Electrical Utilities Criteria

Climate Bonds Standard and Certification Scheme

Draft for public review

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

Revision	Date	Summary of Changes
Rev. 1.0	March 2024	Issue for Certification
Rev. 0.1	December 2023	Issue for Public Consultation

Climate Bond Certified

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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. Sustainable debt issuance as of end of year 2023 was on the order of USD5.5 tn (with 4.4 tn aligned) and 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.

1.2 Environmental scope of the Electricity Utilities Criteria

Currently, Certification requirements address:

- Climate change mitigation; and
- Climate adaptation and resilience.

1.3 What can be Certified under the Electricity Utilities Criteria

The following can be Certified under these Criteria following the update of the overarching Climate Bonds Standard:

- Entities (electrical utilities) and sustainability-linked debt (SLD) issued by those entities under Section 3;
- Use-of-proceeds (UoP) bonds financing mitigation measures (e.g., carbon capture and storage (CCS), carbon capture utilisation and storage (CCUS), and co-firing) under Section 4.

The Climate Bonds Standard provides any cross-sectoral requirements for UoP, SLD, asset or entity Certification which must be met in addition to the electrical utilities-specific requirements described in this document.

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

Electrical utilities-specific information to support applicants and verifiers is available at Electrical Utilities Climate Bonds Initiative as follows:

- *Electrical Utilities Background Paper* detailing how the criteria were chosen,
- *Electrical Utilities Frequently Asked Questions* (FAQs),
- *Electrical Utilities 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,
- The Climate Bonds Standard v4.1 Entity and Sustainability-Linked Debt Checklist documents provide further information on the cross-sectoral requirements for entity and SLD Certification respectively.

For more information on Climate Bonds and the Climate Bonds Standard and Certification Scheme, see www.climatebonds.net.

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 ***Appendix D***.

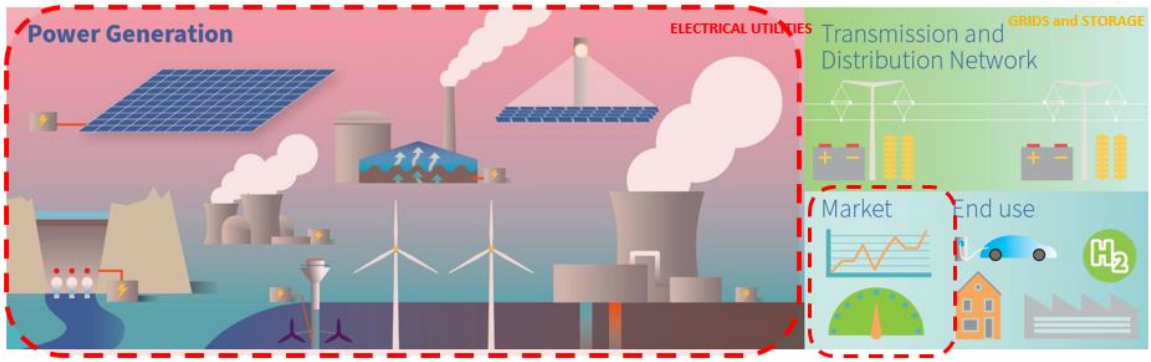
Special thanks are given to ***Dr Ana Díaz Vazquez***, the global energy transition Head at Climate Bonds, and ***Francisco Moreno Castro,*** the energy analyst, for coordinating the development of the Criteria through the Technical Working Group.

2 Electrical Utilities activities in scope

Electricity generation systems are now the largest source of global greenhouse gas (GHG) emissions, accounting for over 40% of energy-related CO_2 emissions.[1] Their transformation over the coming decades plays a crucial role in the decarbonisation of the global economy as low-carbon electricity is essential for decarbonising transport, industrial and buildings sectors via end-use electrification.

2.1 Electricity supply chain in scope

These Criteria apply to eligible electrical utility entities with transition plans. The criteria cover the electricity generation segment of the overall electricity supply chain (framed in red in Figure 1) and the entity's electricity purchased from the grid for distribution or trading in the market. The rest of the power sector supply chain is partially or wholly covered by other sector Criteria (under Section 2.2).



Source: Climate Bonds Initiative

Figure 1: Simplified representation of the power system value chain covering generation, distribution, and supply.

Applicants for Certification must meet the compatible **emission intensity transition pathway** of the sector-specific Criteria, referred to in Section 3.1.1.

In the power sector, the specific measure of emission intensity is the GHG emissions emitted per unit of electricity produced. This is referred to as the **average entity's emission intensity and** must include the direct combustion emissions of the electricity generation portfolio**,** and the emissions resulting from activities such as the electricity purchased for distribution or trading in the market, see Table 1. The Electrical Utilities Criteria also include compatible emission intensity thresholds for non-combustion emissions associated with renewable electricity generation.

[1] International Energy Agency, 2023, www.iea.org/energy-system/electricity

Table 1: Entity-level climate mitigation performance indicators and assessment versus Climate Bonds Standard sector-specific Criteria.

Entity Climate Mitigation Performance Indicator	Emissions assessment	Climate Bonds Standard sector-specific Criteria
Average entity's Emissions intensity	Direct CO_2 combustion emissions and emissions related to purchased electricity	CO_2 emission intensity transition pathway, Section 3.1.1
Life-cycle assessment (LCA) of low-carbon electricity generation emission	Non-combustion emissions Cross-cutting Criteria, Section 5	CO_2e emission intensity thresholds for renewable electricity generation supply chain, Section 3.1.2 and Section 3.1.3
Cofiring and CCS/CCUS	CO_2 leakage control and monitoring Cross-cutting Criteria for low-carbon fuels and biomass, Section 5	Capture and cofiring rate thresholds Section 3.1.2
Date to phase out fossil electricity generation and trading		Benchmarks for fossil electricity generation and trading phase-out, Section 3.1.2

Source: Climate Bonds

To cover important emissions not related to electricity, the Electrical Utilities Criteria stipulates the incorporation of a commitment by the parent company on behalf of the parent group to zero future expansion of fossil fuel activities, covering the exploration, extraction, transport, and refining of fossil fuels after 1 January 2023 as well as a commitment by the parent company of behalf of the parent group to phase-out the trading in fossil fuels by 2040 at the latest. (See Table 2)

Specifically, if any legal entity within the parent group is in the business of the exploration or extraction of fossil fuels or is a utility company generating or supplying power or heat generated from fossil fuels, the parent company has, within the last year, publicly (re)committed to no expansion of any of the following activities across the parent group after 1 January 2023:

(i) The exploration and extraction of proven conventional and unconventional fossil fuel reserves;

(ii) The exploration of new conventional and unconventional fossil fuel resources;

(iii) Natural gas production;

(iv) Refining crude oil to produce derivate products;

(v) The supply and/or use of fossil fuels for power generation and heat;

The commitment includes that trading for speculative activities is not allowed by the company or the parent group and a commitment to cease other fossil fuel trading activities is required for certification. The thresholds for the termination of fossil fuel trading are summarised in Table 2:

Table 2: Commitment for exit the fossil hedging or retail business.

Thresholds for exit the fossil fuel business		Advanced economies[2]	Emerging economies[3]
COAL	Phasing-out trading business	2035	2040
FOSSIL GAS	Phasing-out trading business	2040	2040
OIL	Phasing-out trading business	2035	2040

Source: Climate Bonds

[2] Advanced and emerging economies follows the definition of the IEA

[3] Advanced and emerging economies follows the definition of the IEA

The electricity supply chain in scope is summarised in Table 3. Heat production is excluded from the criteria. Emissions generated from combined heat and power (CHP) plants are allocated according to the GHG Protocol methodology efficiency method (see Box 3).[4]

Table 3: Business segments of the electricity supply chain in scope for the Criteria.

Business segment of the electricity supply chain	Eligible entities or section of the entity	Emissions scope considered
Electricity generation	The electricity generation portfolio	Scope 1 direct combustion fossil fuel emissions Scope 1 non-combustion emissions for hydropower and geothermal electricity generation Scope 3 for biomass electricity generation
Electricity purchased	The electricity purchased from the grid for distribution or trading in the market	Scope 3 for electricity purchased from the grid for distribution or trading in the market
Fossil fuel activities other than electricity production	Commitment to no expansion of exploration, extraction, transport, or refining of fossil fuels. Commitment of phasing-out trading of fossil fuels.	Scopes 1, 2, and 3

Source: Climate Bonds

In addition, the Criteria incorporate eligible mitigation measures for fossil fuel electricity generation aimed at decarbonising fossil fuel generation, listed in Table 4 below.

Table 4: Electrical Utilities Criteria mitigation measures

Power plants	Eligible Mitigation measures	Thresholds
Coal and Gas	CCS for CO_2 capture, transport, and storage CCUS for CO_2 capture, transport, and utilisation	Capture rate 90% Cross-cutting Criteria for CO_2 leakages and storage Utilisation Criteria
	Cofiring with low-carbon synthetic fuels comprising liquid and gaseous biofuels, hydrogen, and hydrogen-derived fuels Cofiring with solid biomass	Cofiring rate 100% Cross-cutting criteria for cofiring low-carbon fuels Cross-cutting Criteria for cofiring with biomass

Source: Climate Bonds

2.2 Alignment with other sector Criteria

Climate Bonds has developed Sector Criteria which cut across the electricity supply chain, the most relevant of which are summarised in Table 5.

[4] Allocation of GHG emissions from a combined heat and power (CHP) plant. WRI/WBCSD. September 2006. (Protocol, 2006)

Table 5: Assets or projects partially or wholly covered by other sector Criteria.

Section of the Electrical Utility supply chain	Covered by other Sector Criteria	Climate Bonds Criteria
Low carbon fuel transportation	Low-carbon gas transport by ship Low-carbon gas pipeline transportation Low-carbon gas transport by truck	Hydrogen Criteria
Electricity transmission and distribution network	Electricity grids	Electrical Grid and Storage Criteria
Storage facilities	Electricity storage	Electrical Grids and Storage Criteria
End-users	Use of electricity in other sectors	Steel, Cement, Basic Chemicals, Transport, Agriculture Criteria
Low-carbon fuels	Hydrogen, ammonia, biomass for electricity production	Hydrogen, Waste management, and Bioenergy Criteria
Renewable electricity generation facilities	Solar, wind, marine, hydropower, geothermal and bioenergy	Solar, Wind, Geothermal, Hydropower, Bioenergy and Marine Criteria.

