

Bioenergy with carbon capture and storage (BECCS) – Quantification of greenhouse gas (GHG) emissions and removals – Specification

July 2025 Version 1



BSI Flex 2006 v1.0:2025-07



Department for
Energy Security
& Net Zero



Publishing and copyright information

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2025
Published by BSI Standards Limited 2025

ISBN 978 0 539 33280 3

ICS 13.020.01; 13.020.40; 13.040

No copying without BSI permission except as permitted by copyright law.

Release history

First version, July 2025

Contents

Foreword	ii
Introduction.....	iv
1 Scope.....	1
2 Normative references	2
3 Terms, definitions and abbreviated terms	3
3.1 Terms and definitions.....	3
3.2 Abbreviated terms	5
4 BECCS removal quantification	6
4.1 General approach to quantification	6
4.2 BECCS project boundary	6
4.3 Leakage.....	8
4.4 Baseline.....	10
4.5 Materiality of emission sources and sinks.....	11
4.6 Relevant GHGs.....	11
4.7 Temporal boundary.....	12
5 Quantification of net removals.....	13
5.1 Formula for quantification of net removals.....	13
5.2 Quantification of transferred CO ₂	14
5.3 Quantification of baseline emissions.....	14
5.4 Quantification of project emissions.....	15
5.5 Quantification of leakage emissions.....	21
6 Reversal management.....	22
Annexes	
Annex A (normative)	
Emissions factors and measures to account for low CI of project emissions and leakage.....	23
A.1 Emissions factors.....	23
A.2 Measures to account for the low CI of project emissions and leakage from energy use at BECCS installations	23
Annex B (normative)	
Environmental and social safeguards, and biomass sustainability criteria	25
B.1 Environmental safeguards.....	25
B.2 Social safeguards.....	25
B.3 Biomass sustainability criteria	25
Bibliography.....	29
List of figures	
Figure 1 – Illustrative value chain for BECCS projects	7
List of tables	
Table B.1 – Biomass sustainability criteria.....	27

Foreword

Publishing information

This BSI Flex was sponsored by the Department for Energy Security and Net Zero (DESNZ). Its development was facilitated by BSI Standards Limited and it was released under licence from The British Standards Institution. It came into effect on 31 July 2025.

Acknowledgement is given to Mirjam Röder, Czaneil Gomez and Daniel Taylor, Aston University, as the technical authors, and the following organizations that were involved in the development of this BSI Flex as members of the Advisory Group:

- Bellona
- British Airways
- Carbon Capture and Storage Association
- Carbon Gap
- CCS+
- CO2RE
- Coalition for Negative Emissions
- DAC Coalition
- Department for Energy Security and Net Zero (DESNZ)
- ICVCM
- Isometric
- Puro earth
- Supercritical
- Sylvera

Acknowledgement is also given to co-opted members of the Advisory Group.

The British Standards Institution retains ownership and copyright of this BSI Flex. BSI Standards Limited, as the publisher of the BSI Flex, reserves the right to withdraw or amend this BSI Flex on receipt of authoritative advice that it is appropriate to do so.

This BSI Flex is not to be regarded as a PAS or British Standard.

The BSI Flex process enables a standard to be rapidly developed, on an iterative basis, in order to fulfil an immediate stakeholder need. A BSI Flex can be considered for further development as a PAS or British Standard, or constitute part of the UK input into the development of a European or international standard.

Relationship with other publications

This BSI Flex is part of the greenhouse gas removal programme, alongside BSI Flex 2007 v1.0:2025-07, *Direct air carbon capture and storage (DACCS) – Quantification of greenhouse gas (GHG) emissions and removals – Specification*.

Information about this document

This is Version 1 of BSI Flex 2006, which has been released to enable stakeholders to engage with the initial content and feed back comments. All comments received will be reviewed to inform the future direction of this document. However, at present there are no plans to develop further versions. Interested parties are encouraged to check the BSI website for updates regarding any future plans.

Copyright is claimed in definitions 3.1.1, 3.1.6, 3.1.7, 3.1.8 and 3.1.13.

The content has been reproduced with the permission of the European Committee for Standardization (CEN). Copyright remains with CEN. All rights reserved.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at knowledge.bsigroup.com, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Use of this document

It has been assumed in the preparation of this BSI Flex that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this document are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. "organization" rather than "organisation").

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

Compliance with a BSI Flex cannot confer immunity from legal obligations.

In particular, attention is drawn to the following specific Acts and regulations:

- Climate Change Act 2008 [1];
- Regulation (EU) 2021/1119 (European Climate Law) [2];
- Directive 2009/28/EC (EU Renewable Energy Directive) [3];
- Directive 2009/31/EC (Geological Storage of Carbon Dioxide Directive) [4];
- Energy Act 2008 [5];
- Energy Act 2023 [6];
- Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 [7];
- Greenhouse Gas Emissions Trading Scheme Order 2020 [8];
- Storage of Carbon Dioxide (Termination of Licences) Regulations 2011 [9];
- Control of Substances Hazardous to Health (COSHH) Regulations 2002 [10];
- Town and Country Planning (Environmental Impact Assessment) Regulations 2017 [11]; and
- Directive 2023/2413/EU (EU REDD III Directive) [12].

