Verified Carbon Standard
A VERRA STANDARD

GCS Requirements

Version 5.0

16 December 2025

CONTENTS

1 INTRODUCTION

This document provides project-level requirements for geological carbon storage (GCS) project activities. GCS is an umbrella term and broadly refers to carbon capture and storage activities (CCS), geological carbon mineralization (GCM), and carbon capture, utilization, and storage (CCUS) in geologic reservoirs. In its current version, this document provides requirements for CCS projects only. Subsequent versions may have additional sections to provide requirements for other GCS activity types and may evolve as methodologies are developed under this scope.

In addition to the requirements set out in this document, GCS projects must conform to all applicable VCS Program rules to be eligible for registration, VCU issuance, and release of buffer credits from the GCS pooled buffer account.

The material in this document has been inspired by and adapted from the following sources:

- US EPA. 2002. *Underground Injection Control Program Class VI Requirements (40 CFR § 146.86) – Injection Well Construction Requirements*. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-146/subpart-H/section-146.86

- US EPA Office of Water. 2013. *Underground Injection Control (UIC) Program Class VI Well Site Characterization Guidance*. https://www.epa.gov/sites/default/files/2015-07/documents/epa816r13004.pdf

- European Union. 2009. *European Parliament and the Council of the European Union (2009) Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC*. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF

- California Air Resources Board. 2018. *Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard*. https://ww2.arb.ca.gov/sites/default/files/2020-03/CCS_Protocol_Under_LCFS_8-13-18_ada.pdf

- International Organization for Standardization. 2017. *ISO 27914:2017 – Carbon Dioxide Capture, Transportation and Geological Storage – Geological Storage*. https://www.iso.org/standard/64148.html

These sources may be used as guidance for project proponents and storage site operators, but this is not required.

2 GENERAL GCS REQUIREMENTS

Each GCS project type (CCS, CCUS, GCM) has unique requirements. This section sets out the rules and requirements applicable to all GCS projects registered with the VCS Program and is in addition to requirements set out in the *VCS Standard*. CCS-specific requirements are set out in Section 3 below.

Appendix 1 illustrates the timelines and milestones relevant to GCS projects.

2.1 Right to Operate

Concept

Project proponents must demonstrate that they have the legal right to control and operate project activities. Given that GCS projects may be developed as vertically integrated or cooperative hubs, and because the risk of reversal at GCS storage sites persists beyond the crediting period, there are requirements for the right to operate that are in addition to those that apply to all project types in the *VCS Standard*.

Requirements

2.1.1 The project description shall be accompanied by evidence establishing right to operate accorded to the project proponent(s) for the plant, equipment, and processes at all capture facility site(s), transportation system(s), and storage sites(s). The *VCS Standard* lists eligible types of evidence in Section 3.6.[1]

2.1.2 For each storage site, evidence shall establish that each of the following either is the project proponent(s), or vests right to operate to the project proponent(s) through an enforceable and irrevocable agreement:

1) The pore space tenure holder(s)

2) The storage site operator(s)

2.1.3 Pore space tenure holders shall establish tenure for the target injection zone which spans the anticipated CO_2 storage area by having one of the following:

1) Title(s) to the pore space supported by relevant documents evidencing that title

2) Lease(s) to the pore space, supported by the following:

a) Where the GCS storage site is in a jurisdiction or a distinct part of a jurisdiction (e.g., the offshore) where all pore space is vested in the state: Evidence of registration of the lease (or equivalent) in the state registry

[1] Section number based on *VCS Standard, v5.0*

b) Where the GCS storage site is in a jurisdiction where some pore space is privately held: A legal opinion from a qualified, independent lawyer, licensed to practice within the jurisdiction where the storage site is located, that endorses that the tenure has been transferred, granted, or leased by the person(s) with the authority or ownership rights to the relevant pore space

2.1.4 Storage site operators shall establish operatorship for a storage site by having:

1) valid licenses, permits, or other such authorizations issued by the regulating jurisdiction to:

a) drill injection and monitoring wells.

b) operate the storage site(s).

2) access rights to all locations with injection and monitoring wells by having the following:

a) Where the GCS storage site is located in a place where there are no private surface owners, both:

i) results of a land title(s) search from a government registry for the relevant surface locations, and

ii) a reference to the constitution or law of that jurisdiction confirming that there are no private surface ownership rights relevant to the project or in that distinct part of the jurisdiction (e.g., offshore) in which the project is located.

b) Where the GCS storage site is located where some surface is privately held, a legal opinion from a qualified, independent lawyer, licensed to practice within the jurisdiction where the storage site is located, that endorses that access rights have been granted by the person(s) with the authority or ownership rights to the relevant locations

2.1.5 Where an agreement evidences that a storage site operator vests right to operate to the project proponent:

1) the agreements shall include clauses that assign responsibility for each of the following at the storage site(s):

a) Storage site closure and/or post-closure requirements, including the effort and cost of site remediation (remedial liability), as well as redress for the release of injected CO_2 (climate liability)

b) Funding for post-injection site care (PISC) costs as per the *GCS Non-Permanence Risk Tool*

2) the project proponent(s) shall have a legal opinion from a qualified, independent lawyer, licensed to practice within the jurisdiction where the project is located, that endorses that the agreements or laws of that jurisdiction assign all the responsibilities described in Section 2.1.5(1).