Source: Climate Bonds

3 Electrical Utilities entity and sustainability-linked debt Certification

The electricity generation-specific Criteria detailed in this section can be used to certify:

- A whole entity (in this case, a business segment or part of the company producing, purchasing and trading electricity (under Section 3.1);
- SLD issued by an entity dedicated to producing, purchasing, and trading electricity (under Section 3.2).

Sections 3.1.1, 3.1.2 and 3.1.3 contain methodological notes applicable to these Criteria.

See also the Climate Bonds Standard for the cross-sectoral requirements for entity and SLD Certification relating to transition plans, disclosure for the Certified entity, and requirements relating to the parent group (if any). These cross-sectoral requirements must be met in addition to the electrical utility-specific requirements described here.

> ***NOTE:*** *Current proposals allow for the Certification of part of a company or group of companies, or SLD, that relate to part of a company or group of companies (see the Climate Bonds Standard for full details). This flexibility enables Certification of the part of a company or group of companies relating to electricity generation, separate from the Certification of other group or company activities of which it forms a part.*

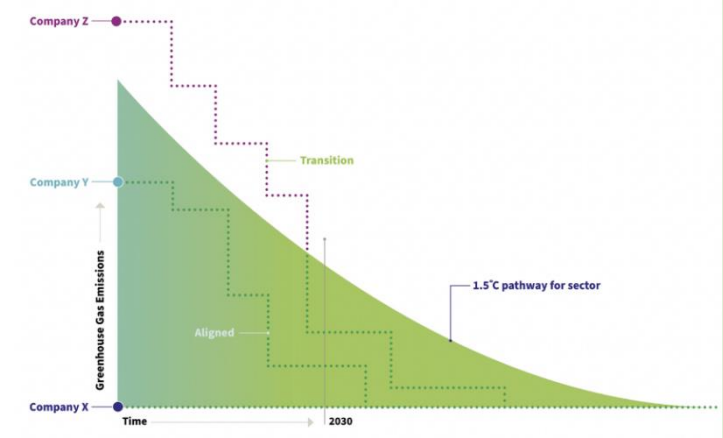
3.1 Electrical Utilities Criteria for entity Certification

Certification requires compliance with the Climate Bonds Standard Sector Criteria. Two levels of entity Certification are available, and depend on when the climate mitigation performance targets align with the Climate Bonds Standard Sector Criteria (see Box 1 and Climate Bonds Standards).

Box 1: 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.



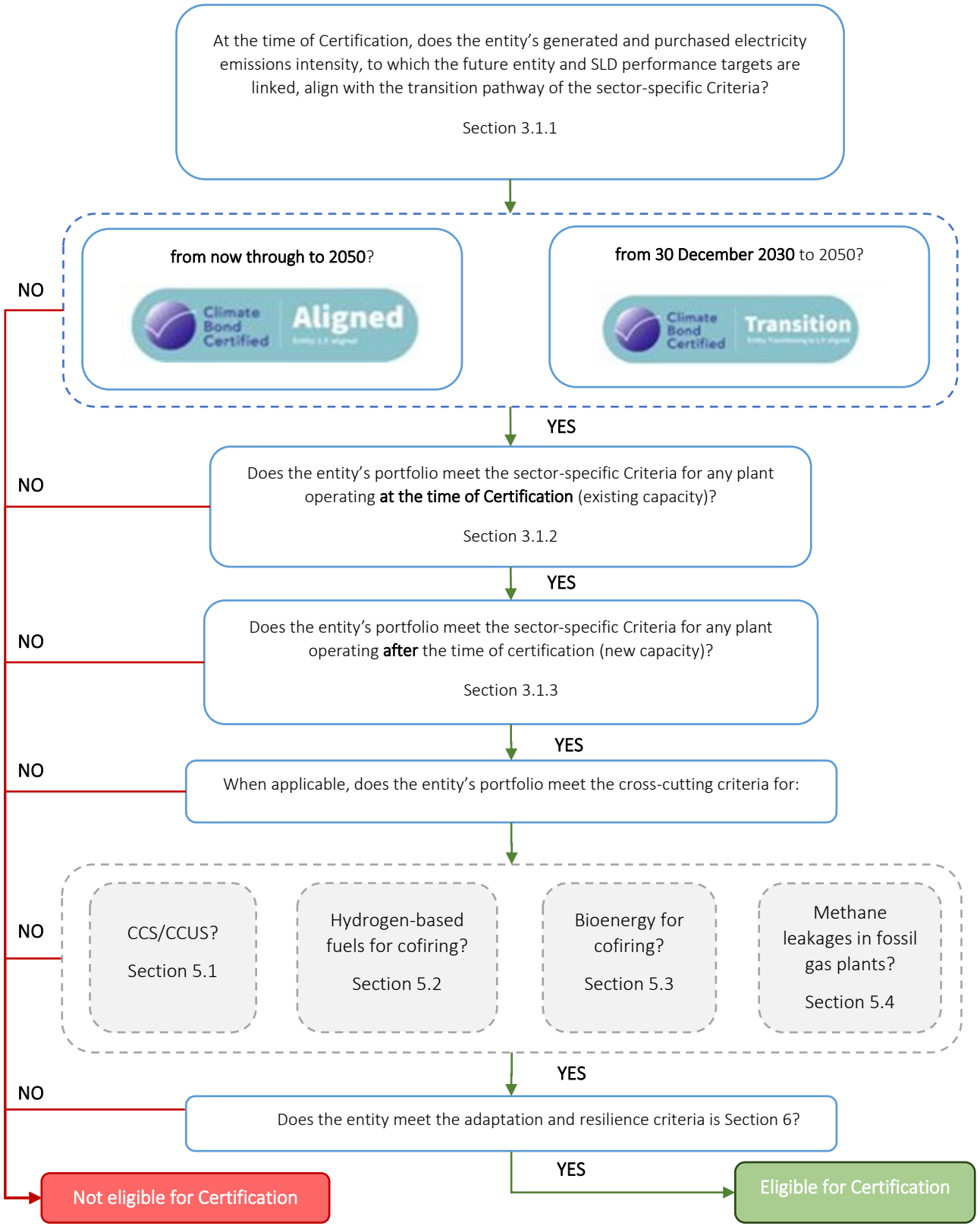
Source: Climate Bonds

Table 6: Tiered Entity Certification.

Entity Tier	Entity Certification Requirements
Tier 1: Aligned	**Climate Mitigation Criteria** 1. At the time of Certification, the entity's average emission intensity meets the sector-specific Criteria transition pathway, and its future **climate mitigation performance targets** continue to align with the transition pathway through to 2050, see Section 3.1.1; 2. At the time of Certification, all the entity's existing capacity meets the sector-specific Criteria for existing capacity, including any plant operating at the time of certification, see Section 3.1.2; 3. At any time after the Certification date, all the entity's new capacity meets the sector-specific Criteria for new capacity, from the first day of commencing operation, including any plant becoming operational post Certification date, see Section 3.1.3; 4. At the time of Certification, and at any time thereafter, all the entity's facilities using CCS/CCUS meet the cross-cutting Criteria for CO_2 transport, storage, and utilisation, see Section 5.1; 5. At the time of Certification, and at any time thereafter, all the entity's facilities using hydrogen and biomass meet the cross-cutting Criteria in Sections 5.2 and 5.3; 6. At the time of Certification, and at any time thereafter, all the entity's facilities using fossil gas meet the cross-cutting Criteria for methane leakages in Section 5.4. **Adaptation and Resilience Criteria** 1. The Certified entity meets the Adaptation and Resilience Criteria described in Section 6, which is reassessed and reconfirmed every five years.
Level 2: Transitioning	The Criteria are the same as for Level 1, except: The Certified entity's average emission intensity does NOT meet the sector-specific Criteria transition pathway at the time of Certification, but the future performance targets align by 30 December 2030 and continue to align thereafter through to 2050. See Section 3.1.1.

Source: Climate Bonds

Figure 2 shows how Certification requires an entity not only to meet the transition emission intensity pathway of the sector-specific Criteria (Section 3.1.1) but also the different generation technologies must comply with the sector-specific Criteria thresholds for existing (Section 3.1.2) and new capacity (Section 3.1.3), thereby aligning the entity's global emissions with the goals of the Paris Agreement.



Source: Climate Bonds

Figure 2: Sector-specific Criteria for entity Certification.

3.1.1 Transition pathway for sector-specific Criteria

Certification at entity-level requires a comprehensive assessment of GHG emissions which must comply with the sector-specific Criteria. This includes a compatible CO_2 emission intensity transition pathway for the power sector (see Table 7) allowing the transition to net-zero emissions by 2040, aligned to the goal of limiting global warming to 1.5-degrees Celsius (IEA, update 2023).[5] (Discussions and assumptions to set this pathway can be found in the Electrical Utilities Background Document referred to in 1.4).

Table 7: The emission intensity transition pathway for the Electrical Utilities Criteria

Transition pathway of the sector-specific Criteria						
Year	2025	2030	2035	2040	2045	2050
Emissions Intensity (gCO_2/kWh)	460	186	48	3	0	0

Source: Climate Bonds, based on IEA data **(IEA, update 2023)**

To be Certified, the entity's average emission intensity needs to align with this sector-specific Criteria transition pathway by 2030 at the latest (for a worked example of how to meet the target see Box 2). This must be calculated following the GHG Protocol, (Gillenwater, 2005), detailed below:

- Scope 1 direct emissions: GHG Protocol for direct emissions from stationary combustion.[6] See Box 3;
- Scope 3 emissions related to the electricity purchased by the entity, which is calculated following the **location-based method** of the GHG Protocol to reflect the average emission intensity of grids on which energy consumption occurs. [7] This involves multiplying the country-specific emission factors, reflecting the average emissions intensity of the grid, by the amount of energy purchased;
- If CHP plants are included in the entity's generation portfolio, total emissions should be allocated both to heat and power. The GHG Protocol describes several methods for this, but the Energy Utilities Criteria suggest the efficient method, shown in Box 3.[8]

Direct CO_2 emissions from the combustion of biomass are not included in scope 1. Negative emissions can be included in the entity's net average emission intensity only when electricity generation from biomass power plant includes CCS/CCUS technologies (BECCS).

