements for Methane Leak Detection and Repayment (LDAR) system

Adapted from recommendations by European Biogas Association (2020) and European Commission, Joint Research Centre. [38,39]

Table 21: Minimum requirements for Methane Leak Detection And Repayment (LDAR) system Checklist for evaluating the issuer's adaptation and resilience performance in respect of a bioenergy facility

Area	Minimum Requirement
Ownership and purpose of the voluntary system	The voluntary system should have a clear ownership. The voluntary system should have a clear purpose.
System boundaries	The accepted boundaries of the system should be well described.
Performing leak detections	Self-control should be the focus of leak detection. Install detection systems for increased indoor methane concentrations and for pressure relief valve openings. Third-party revision for credibility is required.
Quantifying emissions	At least one monthly visual inspection (with no detecting instruments) of high-risk components (pressure relief valve, moving components). At least once a year regular leak detection (and quantification) by an external professional. The methods to quantify emissions should be well described.
Remedying of found leaks	A maintenance and repair plan defining the intervals when components need maintenance and how to repair components that show leaks. If the leaks exceed 2% of the annual production or 50 tonnes per year, a mandatory repair should be scheduled, and an additional test, within 6 months of the leak detection should confirm the effectiveness of the repair.
Reporting of emissions data	A documentation system to report each inspection, leak detection, maintenance and repair. There should be an easy access to annual or periodical results with benchmark possibilities. Short term and long-term goals on leak detection performance and emission reduction should be set.
Knowledge buildup and skills development	Training courses for introducing and maintaining leak detection programs should be organized or a written best management practice document available.

Annex V: TWG and IWG members

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* Participation in IWG meetings does not necessarily reflect endorsement of the criteria and serves to provide critical feedback on the usability-focused consultation process.

End-notes

[1] International Energy Agency
[2] Food and Agriculture Organization of the United Nations (FAO).
[3] Sustainable Biomass Programm. Working Paper. The Cascading Principle. Considerations on guidance and options for applying the Cascading Principle through SBP Standards.
[4] Climate Bonds Initiative Standard. Climate Bonds Standard | Climate Bonds
[5] Use-of-Proceed (UoP) is used as a shorthand throughout this document for a variety or targeted finance instruments, including green loans, repos and assets-backed securities. Annex I of the Climate Bonds Standards v4.3 details the full list of instruments that can be certified.
[6] Climate Bonds Initiative Standard. Climate Bonds Standard | Climate Bonds
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[13] Roundatable on Sustainable Biomass (RSB). GHG Calculator Tools. http://rsb.org/services-products/ghg-calculator/
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[17] Joint Research Centre, Buffi, M., Hurtig, O. and Scarlat, N., Methane emissions in the biogas and biomethane supply chains in the EU, Publications Office of the European Union, Luxembourg, 2024, JRC139485.
[18] High Conservation Value (HCV) habitat criteria in accordance with www.hcvnetwork.org
[19] According to IFC Performance Standards
[20] Hazardous materials include Explosive, flammable, combustible, corrosive, oxidising, toxic, infectious, or radioactive materials (Federal Emergency Management Agency)
[21] UCLID (International Uniform Chemical Information Database) software is a recommended source of data on intrinsic and hazard properties of chemical substances
[22] www.openaccessgovernment.org/climate-toxicology-human-health/68647
[23] Chemical Industries Association, 2021. Safeguarding chemical businesses in a changing climate. How to prepare a Climate Change Adaptation Plan
[24] Ibid.
[25] High Conservation Value (HCV) habitat criteria in accordance with www.hcvnetwork.org
[26] According to IFC Performance Standards
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[31] Joint Research Centre, Buffi, M., Hurtig, O. and Scarlat, N., Methane emissions in the biogas and biomethane supply chains in the EU, Publications Office of the European Union, Luxembourg, 2024, JRC139485.
[32] Ibid.
[33] Ramboll, Scheutz, C., Pattern, J., Hinge, J., & Petersen, S. (2021). Targeted efforts to reduce methane loss from Danish biogas plants (Report No. 4.0). Danish Energy Agency
[34] Adapted from European Biogas Association (2020). Minimum requirements for European voluntary systems for self and external inspection of possible methane emissions on biogas and biomethane plants. EvEmBi Project Consortium; and European Commission, Joint Research Centre, Buffi, M., Hurtig, O. and Scarlat, N., Methane emissions in the biogas and biomethane supply chains in the EU, Publications Office of the European Union, Luxembourg, 2024.
[35] Ibid.
[36] Ibid.

[37] Ramboll, Scheutz, C., Pattern, J., Hinge, J., & Petersen, S. (2021). Targeted efforts to reduce methane loss from Danish biogas plants (Report No. 4.0). Danish Energy Agency

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