Introduction

This standard has been developed in response to the UK Government's updates to the *Greenhouse gas removals (GGR): Business model* [13], published in December 2023, which highlighted that projects need to demonstrate genuine, high-integrity removals, with consistent methodologies for quantifying how much CO₂ has been removed. Government funding and support aims to provide a robust foundation for evaluating projects while fostering transparency, accountability and alignment with policy objectives.

These methodologies are designed to reflect monitoring, reporting and verification policy principles and align with existing government standards. Additionally, the UK Emissions Trading Scheme (UK ETS)¹⁾ Authority set out its intention to include engineered GGRs, subject to the development of a robust GGR standard, including GGR methodologies. The GGR business model is being designed with the consideration of the potential integration of GGRs in the UK ETS to provide an additional source of demand for GGR credits.

Given the rapid development and anticipated timelines, methodologies for early projects involving GGRs will consist of minimum quality thresholds focusing on essential requirements for net removal quantification in the context of the voluntary carbon market. Future methodologies will seek consistency with the UK ETS to support integration of GGRs.

The purpose of this BSI Flex on bioenergy with carbon capture and storage (BECCS) is to:

- support the advancement of GGR technologies by establishing a robust framework for quantifying GGR;
- provide direction for projects applying for revenue support under the UK GGR business model; and
- enhance confidence in carbon markets by contributing to addressing climate change and stimulating innovation in GGR technologies.

This BSI Flex provides a high-level framework to guide the establishment of methodologies by which to quantify GHG emissions and removals, and ultimately net GGRs, achieved by GGR projects involving BECCS.

Following the publication of this BSI Flex, DESNZ and BSI intend to develop more detailed technology-specific methodologies for GGR projects via a series of PAS standards. It is anticipated that these PAS standards will expand on certain provisions contained in this BSI Flex, including, but not limited to, Clause 4, Clause 5, Annex A and Annex B.

¹⁾ Information on the UK ETS is available at <https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets>.

1 Scope

This BSI Flex specifies requirements for quantifying activities in the design and operation of bioenergy with carbon capture and storage (BECCS) greenhouse gas removal (GGR) projects.

NOTE 1 This BSI Flex is intended for use in the UK but could also be used to inform the methodologies used to assess and credit carbon removal in other parts of the world.

NOTE 2 This BSI Flex does not determine specific market processes, policies or other government actions in the UK, several of which are being developed in ongoing work in parallel to the work on this standard. The UK Government intends to specify details of the crediting mechanisms to be used by projects receiving government support, including the carbon crediting programmes, frequency of credit generation and the crediting period length. Projects will be able to use the same methodology for the length of the crediting period. Further details are to be provided in other government documents that detail conditions for government support.

This BSI Flex covers minimum quality thresholds that apply to the quantification of net removals for carbon capture plants at a fixed location that use chemical separations to remove CO₂ from ambient air at high concentrations and that store the captured CO₂ permanently in geologic formations for the purposes of:

- GGR project assessment prior to GGR project development (ex ante); and
- GGR project performance evaluation, monitoring and reporting during GGR project deployment (ex post).

This BSI Flex does not cover:

- methods for capturing atmospheric CO₂ other than engineered systems at a fixed location that use chemical separations to remove CO₂ from ambient air at high concentrations;
- methods for capturing atmospheric CO₂ from energy from waste facilities;
- methods for storing captured atmospheric CO₂ other than permanent storage in geological formations; or
- methods for utilizing captured atmospheric CO₂, e.g. as a chemical feedstock to produce products or materials with short lifetimes.

This BSI Flex is of use to:

- stakeholders involved in establishing revenue support under the UK GGR business model or in other types of support schemes;
- installation developers wishing to select methodologies from independent crediting programmes and other entities for the purpose of originating carbon credits for sale in approved markets, or for other greenhouse gas (GHG) accounting purposes; and
- stakeholders seeking guidance on methods for determining the amount of transferred CO₂, net removals or carbon credits that might result from BECCS projects.

This BSI Flex might be of interest to:

- independent crediting programmes and other assessment and crediting methodology developers seeking a basis on which to establish estimates of negative emissions achieved by BECCS activities; and
- stakeholders wishing to understand more about standardizing GHG monitoring, reporting and verification, and the accounting methods for BECCS in respect of net removals.

2 Normative references

There are no normative references in this document.²⁾

²⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1 baseline scenario

hypothetical reference case that best represents the activities most likely to occur in the absence of a proposed greenhouse gas removal project

[SOURCE: BS EN ISO 14064-2:2019 ©, 3.2.6, modified – “conditions” replaced by “activities”; “greenhouse gas project” replaced by “greenhouse gas removal project”]

3.1.2 conservative

use of cautiously moderate assumptions, values and procedures to avoid over-estimating greenhouse gas emission reductions or removal enhancements

3.1.3 geological CO₂ storage site

infrastructure and equipment, including surface facilities, wells and monitoring equipment, that are used for the geological storage of CO₂ within the storage site

NOTE In the UK, such sites are licensed under the Storage of Carbon Dioxide (Licensing etc.) Regulations 2010 [7].