[5] Carbon dioxide accounts for the majority of greenhouse gas emissions from most stationary combustion units. When weighted by their Global Warming Potentials (GWPs), CO_2 typically represents over 99 percent of the greenhouse gas emissions from the stationary combustion of fossil fuels. (Potential exceptions include CH4 from open burning processes and N_2O from some engines with catalytic NOx emissions controls)

[6] Calculation Tool for Direct Emissions from Stationary Combustion. WRI/WBCSD. July 2005. (Gillenwater, 2005)

[7] GHG Protocol Scope 2 Guidance. WRI (Sotos, 2015)

[8] Allocation of GHG emissions from a combined heat and power (CHP) plant. WRI/WBCSD. September 2006. (Protocol, 2006)

Box 2: Example for how to meet the Electrical Utilities Criteria transition pathway.

Applicants for entity Certification should meet the Climate Bonds Standards:

- Time horizon targets: the climate mitigation performance targets cover the time from the date of Certification to the date the activity is intended to reach net-zero emissions, or 2050, whichever is sooner;
- Interim climate mitigation performance targets: the climate mitigation performance targets include interim targets on a three-yearly basis for the nine years following the date of Certification and a five-yearly basis thereafter over the full-time horizon;
- Alignment with the Electrical Utilities Criteria transition pathway described in Section 3.1.1, where the climate mitigation performance targets are benchmarked against the transition pathway and align with it by 31 December 2030 at the latest.

A linear trajectory should be assumed for time periods between the dates and thresholds provided:

Example: Compliant

An entity applying for Certification in 2024 with the following climate mitigation performance targets.

Climate Mitigation Performance Targets						
Year	**2024**	**2027**	**2030**	**2033**	**2038**	**2043**
Average emission intensity (gCO_2/kWh)	564	350	170	50	10	0

Compared against the sector transition pathway.

Sector Specific Criteria						
Year	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Average emission intensity (gCO_2/kWh)	460	186	48	3	0	0

The entity's Certification tier is classified as **Transition** because:

- At the time of Certification, the entity's average emission intensity is higher than the sector-specific Criteria values; but;
- In 2030 the entity is aligned with the transition pathway; and
- Remains aligned until the end of the Certification time horizon.

An annual verification report from an approved verifier is required to maintain the Certification.

To be certified, an entity must also address **non-combustion or indirect emission** Criteria, which include thresholds for different generation technologies (detailed in Sections 3.1.2 and 3.1.3).because they are not included in the entity's average emission intensity. Hence, non-combustion or indirect emissions must be integrated in the entity's climate mitigation performance targets, depending greatly on regional and technology variants.[9] Furthermore, as the electricity mix is decarbonised, indirect emissions will become an increasingly important part of power sector emissions. Therefore, non-combustion or indirect emissions need to be addressed in order to achieve near-zero power sector emissions targets.

[9] Nature Energy, Articles. Understanding future emissions from low carbon power systems. (Michaja Pehl, 2017)

Box 3: Example of accounting and reporting CO_2 direct emissions for combustion, following GHG Protocol methodology.

GHG Protocol suggest two methodologies to measure direct combustion emissions:

- Direct measures of the mass of CO_2 in the exhaust gas, usually as continuing emissions monitoring (CEM);
- **Calculation of CO_2 emissions based on proxy data.**

GHG Protocol recommends the calculation-based method for estimating CO_2 emissions due to cost and practicality reasons.

Calculation-based methods require data from:

- **Fuel consumption;**
- **Emissions factors.**

An example of an equation based on fuel consumption data:

Equation 1: Calculation based method for CO_2 emissions

$$E = A_{f,v} \cdot F_{c,v} \cdot F_{ox} \cdot (44/12) \quad \text{or} \quad E = A_{f,m} \cdot F_{c,m} \cdot F_{ox} \cdot (44/12) \quad \text{or} \quad E = A_{f,h} \cdot F_{c,h} \cdot F_{ox} \cdot (44/12)$$

Where,

E =	Mass emissions of CO_2 (short tons or metric tons)
$A_{f,v}$ =	Volume of fuel consumed (e.g., L, gallons, ft^3, m^3)
$A_{f,m}$ =	Mass of fuel consumed (e.g., short tons or metric tons)
$A_{f,h}$ =	Heat content of fuel consumed (GJ or million Btu)
$F_{c,v}$ =	Carbon content of fuel on a volume basis (e.g., short tons C/gallon or metric tons C/m^3)
$F_{c,m}$ =	Carbon content of fuel on a mass basis (e.g., short tons C/short ton or metric tons C/metric ton)
$F_{c,h}$ =	Carbon content of fuel on a heating value basis (e.g., short tons C/million Btu or metric tons C/GJ)
F_{ox} =	Oxidation factor to account for fraction of carbon in fuel that remains as soot or ash
(44/12) =	The ratio of the molecular weight of CO_2 to that of carbon

Note: Activity data and carbon content factors should be in the same basis (i.e., volume, mass, or energy). For gaseous fuel quantities in terms of volume, care should be taken to ensure all data are on a consistent temperature and pressure basis.

Source: GHG Protocol (Gillenwater, 2005)

Other emissions factors can lead to different equations. GHG Protocol also provides direct CO_2 emissions factors to fuel consumption by type of fuel.

Average emission intensity for the entity climate performance targets

To calculate the average emission intensity, the total CO_2 emissions (from generation and related to electricity purchased) are divided by the total electricity of the entity (generated and purchased). In the example, CO_2 emissions from generated electricity are calculated through emissions factors. Low-carbon electricity generation, including nuclear, solar, wind, hydropower, bioenergy and marine, account for 0 gCO_2/kWh in direct combustion emissions.

CO_2kWh for electricity generation =

$$= \frac{\sum_{fuels} \langle (Input_{Electricity\ plants} + Input_{CHP\ plants/Ele} + Own\ use_{Plants/Ele}) \times EF_{fuel} \rangle}{Ele_{Inland}}$$

Where:

- CO_2kWh : Carbon factors (in CO_2/kWh) calculated at the generation point
- $\sum_{fuels}$: Sum over the fuels.
- $Input_{plants}$: Fuel input into the plants (both main activity and autoproducer) expressed in energy unit.
- $Input_{CHP\ plants/Ele} = Input_{CHP\ plants} - \frac{Heat\ output}{\eta_{heat}}$
- η_{heat} efficiency of heat generation - assumed to be 0.9 (*i.e.* 90%) except when the observed efficiency of CHP generation is higher than 90%, in which case emissions are allocated using the proportionality approach ($EFF_{HEAT} = EFF_{ELEC} = EFF_{CHP}$).
- $Own\ use_{Plants/Ele} = Own\ use_{Plants} \times \frac{Total\ electricity\ output}{Total\ electricity\ output + Total\ heat\ output}$
- EF_{fuel} : default emission factors as provided in the *2006 IPCC Guidelines*.
- Ele_{Inland} :
  - For the total emission factor: includes the generation from all sources (i.e. as well the non-emitting sources).
  - For the emission factors by fuel (oil, coal, gas, non-renewable waste and Memo: biofuels): includes only the electricity generated by the corresponding fuel.

Source: IEA (Emissions Factors 2021)

Box 4: Example of how to allocate emissions to electricity from CHP power plants following GHG Protocol methodology.

GHG Protocol details several methods to assign emissions to the electricity generated in a CHP plant, the most common of which are:

- Efficiency method;
- Energy content method;
- Work potential method.

The **efficiency method** is preferred for the *Allocation of GHG emissions from a combined heat and power (CHO) plant* document. Steps detailed in this document are:

- 1. Determine the total direct emissions and the total steam and electricity outputs for the CHP systems (as detailed in Box 3);
- 2. Estimate the efficiencies of steam and electricity production;
- 3. Determine the fraction of total emissions to allocate to steam and electricity production.

$$E_H = \frac{H/e_H}{H/e_H + P/e_P} * E_T \qquad \text{and} \qquad E_P = E_T - E_H$$

where:

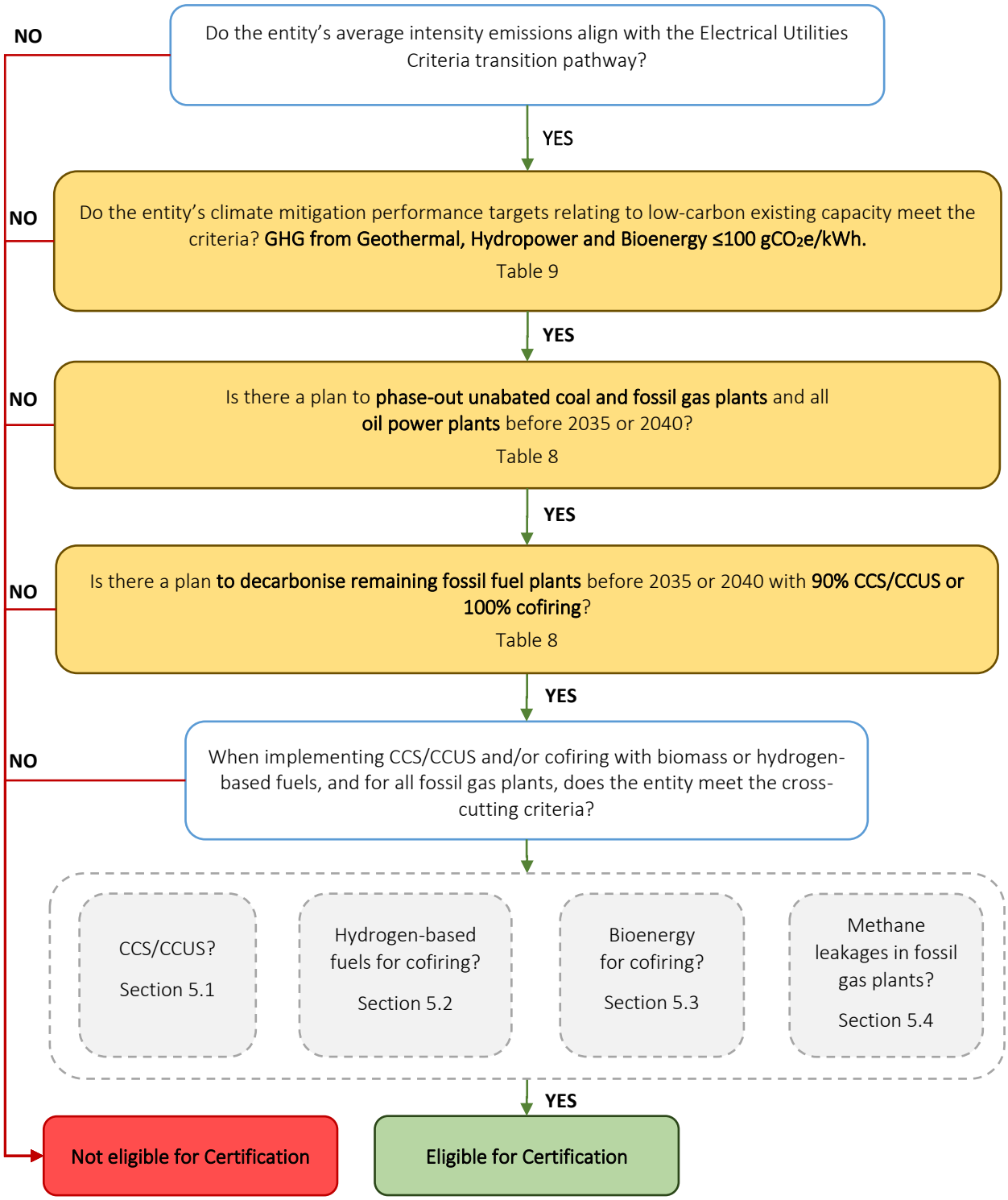
E_H	=	emissions allocated to steam production
H	=	steam output (energy)
e_H	=	assumed efficiency of steam production
P	=	delivered electricity generation (energy)
e_P	=	assumed efficiency of electricity generation
E_T	=	total direct emissions of the CHP system
E_P	=	emissions allocated to electricity production