2.1.6 Where right to operate changes or the parties to the agreements referenced in Section 2.1.5 change, the project proponent shall have:

1) an executed assignment and novation agreement, or equivalent, such that the new owners and contractual parties assume all the rights and obligations in the original agreements and pore space tenure instruments.

2) a legal opinion from an appropriately qualified, independent lawyer, licensed to practice within the jurisdiction where the project is located, that endorses that the assignment and novation agreement or equivalent serves to transfer to the new owners and contractual parties all the rights and obligations in the original agreements and pore space tenure instruments.

2.2 Project Location

2.2.1 The project location shall be specified in the project description, with the following information provided:

1) The GHG emissions source location(s) (not applicable in the case of direct air capture) at the capture site(s), specified by geodetic coordinates

2) The planned CO_2 transportation network specified by a geodetic polygon, modes of transportation to be used, and their respective anticipated transport distances (where applicable)

3) The geographic area(s) of any expansion of project activities (see Section 2.4), specified by geodetic polygons

4) The flowing CO_2 connection point(s) between the added project activities and the original or previously added project areas, with each connection point specified by geodetic coordinates

5) The injection and monitoring wellhead surface location(s) and bottom hole location(s) from deviated and/or horizontal wellbores where applicable, specified by geodetic coordinates and the bottom hole depth

6) A vertical surface projection of the storage reservoir area of review delineated with geodetic polygons provided in a KML file

7) The total area of the storage reservoir surface footprint

2.3 Non-Permanence Risk

Concept

To safeguard against the risk of CO_2 loss (a reversal) from a GCS project, the Verra Registry maintains a GCS pooled buffer account that holds a percentage of all GCS project credits. Buffer credits are canceled to cover carbon known or believed to be lost. As such, VCUs already issued to projects that subsequently fail are not canceled and do not have to be "paid back." Procedures related to GCS buffer credits and the buffer pool are described in the *Registration and Issuance Process,* Section 5.

Requirements

2.3.1 Project proponents shall prepare a non-permanence risk report:

1) in accordance with the *Procedure for Applying the GCS Non-Permanence Risk Tool (NPRT)* at validation and each verification.

2) using the digital *GCS NPRT* available in the Verra Project Hub.

3) and include it as an annex to the project description or monitoring report, as applicable, or provide it as a stand-alone document.

2.3.2 Buffer credits shall be deposited in the GCS pooled buffer account based on the non-permanence risk report assessed by the validation/verification body. Buffer credits are not VCUs and cannot be traded.

2.3.3 Validation of non-permanence risk analyses may be conducted by the same validation/verification body that is conducting the validation or verification of the project and at the same time as the validation or verification of the project.

2.3.4 Where an event occurs that is likely to qualify as a loss event, the project proponent shall follow the loss event reporting requirements set out in the *Registration and Issuance Process*.

2.3.5 At the verification after the loss event, the monitoring report shall restate the loss from the loss event and calculate the net reductions and removals for the monitoring period, including the loss event, in accordance with the requirements set out in the applied methodology and the *Registration and Issuance Process*.

2.3.6 At a verification event where a reversal has occurred, the project proponent shall follow the buffer account reconciliation requirements set out in the *Registration and Issuance Process,* and no further VCUs shall be issued to the project or any other project with the same project proponent, or combination of project proponents, until the deficit is remedied. The deficit is equivalent to the full amount of the reversal, including GHG emissions from losses to project and baseline carbon stocks.

2.3.7 As set out in the *Registration and Issuance Process*, where project proponents fail to submit a verification report within the prescribed period from the previous verification event, a percentage of buffer credits is put on hold under the conservative assumption that the carbon benefits represented by buffer credits held in the GCS pooled buffer account may have been reversed or lost in the field.

2.4 Expansion of GCS Projects

Concept

A GCS project includes the full value chain of capture, transport, and storage. GCS projects may be expanded over time by adding additional elements of the value chain such as additional capture, transport, or storage sites and sharing existing infrastructure.

A new element added to a project does not represent the full value chain of capture, transport, and storage itself, and as such it is not a standalone project. It is not another instance of a project activity and is not a grouped project. A project expansion is not a unison of multiple projects but rather is restricted to the addition of project activities (capture, transport, and/or storage sites).