[SOURCE: BS ISO 27914:2025, ©, 3.45, modified – term changed from “storage facility” to “geological CO₂ storage site”; note added]

3.1.4 greenhouse gas removal project

activity or activities that result in the net removal of greenhouse gases from the atmosphere by enhancing carbon removal processes through deliberate human intervention

NOTE 1 Includes activities that result in net emissions below a defined baseline through the durable storage of greenhouse gases.

NOTE 2 Greenhouse gas removal projects are distinct from emission reduction projects and aim to deliver net removals (see 3.1.11). The baseline represents the starting point for calculating net emissions and is not altered by the activity itself.

3.1.5 greenhouse gas removal project lifetime

assumed operational period of a greenhouse gas removal project for the purpose of incorporating temporal elements associated with quantification

NOTE The assumed project lifetime is within the range of 15 years to 50 years.

3.1.6 greenhouse gas reservoir

component, other than the atmosphere, that has the capacity to accumulate greenhouse gases, and to store and release them

[SOURCE: BS EN ISO 14064-2:2019 ©, 3.1.4]

3.1.7 greenhouse gas sink

process that removes a greenhouse gas from the atmosphere

[SOURCE: BS EN ISO 14064-2:2019 ©, 3.1.3]

3.1.8 greenhouse gas source

process that releases a greenhouse gas to the atmosphere

[SOURCE: BS EN ISO 14064-2:2019 ©, 3.1.2]

3.1.9 leakage

greenhouse gas emissions occurring outside of the project boundary that are attributable to the project because of assessed indirect impacts of the greenhouse gas removal project on wider market behaviours and activities

3.1.10 methodology

protocol prescribing the way in which emissions, emission reductions and carbon removal are to be quantified by project proponents

3.1.11 net removals

greenhouse gas removals from the atmosphere resulting from a greenhouse gas removal project after accounting for transferred CO₂, project emissions and leakage emissions over a defined period

3.1.12 project emissions

greenhouse gas emissions arising as a direct result of the construction, operation and decommissioning of the greenhouse gas removal project

3.1.13 project proponent

individual or organization that has overall control and responsibility for a greenhouse gas removal project

[SOURCE: BS EN ISO 14064-2:2019 ©, 3.3.2, modified – term changed from “greenhouse gas project proponent” to “project proponent”; “greenhouse gas project” replaced by “greenhouse gas removal project”]

3.1.14 transferred CO₂

amount of CO₂ captured and transferred from the capture installation into a transport and storage system for the purpose of long-term storage in a permitted geological storage site

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

BECCS	bioenergy with carbon capture and storage
CCS	carbon capture and storage
CfD	Contracts for Difference
CH ₄	methane
CI	carbon intensity
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
EAC	environmental attribute certification
ETS	emissions trading scheme
GGR	greenhouse gas removal
GHG	greenhouse gas
GWP100	100-year global warming potential
IPCC	Intergovernmental Panel on Climate Change
NF ₃	nitrogen trifluoride
N ₂ O	nitrous oxide
PPA	power purchase agreement
REC	renewable energy certificate
RED III	Renewable Energy Directive III
REGO	renewable energy guarantee of origin
RHI	Renewable Heat Incentive
RO	Renewables Obligation
RTFO	Renewable Transport Fuel Obligation
SF ₆	sulfur hexafluoride

4 BECCS removal quantification

4.1 General approach to quantification

Project proponents shall quantify the net removals achieved by a GGR project within a given time period (t) by subtracting from the baseline emissions the level of transferred CO₂, less project emissions and leakage emissions.

NOTE Quantification can be undertaken for the purpose of:

- GGR project assessment prior to GGR project development; and
- GGR project performance evaluation, monitoring and reporting during GGR project implementation.

For the GGR project assessment, project proponents shall assume values and parameters for the purpose of making an ex-ante quantitative estimate of net removals.

For the GGR project performance evaluation, project proponents shall collect data through a monitoring plan for the purpose of ex-post quantification of achieved net removals.

4.2 BECCS project boundary

The project shall establish a comprehensive assessment boundary (see Figure 1) that encompasses the following emission sources and sinks:

- a) the project boundary, including all BECCS project activities from biomass feedstock production, processing, sourcing, pre-treatment and transport to BECCS installation;
- b) all activities involved in bioenergy with carbon capture and CO₂ storage;
- c) flows and material inputs occurring outside the project boundary but within the assessment boundary, e.g. energy imported for BECCS activities;
- d) the baseline against which the project is assessed; and
- e) leakage, where the BECCS project and related activities (e.g. feedstock production and processing, carbon capture, transport and storage activities) lead to indirect emissions.