Source: GHG Protocol (Allocation of GHG emissions from a CHP Plant. 2006)

- 4. Calculate emission rates for steam and electricity production dividing the total emissions from electricity production by the total amount of electricity produced to get an emission rate.

3.1.2 Criteria for facilities operating at the time of Certification (existing capacity)

Existing capacity includes any plant operated by the entity at the time of Certification which must meet the sector-specific Criteria for existing capacity, the thresholds of which are shown in Table 8. Additionally, cross-cutting criteria for CCS/CCUS, cofiring and methane leakages in fossil gas plants are detailed in Section 5.



Source: Climate Bonds

Figure 3: Electrical Utilities Criteria for an entity's existing capacity.

Table 8: Electrical Utilities Criteria thresholds and benchmarks for fossil fuel existing capacity.

Mitigation Criteria for fossil fuel existing capacity		Advanced economies[10]	Emerging economies[11]
COAL	Phasing-out unabated plants	2035	2040
	If NOT • Cofiring with 100% low-carbon fuels; • CCS retrofit with a carbon-capture rate of 90% and storage.	2035	2040
FOSSIL GAS	Phasing-out unabated plants	2040	2040
	If NOT • Cofiring with 100% low-carbon fuels; • Retrofit with a carbon-capture rate 90% and storage.	2040	2040
OIL	Phasing-out all plants	2035	2040

Source: Climate Bonds based on IEA **(IEA, update 2023)**

These criteria do not allow for any new fossil fuel capacity, although for transitional purposes, the replacement of coal-fired capacity to accelerate the shift from more polluting activities to gas may be considered under certain circumstances (see Box 5).

Box 5: Coal can be switched to gas under the following conditions:

- When security of electricity supply is at risk;
- The fossil gas capacity replaces an existing coal generation plant;
- The fossil gas plant does not exceed **the replaced facility's capacity;**
- The entity's direct average emission intensity remains below the Sector Criteria emission intensity pathway;
- The entity has a **coal and gas phase-out plan** in place.

Safeguards:

- Critical grid security needs to be demonstrated, and agreed to, on an ad hoc basis;
- System-wide proof that renewable energy systems are not suitable.

Criteria for existing low-carbon technology plants are shown in Table 9.

[10] Advanced and emerging economies follows the definition of the IEA

[11] Advanced and emerging economies follows the definition of the IEA

Table 9: The sector-specific Criteria thresholds for low-carbon existing capacity.

Power generation for Low carbon technologies	Scope 1 emissions threshold	Scope 3 emissions threshold
Solar	No direct emissions	Automatically eligible
Wind	No direct emissions	Automatically eligible
Hydropower	Threshold: 100 gCO_2e/kWh[12] (Methane emissions from the reservoir)	Negligible
Geothermal	Threshold: 100 gCO_2e/kWh[13]	Negligible
Bioenergy and BECCS	No direct emissions (combustion emissions compensate for the carbon captured during the growth of the biomass)	Threshold: 100 gCO_2e/kWh[14] (emissions from processing and transporting the biomass) Meet Cross-Cutting Criteria. *Section 5.3*

Source: Climate Bonds Initiative based science and academic literature [15]

Life-cycle analysis (LCA) is required to account for the non-combustion emissions: scope 1 for hydropower and geothermal, as well as scope 3 for processing and transporting biomass for electricity production. These emissions are calculated by considering the amount of carbon dioxide equivalent (CO_2e) emissions released during the LCA per unit of electricity generated.

[12] Accounting for GHG emissions must follow **The G-RES Tool** methodology as required in section 3.2 of the Climate Bonds Hydropower Criteria

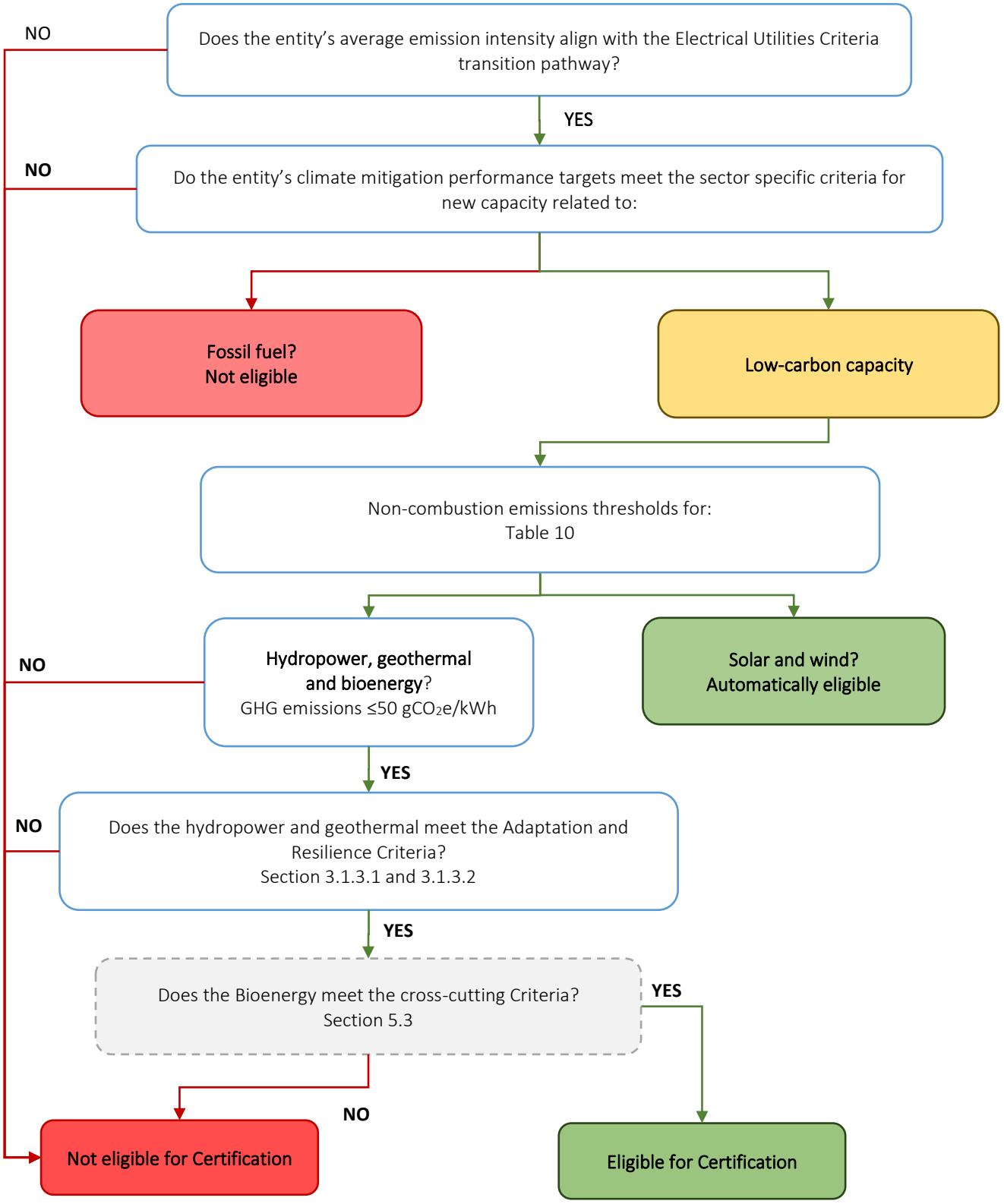
[13] Accounting the GHG emissions must follow the methodology detailed in ***Appendix C*** of the Climate Bonds Geothermal Criteria. Appendix C: Proposed method for estimating GHG emissions in geothermal power plants

[14] Accounting for GHG emissions must follow the **BioGrace II** methodology as required in ***section 3.2*** of the Climate Bonds Bioenergy Criteria

[15] See the Electrical Utilities Background Paper for information sources and rationale behind these thresholds.

3.1.3 Criteria for new facilities after Certification (new capacity)

Post-Certification date, any plant becoming operational must continue to meet the Electrical Utilities Criteria and thresholds for the entity's new capacity shown in Figure 4 and Table 10. Cross-cutting Criteria for bioenergy are detailed in Section 5.3.



Source: Climate Bonds own elaboration.

Figure 4: Electrical Utilities Criteria for entity's new capacity.

Table 10: Electrical Utilities Criteria thresholds for low-carbon new capacity.