A project expansion can occur at any time and might not have been planned during the initial project design. The initial project before an expansion may include multiple transport facilities and capture and/or storage sites. Therefore, the initial project may have either a cooperative hub or vertically integrated operating model, and both operating models can have project expansions.

The expansion of GCS projects is managed on a case-by-case basis through the existing project description deviation requirements, with specific considerations for GCS project types.

Requirements

Eligibility Criteria

2.4.1 Expanded projects shall have a dedicated connection of CO_2 flowing between the expansion and the initial project or other previous project expansions. A dedicated connection may include, among others, a pipe connection, CO_2 transfer terminals for ships, or terminals for trucks.

Project Description for Expanding GCS Projects

2.4.2 The project expansion shall be documented as a project description deviation in accordance with the requirements set out in the *VCS Standard.*

2.4.3 Both the original and expanded project description documents shall be made available at all subsequent verifications.

2.4.4 The description and justification of the project description deviation shall include the following:

1) A description of the project expansion
2) A description of the use of any additional GCS methodologies or modules (where applicable)
3) The location of project expansion areas and connection points as specified in Section 2.2
4) Details of any new project proponents or other entities involved in the expanded project

5) Determination that the expanded project conforms to the applicability criteria of the applied methodology

6) A description of how the expansion impacts additionality or the appropriateness of the baseline scenario

3 CCS REQUIREMENTS

3.1 CCS-specific Matters

Regulatory Oversight

3.1.1 The storage site shall be located in a jurisdiction where regulatory oversight:

1) is provided by the government or a government agency (i.e., a statutory regulator).

2) meets the minimum criteria set out in Section 3.1.3.

3.1.2 Where the regulatory program meets the minimum criteria set out in Section 3.1.3 below, regulatory oversight may be demonstrated through receipt and continued validity of a permit, license, or other such authorization to construct and operate injection wells and store CO_2 in geologic reservoirs. Regulatory oversight may exist at various combinations of supra-national (e.g., the European Union), national, and sub-national levels.

3.1.3 Regulatory oversight means the following characteristics of a project are regulated:

1) **Storage site(s) selection and reservoir characterization:** Regulators have evaluated, and found adequate for the project activity, at least all of the following:

a) Reservoir capacity, including the geometry and extent of storage, and the spatial distribution of relevant geological properties (e.g., porosity, permeability, pressure, temperature, and/or fluid saturation)

b) Injectivity of the storage reservoir, including a geological and hydrogeological characterization of the storage reservoir

c) Trapping mechanism(s), including characterization of the primary seal, secondary seals (where present), and any other confining strata, faults, and fractures

d) The integrity of existing wells that penetrate the reservoir

e) Potential interaction with other subsurface activities including hydrocarbons, mineral resources, geothermal energy sources, dissolved minerals, water disposal, and other CCS projects

f) Geochemical interactions of the caprock, storage reservoir rock, and injected fluid

g) Geo-mechanical properties including natural seismicity, tectonic activity, faults, in-situ stress properties, and rock mechanical properties of both the storage reservoir and seals

2) **Well design, construction, and operating limits:** Regulators have evaluated and found adequate for the project activity at least all of the following:

a) Well designs meet the injection depth and injection rate for the project while:

i) maintaining wellbore integrity for the anticipated lifetime of the project until storage site closure,

ii) protecting groundwater sources, and

iii) withstanding anticipated conditions during the project.

b) Well casing, tubing, strings, and liners are of appropriate strength, material, and geometry to withstand the anticipated project conditions for the lifetime of the project until storage site closure, including pressure, corrosivity, temperature, and stress.

c) Cementing procedures and materials structurally support the well and casings, provide annulus seals below the base of protected groundwater and isolation at different reservoir intervals, and are appropriate to withstand the anticipated project conditions and post-injection conditions.

3) **Monitoring requirements:** Regulators require a monitoring program for the project activity that includes at least both of the following:

a) The CO_2 storage complex is monitored during the injection and closure period.

b) Responsibility for monitoring is unambiguously assigned.

4) **Storage site closure requirements:** Regulators have a documented process for the closure of storage sites that includes at least all of the following:

a) Storage sites are closed at their end-of-life.

b) Conditions, or qualifying criteria to be evaluated, are defined for successful site closure.

c) Responsibility for storage site closure, PISC funding, and post-closure liabilities are defined. Post-closure liabilities include the effort and cost of site remediation (remedial liability), but do not need to include redress for the release of injected CO_2 to the atmosphere or other zones (climate liability).

Reservoir Management

3.1.4 The storage site operator shall operate the storage site(s) such that the reservoir pressure does not reactivate faults or fracture the caprock at any point in time, and the following applies:

1) For depleted oil and gas reservoirs, the reservoir pressure shall not exceed the original pressure of the reservoir except locally around injectors during injection and well stimulation, where it must remain below the caprock fracture pressure.