Power generation for low carbon technologies	Scope 1 emissions do not exceed the threshold:	Scope 3 emissions do not exceed the threshold:
Solar	No direct emissions	Automatically eligible
Wind	No direct emissions	Automatically eligible
Hydropower	**Threshold: 50 gCO_2e/kWh** (Methane emissions from the reservoir) Demonstration of compliance: See *section 3.1.3.1*	Negligible (The direct and indirect emissions associated with the construction of the plants are not material due to the long-life span of the plant)
Geothermal	**Threshold: 50 gCO_2e/kWh** (non-condensable gases from the geothermal fluid) Demonstration of compliance: See: Climate Bonds Geothermal Criteria See *Appendix C*	Negligible
Bioenergy	No direct emissions (combustion emissions compensate for the carbon captured during the biocycle of the biomass)	**Threshold: 50 gCO_2e/kWh** (Emissions from processing and transporting the biomass) Meet Cross-Cutting Criteria. Section 5.3 Demonstration of compliance: See Section 3.1.3.3
Bioenergy with BECCS	Negative emissions form CO_2 captured.	

Note: these are emission thresholds
Source: Climate Bonds Initiative based on science and academic literature[16]

3.1.3.1 Hydropower safeguards for the Criteria

According to literature[17], although hydropower is generally considered to be a good alternative to fossil fuel power generation, studies have shown that reservoir emissions in tropical climates could be very high, up to 2200.[18] Therefore, the Criteria establish the threshold of 50 gCO_2e/kWh for any new hydropower capacity built by the entity after Certification, using the G-RES Tool to estimate and report net greenhouse gas emissions from a reservoir.

Additionally, new hydropower facilities must undergo a specific site assessment following IEA Hydro Framework guidelines: The Hydropower Sustainability ESG Gap Analysis Tool (HESG). This analysis must be carried out by an accredited assessor, which will identify any significant gaps the facility demonstrates against international good practice. Such gaps, if identified, require the establishment of an environmental and social action plan (ESAP) to take remedial action. Further details can be found in Climate Bonds Hydropower Criteria.

3.1.3.2 Geothermal safeguards for the Criteria

Based on Climate Bonds Geothermal Criteria, geothermal power plants are required to cover possible environmental, health and safety (EHS) impacts:

- Projects are required to comply with best practice international guidelines / standards on environmental, health and safety (EHS) for geothermal power generation (e.g. International Finance Corporation (IFC)/World Bank). As these detailed EHS guidelines contain guidance on air emissions, note that compliance with them is a necessary but not sufficient requirement for certification, as the emissions performance required for Climate Bonds certification is more stringent. In addition, the

[16] See the Electrical Utilities Background Paper for information sources and rationale behind these thresholds.
[17] Hydropower: In IPCC Special Report on Renewable Energy Sources and Climate Change (Kumar, 2011)
[18] Nature Energy, Articles. Understanding future emissions from low carbon power systems. (Michaja Pehl, 2017)

IFC have advised us that the applicability of EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables are taken into account;

- Meeting IFC Performance Standards on Environmental and Social Sustainability are strongly recommended (e.g. IFC PS5 Land Acquisition and Involuntary Resettlement, or IFC PS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources);
- Any Enhanced Geothermal Systems project must comply with US Department of Energy Protocol for Addressing Induced Seismicity Associated with Enhanced Geothermal Systems[19].

3.1.3.3 Methodological notes for bioenergy

Bioenergy has direct emissions assumed to be 0 gCO_2/kWh but could be responsible for higher indirect emission than fossil coal power plants.[20] Emissions from electricity production with biomass are mostly dependent on the type of feedstock, the biomass processing and transportation, and land use change.

The Electrical Utilities Criteria establish an emission intensity threshold of **50 gCO_2e/kWh** when using biomass for electricity production (aligned to 5 gCO_2e/MJ biomass consumed in a power plant with 40% of electricity efficiency), which embeds the emissions produced during the processing and transportation of the biomass.

Biomass power plants equipped with CCS/CCUS systems can contribute negative emissions to the entity's net balance, which are reported in the entity's average emission intensity, as detailed in Table 10. The biomass used for fuel in the power plant must meet the cross-cutting Criteria for biomass development in Section 5.3.

The Climate Bonds Bioenergy Criteria propose the **BioGrace II** methodology to account for the emissions embedded in the production and transportation of biomass to be used as a fuel for electricity generation (Table 11 below).

Table 11: Emissions addressed in bioenergy.

GHG emissions accounting methodology for bioenergy	
Methodology	**Emissions included**
BioGrace II	• Feedstock production; • Feedstock processing; • Biofuel/bioenergy production; • Biofuel storage and blending; • Intermediate and final transportation steps.

Source: Climate Bonds Bioenergy Criteria

[19] Protocol for addressing induced seismicity associated with enhanced geothermal systems (energy.gov)
[20] Nature Energy, Articles. Understanding future emissions from low carbon power systems. (Michaja Pehl, 2017)

3.2 Electrical Utilities Criteria for sustainability-linked debt Certification

Two levels of SLD Certification are available, depending on when the climate mitigation performance targets align with the Climate Bonds Standard Sector Criteria, (see the Climate Bonds Standards and Box 1)

Table 12: SLD Tiered Certification.

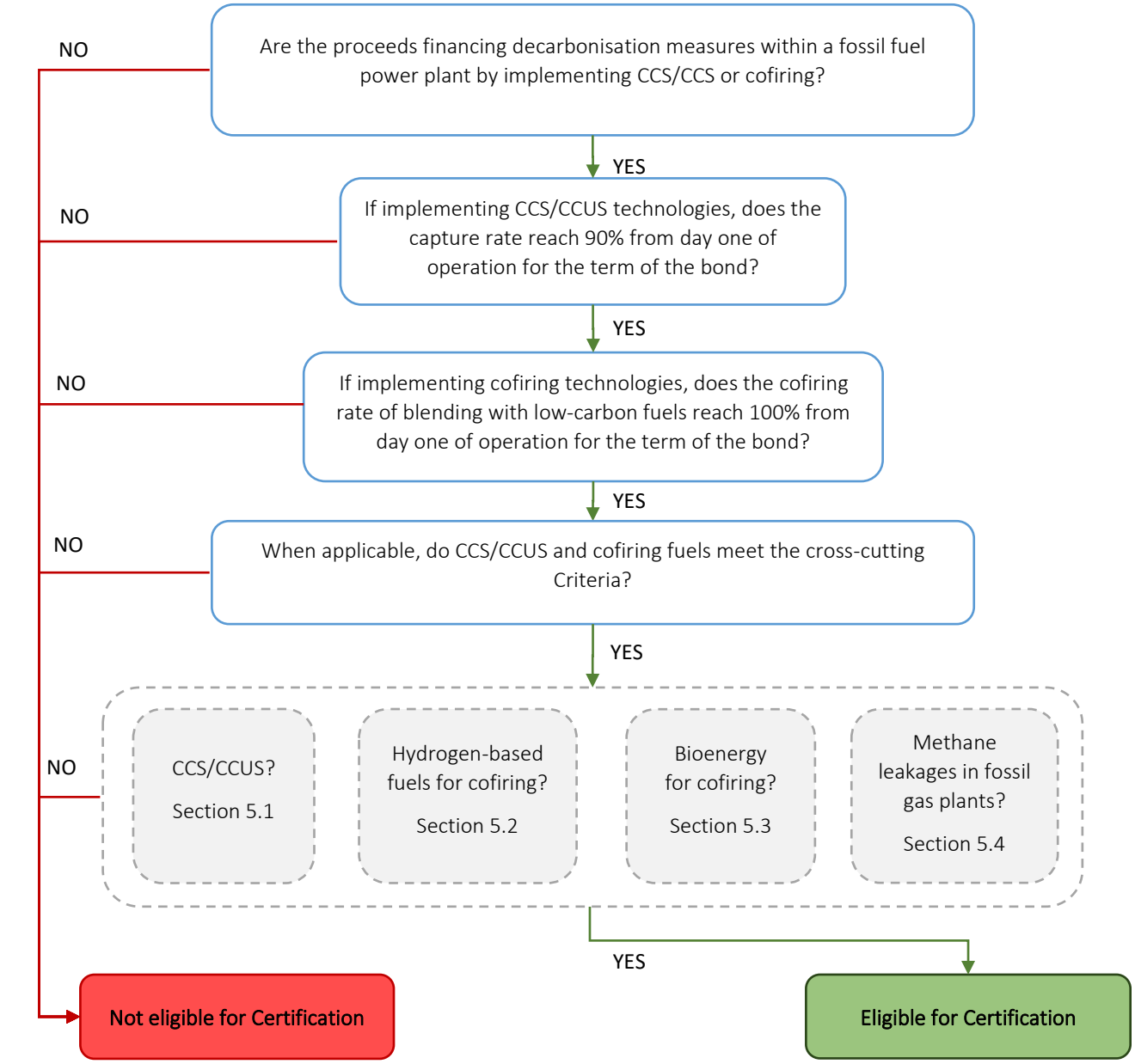
SLB Tier	SLD Certification Requirements
Tier 1: Aligned	**Climate mitigation criteria** 1. At the time of certification, the certified Entity's electrical utility average emissions intensity meets sector specific criteria transition pathway to which the **Climate Mitigation Performance Targets** of the debt are linked *and* its future Performance Targets to which the debt is linked continue to align with the sector specific criteria transition pathway through to 2050 (see Section 3.1.1); *and* 2. At the time of certification, all the Certified Entity's existing capacity meet the sector specific criteria for existing capacity, including any plant operating at the time of certification, section 3.1.2*)* 3. At any time after the certification date, all the Certified Entity's new capacity meet the sector specific criteria for new capacity, from day 1 of commencing operation, including any plant becoming operational post certification date, section 3.1.3. 4. At the time of certification, and at any time after the certification date all the Certified Entity's facilities using CCS/CCUS, meet the cross-cutting criteria for CO_2 transport, storage, and utilization section 5.1. **5.** At the time of certification, and at any time after the certification date all the Certified Entity's facilities using hydrogen and biomass, meet the cross-cutting criteria in section 5.2 and section 5.3 6. At the time of certification, and at any time after the certification date all the Certified Entity's facilities using fossil gas, meet the cross-cutting criteria for methane leakages in section 5.4. **Adaptation and Resilience Criteria** 7. The Certified Entity meet the adaptation and resilience criteria described in Section 6, and that is reassessed and reconfirmed every five years.
Tier 2: Transition	The criteria are the same as for Level 1, except: At the time of certification, the average emissions intensity of the electrical utility to which the **Climate Mitigation Performance Targets** of the debt are linked do not meet the sector specific criteria transition pathway, but its future Climate mitigation Performance Targets align by 30 December **2030** and continue to align thereafter through to 2050 (see Section 3.1.1).

Source: Climate Bonds own elaboration

4 Use of proceeds bonds for mitigation measures

4.1 Mitigation measures Criteria

These Criteria can also cover UoP bonds for mitigation measures applied to fossil fuel power plants, where capital investment should be focussed on achieving significant emissions savings at the facility level. Given their CO_2 emissions mitigation potential, two main decarbonisation measures can be certified: CCS/CCUS technologies for power plants; and preparing the turbine burner/combustion chamber for cofiring with low-carbon fuels, comprising liquid and gaseous biofuels, hydrogen, and hydrogen-derived fuels (ammonia and synthetic hydrocarbon fuels produced from hydrogen and CO_2), see Figure 5.



Source: Climate Bonds

Figure 5: Criteria for specific mitigation measures within fossil fuel power plants.

4.1.1 Demonstration of compliance

The applicant shall provide evidence of the decarbonisation measures that will be implemented and have a contract or agreement with a Certified energy auditor demonstrating in an annual report that the asset performance is equivalent to the performance requirements shown un Figure 5, from day one of operation for the term of the bond.

5 Cross-cutting Criteria

5.1 Additional Criteria for carbon capture and storage and carbon capture utilisation and storage

CCS and CCUS, both on an individual basis and as part of a whole facility being evaluated, are eligible provided there is evidence to demonstrate the CO_2 will be appropriately transported, stored and/or used in accordance with the Criteria in Table 13 below.[21]

Table 13: Criteria for CO_2 transportation, storage, and utilisation.

Component	Requirements
Transport[22]	1. The CO_2 transported from the installation where it is captured to the injection point does not lead to CO_2 leakages above 0.5 % of the mass of CO_2 transported. 2. Appropriate leakage detection systems are applied, and a monitoring plan is in place, with the report verified by an independent third party.
Storage[23]	1. Characterisation and assessment of the potential storage complex and surrounding area, or exploration[24] is carried out in order to establish whether the geological formation is suitable for use as a CO_2 storage site. 2. For operation of underground geological CO_2 storage sites, including closure and post-closure obligations: a. appropriate leakage detection systems are implemented to prevent release during operation. b. a monitoring plan of the injection facilities, the storage complex, and, where appropriate, the surrounding environment is in place, with the regular reports checked by the competent national authority. 3. For the exploration and operation of storage sites, the activity complies with ISO 27914:2017225[25] for geological storage of CO_2.
Utilisation	Utilisation of direct CO_2 emissions from electricity generation is only eligible when the CO_2 is used for the manufacture of durable products (e.g., construction materials stored in buildings, or recyclable products such as PET). CO_2 should not be used for products that release the CO_2 immediately when these are used (such as in urea, carbonated beverages, or fuels), nor for enhanced oil recovery, and the production of other forms of fossil energy sources.

Source: Criteria based on EU taxonomy[26]

Furthermore, the use of any certification scheme would be encouraged. Examples of certification schemes include the U.S. EPA Class VI well certification, which includes reservoir characterisation.[27] A further example would be the DNV GL certification framework to verify compliance with the ISO 27914:2017 carbon dioxide capture, transportation, and geological storage - geological storage.[28]

[21] Either directly from the applicants or through contracts or agreements with a third party.

[22] From the technical screening criteria for qualifying as contributing substantially to climate change mitigation for "Transport of CO_2" in Annex 1 of the Commission Delegated Regulation (EU) 2021/2139 (EU taxonomy)

[23] From the technical screening criteria for qualifying as contributing substantially to climate change mitigation for "Underground permanent geological storage of CO_2" in Annex 1 of the Commission Delegated Regulation (EU) 2021/2139

[24] "Exploration' means the assessment of potential storage complexes for the purposes of geologically storing CO_2 by means of activities intruding into the subsurface such as drilling to obtain geological information about strata in the potential storage complex and, as appropriate, carrying out injection tests in order to characterise the storage site

[25] ISO Standard 27914:2017, Carbon dioxide capture, transportation and geological storage - Geological storage: www.iso.org/standard/64148.html)

[26] https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en

[27] www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-co2

[28] www.dnv.com/news/dnv-gl-launches-certification-framework-and-recommended-practice-for-carbon-capture-and-storage-ccs--108096

5.2 Additional Criteria when using hydrogen or hydrogen-derived fuels for cofiring

Utilisation of cofiring with low-carbon hydrogen-based gaseous fuels is only eligible when the hydrogen used meets the Climate Bonds Hydrogen Production and Delivery Criteria, which establish a limit on the emission intensity for hydrogen production and delivery, see Table 14.

Table 14: Hydrogen carbon intensity thresholds.[29]

Asset Type	Criteria			
	2023[28]	2030	2040	2050
Production and delivery of hydrogen	3.0 $kgCO_2e/kgH_2$	1.5 $kgCO_2e/kgH_2$	0.7 $kgCO_2e/kgH_2$	0 $kgCO_2e/kgH_2$

Source: Climate Bonds Hydrogen Production and Delivery Criteria

To demonstrate compliance with any of the emission intensity thresholds, the applicant is required to carry out an LCA for hydrogen production and calculate GHG delivery emissions as described in Appendix A. The total GHG emissions to be benchmarked against the threshold shall include both production and transportation emissions.

5.3 Additional Criteria when using biomass or biofuels as a fuel

The use of biomass for electricity production can have a negative impact on climate change mitigation and/or the resilience of ecosystems to climate risks. High emissions can be generated where land with pre-existing high carbon stocks is converted for feedstock cultivation, and/or where feedstocks are transported long distances from cultivation sites to bioenergy facilities.

Utilisation of cofiring with low-carbon gaseous fuels based on biomass is only eligible when the biomass used meet the following Mitigation Criteria and Adaptation & Resilience Criteria. (For further information, see Appendix B)

Mitigation:

- **Biomass sources allowed**. (See Appendix B);
- **A reduction to the risk of indirect Land Use Change (iLUC)**. (See Appendix B);
- **GHG Emissions**: GHG emissions of biomass must not exceed **5.5 gCO_2e/MJ** (that implies **50 gCO_2e/kWh** in an electrical plant with a 40% efficiency) for embedded emissions in biomass production and transporting.

Adaptation and Resilience:

- A **climate risk assessment** is required with an adaptation plan where high risks are identified, which is assessed via the Adaptation and Resilience Checklist (Section 3.3.1 of the Climate Bonds Bioenergy Criteria); and
- **Source feedstock** compliance with established and approved best practice standards for the industry to ensure feedstock production is environmentally sustainable and climate resilient (Section 3.3.2 of the Climate Bonds Bioenergy Criteria); and
- **Identification of food risks,** if any, with a plan to address significant risks (Section 3.3.3 of the Climate Bonds Bioenergy Criteria).

A deforestation and conversion free plan is required. Details can be found in Agri-Food DCF criteria (published in 2024).

5.4 Cross-cutting for methane leakages in fossil gas plants

Although fossil gas has been considered a transition fuel due to its low-combustion emissions, recent studies demonstrate that methane leakages in transportation of fossil gas can make it as highly emitting as coal. [30] For this reason, when investments involve fossil gas plants, the Criteria require action to limit methane leakages. These include the detection and reparation of methane

[29] Hydrogen Production and Delivery Criteria under the Climate Bonds Standards. Climate Bonds Initiative. December 2023.

[30] https://gas-vs-coal-calculator.rmi.org/

leakages at operational level, physical measurement of emissions to be reported, leaks to be eliminated, or a leak detection and repair programme to be introduced, following EU Taxonomy regulation.[31]

[31] Electricity generation from fossil gaseous fuels

6 Adaptation and Resilience Criteria

This section describes the Adaptation and Resilience (A&R) component of the eligibility Criteria for certifying entities. The aim of these Criteria is to ensure that the entity is wholly resilient and adapted to climate and can continue to provide electricity.

Climate Bonds proposes the following definition for Resilience: 'the capacity of economic, social or ecological assets or systems to resist, absorb, accommodate, adapt to, transform, and recover from the current and projected impacts of climate change, both direct and indirect, maintaining their basic structure and function'.

To demonstrate compliance, the Certified entity must hold a risk assessment they have undergone or will undergo including the identified, planned, and implemented measures to manage and mitigate climate risks.

The Certified entity must follow best-practice standards or similar schemes to carry on the risk assessments, where the issuer can demonstrate the standard has sufficient requirements and thus is robust.

Based on Climate Bonds Resilience Principles, the risk assessments presented by the entity must demonstrate the following are covered:

1. Understanding and identifying the context: Boundaries and interdependencies.
2. Addressing climate risks: Identify the climate risks and address them by undertaking risk-measures and adopting management plans ensuring that the entity is robust and fit-for-purpose in the face of uncertainty.
3. Addressing resilience benefits: Deliver resilience benefits over and above identified risks.
4. Undertaking of regular (re)evaluation of the climate resilience performance, adjusting to risk reduction measures over time as needed.

Definitions

Adaptation and Resilience Criteria: Rules or principles for evaluating and preventing physical climate risk and assessing the vulnerability of an asset or entities to the effects of climate changes, which aim to reduce of this vulnerability. These rules generally guarantee that the activities don't do any significant harm to other assets within their system boundaries which covers the area affected by the activity.

Advanced economies: OECD regional grouping and Bulgaria, Croatia, Cyprus, Malta and Romania.

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

Base load: It is the minimum level of electricity demand required over a period of 24 hours, which must be guaranteed by the electricity system.

Carbon capture and storage (CCS): describes a suite of technologies that capture waste CO_2, usually from large point sources, transport it to a storage site, and deposit it where it will not enter the atmosphere. Stored CO_2 is injected into an underground geological formation, which could be a depleted oil and gas reservoir or other suitable geological formation.

Carbon capture, utilisation, and storage (CCUS): describes a suite of technologies that capture waste CO_2, usually from large point sources, to then use it in other processes, or to make products.

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 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 v4.0) 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 $34 trillion 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 GHG emissions to limit the global temperature increase to 2.0-degree or even 1.5-degrees above pre-industrial levels.

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: Limits 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 greenhouse gas 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.

CO_2 geological storage: The process of keeping CO_2 in underground geologic formations, usually pressurising the carbon dioxide until it becomes a liquid.

CO_2 transport leakages: Undesired CO_2 losses to the atmosphere during the transportation from where it was sequestered to where stored.

Critical interdependencies: The asset or activity's boundaries and interdependencies with surrounding infrastructure systems. Interdependencies are specific to local context but are often connected to wider systems through complex relationships that depend on factors 'outside the asset fence' that could cause cascading failures or contribute to collateral system benefits.

Decarbonisation pathways: Transformation processes, strategies, or indications 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 greenhouse gas emissions and remove the amount of carbon gaseous compounds in the atmosphere.

Distribution: The final stage of the electricity value chain, where electricity is carried from the transmission system to individual consumers.

Electricity generation portfolio: The strategic collection of investments and assets in electricity generation technologies and projects by energy source.

Electrification: The process of using electricity to provide services that were previously met by other energy sources, usually fossil fuels. If the electricity originates from renewable sources, it can help to decarbonise the economic system.

Emerging economies: All other countries not included in the advanced economies regional grouping.

Emission intensity: Volume of emissions per unit of a representative factor in the assessed sector, which in the electricity utilities sector is kWh generated, so the emissions intensity is the grams of CO_2 eq per kWh generated: gCO_2/kWh.

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

Energy utility: A company that provides energy, mainly electricity and fossil gas, but also heat.

Fossil gas: It is a hydrocarbon fuel mostly composed by 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.

Investment period: The interval between the bond's issuance and its maturity date; otherwise known as the bond tenor.

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

Low-carbon fuels: Materials, that when burned provide thermal energy with fewer emissions than fossil fuels, which can be used to generate electricity.

Low-carbon technologies: Technologies referred to as innovative technical solutions that are characterised by a low-emission intensity, compared to state-of-the-art alternatives. Considered best-in-class technologies with a focus on environmental impact, examples of electricity utility low-carbon technologies would be solar, wind, marine, bioenergy, hydropower, geothermal, and nuclear.

Mitigation Criteria: Rules and principles containing thresholds, benchmarks, and milestones for sector activities whose objective is the reduction of the harmful effects of greenhouse gases emissions.

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

Natural gas: A naturally occurring mix of gaseous hydrocarbon consisting primarily of methane in addition to other alkanes.

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-zero emissions scenario (NZE): A science-based scenario designed to show what is needed across the main sectors by various actors, and by when, for the world to achieve net-zero energy-related and industrial process CO_2 emissions by 2050. It also aims to minimise methane emissions for the energy sector.

Net-zero emissions: A situation where global greenhouse gas emissions from human activity are in balance with emissions reductions. To achieve this situation, human-caused emissions should be reduced as close to zero as possible.

Net-zero targets: Global policy instruments for international GHG reductions to achieve net zero emissions.

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

Offsetting: A climate action that enables organizations to compensate for the emissions they put into the atmosphere, by supporting worthy projects that reduce emissions in other regions of the world.

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-degrees above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5-degrees above pre-industrial levels.

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

Scenarios: Science-based plausible descriptions of how the future may unfold based on several assumptions (economic, social, behavioural, technological), which generally form part of a set of alternative pathways. Examples are the IEA net zero emissions scenario and the NDC Scenario.

Scope of emissions: Scope 1, 2 and 3 are terms devised by the GHG Protocol to categorise the different sources of carbon 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.

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.

Synthetic Fuels: Liquid or gaseous fuels produced artificially that originate from renewable raw materials or electricity generated using renewable energy sources. They tend to have the same properties as fossil fuels and can replace them.

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.

Unabated fossil fuel: Fossil fuels, the use of which continues without any intervention to substantially reduce the amount of greenhouse gas emitted throughout their life cycle.

Acronyms

BECCS	Bioenergy equipped with CCUS
CAPEX	Capital expenditures
CBS	Climate Bonds Standard
CBSB	Climate Bonds Standard Board
CCGT	Combined circle gas turbine
CCS	Carbon capture and storage
CCU	Carbon capture and utilisation
CCUS	Carbon capture, utilisation, and storage
CEM	Continuing emissions monitoring
CHP	Combined Heat and Power
CO_2	Carbon dioxide
CSP	Concentrating solar power
EU	European Union
FSC	Forest Stewardship Council
GHG	Greenhouse gases
IAMC	Integrated alarm, monitoring and control systems
IEA	International Energy Agency
IGCC	Integrated gasification combined cycle
IFC	International Finance Corporation
IPPC	Intergovernmental Panel on Climate Change
ISCC	International Sustainability & Carbon Certification
IWG	Industrial working group
KPI	Key performance indicator
LCA	Life Cycle Assessment
NGCC	Natural gas combined cycle
NZE	Net zero emissions by 2050 scenario
O&M	Operation and maintenance
PV	Photovoltaic
RSB	Roundtable on Sustainable Biomaterials Association
RTRS	Round Table of Responsible Soy Association
SBTi	Science Based Targets initiative
SLB	Sustainability-linked bond
SLD	Sustainability-linked debt
T&D	Transmission and distribution
TPI	Transition Pathway Initiative
TWG	Technical working group
UoP	Use of process
WRI	World Resource Institute
WBCSD	World Business Council for Sustainable Development

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Appendix A: Life Cycle Assessment for hydrogen[32]

The Life Cycle Assessment (LCA) should follow the latest releases of ISO Standard (ISO 14040, ISO 14044 for life-cycle assessment, and ISO 14067 for product carbon footprint).[33] The Recommendation 2013/179/EU will be acceptable for assets located in the EU. Results should be verified by an independent third party.

GHG emissions must be estimated for a purity of 99.9% vol, and a gauge pressure of at least 3 MPa using correction factors. For pressures higher than 3 MPa, additional energy compression emissions must also be included.

The methodology factor in a Global Warming Potential for a period of 100 years (GWP100) for methane should be 30.[34]

GHG emissions accounting:

$$Etotal = E1 + E2 + E3 + E4 + E5 - E6 + E7 + E8$$

E total: Total emissions

E1: Upstream feedstock related emissions (including sourcing, processing, transport, and storage).[35]

E2: Upstream energy related emissions (including sourcing, processing, transport, and storage).

E3: Fugitive emissions (including hydrogen emissions).

E4: Process emissions.

E5: CCS/CCUS emissions related to energy consumption and leakages.

E6: Carbon emissions captured.

E7: Compression and purification emission (energy required to compress and purify hydrogen).

E8: Transportation emissions to the site where hydrogen will be used (energy and electricity related emissions, and fugitive emissions during transportation).[36]

Additional guidance for different production pathways up to the point of production:[37]

The International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) methodology working paper contains guidelines for GHG accounting calculation method for the following production pathways up to the point of production:[38]

- Steam Methane Reforming combined with CCS/CCUS: Appendix P1 of IPHE working document;
- Biomass as a feedstock combined with CCS/CCUS: Appendix P5 of IPHE working document;
- Manure-based production: P5.4 Biodigestion;
- Land fill gas-based production: P5.4 Biodigestion;
- Biomass from secondary sources: P.5.5 Biomass gasification;
- The IPHE working document also has guidelines for emission sources and allocation for biomass-based production:
  - Emissions sources in Biomass-Based Hydrogen Routes/CCS/CCUS: Appendix P.5.6;
  - Allocation for the Biomass/CCS/CCUS pathway: Appendix P.5.7.

[32] Climate Bonds Standards Version 4.0. *Globally Recognised, Paris-aligned certification of debt Instruments, Entities and Assets using robust, science-based methodologies*. Updated version 2023. Please assure that this is the latest version on Climate Bonds Standards.

[33] ISO standards available at: www.iso.org/standard/38498.html; www.iso.org/standard/37456.html

[34] Sixth Assessment Report - IPCC

[35] Depending on the feedstock, it can be extraction, cultivation, or collection

[36] Transportation infrastructure emissions are not included

[37] The IPHE methodology will develop guidelines for transport emissions accounting in the coming months.

[38] www.iphe.net/_files/ugd/45185a_6159cefcd88f4d9283ab0e60f4802cb4.pdf

Appendix B: Requirements for biomass when used as a fuel

Biomass sources allowed in the criteria.

The Criteria identify the sources allowed to be used as a fuel. Biomass can be used for generating power, cofiring with fossil fuel or BECCS when generated from:

- Woody energy crops: Crops cultivated specifically to provide feedstock for energy industries;
- Agricultural residues (e.g. olive waste): Straw, husks, stover, branches, leaves, barks, and other portions of wood left on the field after harvests.

Woody biomass from licensed forest cleaning is not eligible.

To be eligible under these Criteria all these sources must meet all the requirements established in this appendix for indirect land use change, GHG emissions threshold, adaptation and resilience and food security.

Criteria for indirect Land Use Change (iLUC).[39]

Bioenergy facilities must either:

- Be certified under the Roundtable on Sustainable Biomaterials Association (RSB) low indirect land use change (iLUC) optional module to demonstrate that they have low indirect land use impact; or
- Provide evidence and documentation to demonstrate that they meet low iLUC risk biomass criteria and compliance indicators under the RSB optional module, i.e.:
    - Yield increase: issuers demonstrate that source feedstock for the facility is produced through an increase in yield compared to a reference date, without any additional land conversion. The biomass that is produced above the baseline scenario is eligible;
    - Unused/degraded land: issuers demonstrate that source feedstock for the facility is produced from land that was not previously cultivated or was not considered arable land;
    - Use of waste/residues: issuers demonstrate that the raw material used is derived from existing supply chains and does not require dedicated production from arable land.

GHG Emissions threshold for bioenergy.

GHG emissions of biomass must not exceed **5.5 gCO_2e/MJ** (that implies **50 gCO_2e/kWh** in an electrical plant with a 40% efficiency) for embedded emissions in biomass production.

To demonstrate compliance with these values, issuers are required to use one of the tools in Table 15 below for GHG emissions calculation.

[39] Bioenergy Criteria under the Climate Bonds Standards. Section 3.2.2. Climate Bonds Initiative. August 2022

Table 15: Endorsed GHG Calculation Tools.

Name	Technical Scope	Origin
BIOGRACE II	Biomass for electricity	EU
UK Solid and Gaseous Biomass Carbon Calculator	Solid biomass and biogas used for heat and electricity generation	UK

Source: Climate Bonds Bioenergy

Checklist for adaptation and resilience:[40]

The checklist is a tool to verify that the issuer has implemented sufficient processes and plans in the design, planning and decommissioning phases of the asset or project to ensure that the operation and construction is appropriately adaptive and resilient to climate change and supports the adaptation and resilience of other stakeholders in the surrounding ecosystem.

All elements of this checklist must be addressed with appropriate evidence that these requirements are being met or are not applicable in respect of the specific assets and projects linked to the bond. It is expected that this 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, environmental impact assessments, vulnerability assessments, and associated adaptation plans.

Table 16: Checklist for evaluating the issuer's adaptation and resilience performance in respect of a bioenergy facility.

No.	Adaptation and Resilience checklist for bioenergy facility	Proof Given	Overall Assessment
		For verifier to complete	
Section 1: The issuer identifies the climate-related risks and vulnerabilities to the asset/site.			
1.2	Processes are in place (as part of both the asset design and ongoing management) to assess key risks to the assets from a changing climate. The risks should be identified and interpreted in terms of the impact on the asset and the related effects for the business e.g., impact on operating feasibility and schedules and potential system outages, impact on maintenance requirements, etc. These key risks should include the following, plus any others felt to be of concern for the operation of these assets. This list taken from World Bank Climate and Disaster Risk Screening Tools: • Temperature changes, and extremes of temperature; • Extreme precipitation and flooding; • Drought; • Sea level rise and storm surge; • Strong winds. How these affect the asset or site in question will be highly variable and will be for the issuer to identify and relate to their operations. These assessments should use climate information, modelling, and scenarios from a peer reviewed source. This assessment should be done regularly. The frequency of the assessment will depend on the nature of the climate-related risks and vulnerabilities, and should be specified by the issuer and reported against in subsequent annual reporting.		
Section 2: The issuer identifies the impacts in larger context (spatially and temporally) beyond the asset/site (i.e., the impacts of the linked assets and projects on the broader ecosystem and stakeholders in that ecosystem).			

[40] Bioenergy Criteria under the Climate Bonds Standards. Section 3.3.1. Climate Bonds Initiative. August 2022

No.	Adaptation and Resilience checklist for bioenergy facility	Proof Given	Overall Assessment
		For verifier to complete	
2.1	Processes are in place (as part of both the asset design and ongoing management) to assess the impact of the bioenergy asset on the climate resilience of other stakeholders in the social, economic, and environmental system in which it operates and mitigate or reduce any negative impacts. These assessments address: • Any ways in which bioenergy facilities might affect the climate resilience of other users/stakeholders; • Any ways in which bioenergy facilities improve the adaptation capacity of other users/stakeholders. For example, they may include: • Impact on water quality and quantity for other users in the basin; • Waste and pollution emitted; • Fire hazards.		
Section 3: The issuer has designed and implemented strategies to mitigate and adapt to these climate risks and vulnerabilities to the underlying assets and projects and the broader ecosystem and its stakeholders.			
3.1	An adaptation plan has been designed and is being implemented to address the risks identified in the assessments above. The issuer has designed or amended investment and maintenance plans for the assets or projects and the broader ecosystem and its stakeholders. This is to ensure that the asset and its scheduled maintenance is sufficient to cope with the ongoing impacts of climate change and a plan has been established to govern how emergency maintenance needs arising from sudden climate change impacts (e.g., extreme storms) are approached. The issuer has training, capacity, and governance arrangements in place for how the organisation will deal with the impacts of exceptional events (e.g., droughts, floods, severe pollution events, extreme storms, and strong winds). The issuer has monitoring and reporting systems and processes to identify high risk scenarios. The issuer has contingency plans to address disruption to operations or loss of the asset and any resulting broader environmental or social damage. The issuer has processes for feeding risk assessment back into decision making. The issuer has a budget allocated to implementing the adaptation plan and has a named member of staff responsible for its implementation. The issuer complies with any existing broader or higher-level adaption plans, such as NAPAs.		

Source: Climate Bonds Bioenergy

Criteria for source feedstocks adaptation and resilience[41]

Issuers are required to demonstrate that they are sourcing feedstocks produced in an environmentally sustainable manner and thereby support climate resilience. Climate Bonds recognise two options to achieve this successfully.

- **Option A**: Feedstock used are certified under one of the following, pre-approved best practice standards.
  - RSB;
  - Round Table of Responsible Soy (RTRS);

[41] Bioenergy Criteria under the Climate Bonds Standards. Section 3.3.2. Climate Bonds Initiative. August 2022

- Forest Stewardship Council (FSC);
- International Sustainability & Carbon Certification (ISCC) Plus;
- Climate Bonds Agriculture Criteria.

- **Option B:** Feedstocks are certified under a standard or a similar scheme where the issuer can prove the standard has sufficient requirements and thus is robust.

Where approved, certification of all source feedstock must be maintained for the full duration of the entity's certification.

Criteria for food security[42]

Issuers are required to identify food security risk, if any; and have a plan to address it when the risk is significant.

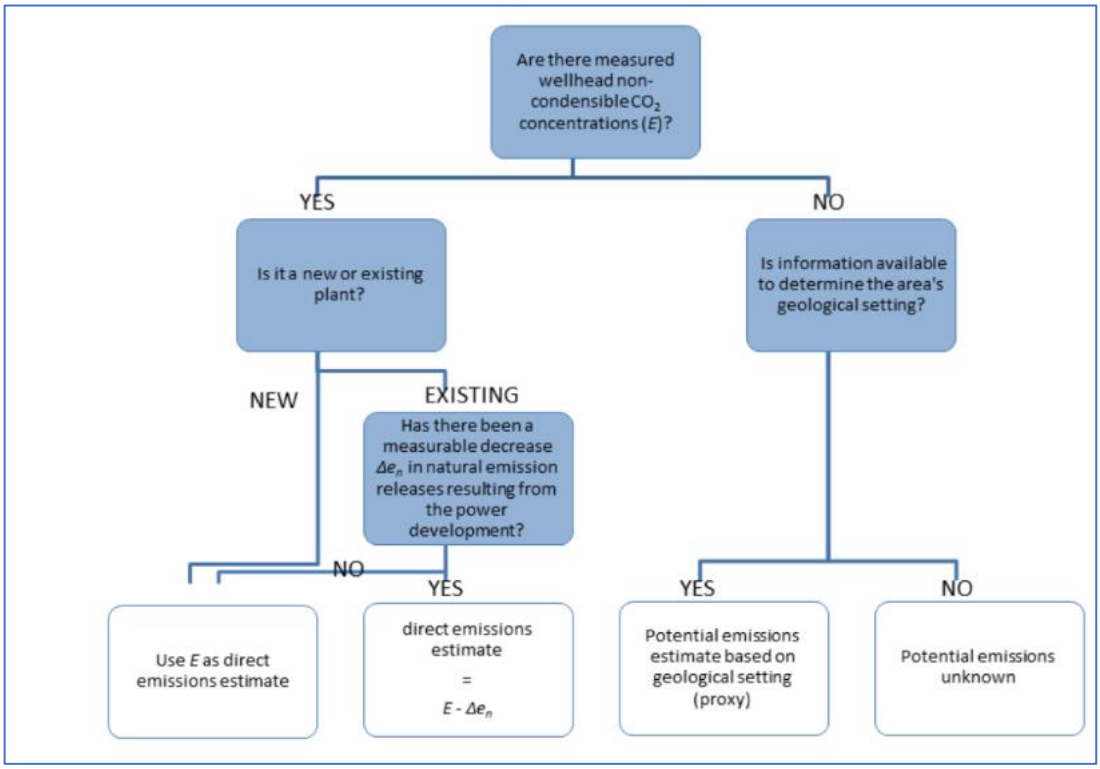
The requirement for addressing food security risk is based on RSB Food Security Assessment Guidelines.[43] Issuers are required to first evaluate food security at national level by checking the latest International Food Policy and Research Institute's Global Hunger Index (GHI)[44] to see whether their sourcing feedstock are produced in food-insecure nations. If the feedstock production is located in a country with low or moderate ranking on the GHI, there is no further requirement.

[42] Bioenergy Criteria under the Climate Bonds Standards. Section 3.3.3. Climate Bonds Initiative. August 2022

[43] RSB Food Security Guidelines. Version 3.0. January 2018.

44 www.globalhungerindex.org/

Appendix C: Proposed method for estimating GHG emissions in geothermal power plants



Source: Climate Bonds Geothermal Criteria

Figure 6: Methodologies required for GHG assessment of geothermal assets.

This process acknowledges the following practical considerations in determining direct emissions:

- Wellhead non-condensable gas estimates may not be available, and a proxy measure based on potential emissions determined from geological setting may be the only viable option;
- The release of direct CO_2 emissions due to the operation of the power station may result in lower natural release. This should be taken into account when these can be estimated. This canon l be achieved once the power station is in operation. It is proposed that this could be used in the case of retrofit of existing stations, or for re-applications for certification of facilities thar were initially rejected.

Appendix D: TWG and IWG members

Climate Bonds Coordinator:			
Francisco Moreno Castro	Energy Analyst Climate Bonds Initiative		
Technical Lead Advisor:			
Ana Díaz Vázquez	Global Energy Transition Head Climate Bonds Initiative		
TWG Members			
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Catalin Dragostin	Director Energy Serv, Vice-President Excorom	**Steve Pye**	Associate Professor of Energy Systems, UCL
Cristobal Budnevich Portales	Policy Officer and Data Analyst, TPI	**Tetsuo Saito**	Senior Research Fellow, Renewable Energy Institute
Kae Takase	Renewable Energy Institute	**Tom Luff**	Energy Strategy and Policy Expert, Energy System Catapult
Ruhn Zhang	Agora Energiewende	**Wu Di**	Senior Power Sector Analyst, Institute of Energy, Peking University
Ryan Foelske	Manager on Utility Transition Finance Team, RMI		

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

IWG Members			
Adrian Ghita	Executive Director Romanian Energy Efficiency Fund	**Lazeena Rahman**	Senior Energy Finance Specialist – Energy Transition Mechanism ADB (Asia Development Bank)
Alison Chan	Investment Director – Sustainable Finance Metrics Credit Partners	**Margaret Onije**	General Manage BGI Resources Limited
April Strid	Head of Research and Development and Lead Verifier Kestrel	**María Dolores Domenech**	Sustainability Manager Acciona
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Attravanam Gautam	CFO TATA Renewable Tata Power	**Monica Reid**	CEO and Founder Kestrel
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