2) For saline aquifers, the reservoir pressure must remain below the caprock fracture pressure.

3.2 Project Design

3.2.1 For injection in saline aquifers, the storage reservoir(s) shall have a temperature and pressure sufficient to maintain the CO_2 in liquid, supercritical, or dense phase.

3.2.2 A project may have multiple storage sites only where all of the following criteria are met:

1) All storage sites have a common storage site operator.

2) All storage sites have interconnected surface infrastructure.

3) All storage sites are located within the same jurisdictional boundary (capture and transport may be in different jurisdictions).

4) All storage sites in a project are overseen by the same regulatory authorities and operate under an integrated regulatory approval (this may include through revisions, renewals, extensions, or updates to previous approvals).

3.3 Reservoir Model

3.3.1 The storage site operator shall create the following:

1) A reservoir model based on numerical modeling simulation tools

2) A geologic evaluation that is supplemental to the reservoir model where dynamic data limitations and uncertainties exist

3.3.2 The reservoir model and geologic evaluation shall incorporate geological and geophysical data obtained from storage site selection activities, reservoir characterization activities, and ongoing results from the monitoring program. This may include well log data, petrophysical analysis, core data, test data, geophysical data (e.g., seismic, gravity), pressure data, and any other relevant data or analyses available.

3.3.3 The reservoir model shall include at least the following two elements:

1) Geostatic model: a representation of the storage complex that allows evaluation of potential behaviors

2) Flow model: a representation of the flow of CO_2 and other fluids through the storage complex. This shall build from the geostatic model, using pressure- and saturation-

dependent properties, well locations, and geometries to calculate the pressure/saturation distribution in the reservoir and the injection profiles over time.

3.3.4 The geologic evaluation shall include a geochemical and geo-mechanical evaluation that is based on outputs from the reservoir model. The evaluation shall predict risks of induced seismicity, CO_2 interactions with the geological complex, and where relevant stress changes, deformations.

3.3.5 The storage site operator shall apply the reservoir model and geologic evaluation to:

1) assess the risk of CO_2 loss (i.e., leaks).
2) evaluate the conformance of plume behavior to expectations as the project activity progresses.
3) estimate the pressure differential between pre-injection and post-injection pressures in the injection zone(s).
4) predict the CO_2 plume extent and pressure front at the expected time of site closure and the end of the post-injection assessment period (PIAP).

3.3.6 Any reservoir model or geological evaluation indicating potential non-negligible CO_2 containment loss shall be included in an update to the monitoring program as a concern and vulnerability.

3.4 CCS Monitoring Program

Concept

CCS monitoring activities seek to detect CO_2 leak precursors at a storage site to prevent and detect CO_2 leaks and quantify GHG emissions from a reversal should one occur.

A monitoring program used to satisfy jurisdictional regulatory requirements may be used to fulfill VCS Program monitoring requirements where it meets the requirements in this section.

Requirements

CCS Monitoring Program Document

3.4.1 The project description shall be accompanied by a CCS monitoring program document that includes at least the following elements:

1) Monitoring objectives and performance metrics based on systematic risk analysis and identification of potential leakage pathways
2) A description of methods used to assess the movement of the injected CO_2 plume or change in saturation, characterize the conformance of CO_2 behavior to expectations, and confirm the containment

3) A description of each monitoring technique including all of the following:

    a) Instruments and equipment used

    b) Contribution to the monitoring objectives and performance metrics established in 3.4.1(1)

    c) Application to the near-surface (including around any existing or abandoned wellbores) and subsurface

    d) Application during pre-injection, injection, closure, and post-closure

    e) Technical specifications such as sensitivity, range, depth, detection thresholds, detection frequencies, and vertical and spatial resolutions

4) A discussion of concerns and vulnerabilities including:

    a) the highest risks to permanent containment based on a systematic risk analysis.

    b) any non-negligible CO_2 containment loss model results as per Section 3.3.6.

    c) any relevant updates arising from ongoing monitoring program results and reservoir model results.

5) Urgent response and remedial plans in the event of a leak

Operations and Monitoring

3.4.2 The storage site operator shall implement the activities described in the CCS monitoring program document for the duration of the project injection period and the post-injection period until storage site closure. The project proponent shall implement post-closure monitoring where this is defined in the monitoring program.

3.4.3 The post injection site care (PISC) period shall be no less than seven years. Where regulators allow storage site closure before seven years, post-closure monitoring is required and must be defined in the CCS monitoring program document.

3.4.4 The monitoring program shall be updated, at a minimum, according to each of the following:

1) At each project crediting period renewal

2) Upon a project expansion

3) Upon prediction of a non-negligible CO_2 containment loss in the reservoir model as set out in Section 3.3.6

4) Upon identification by the monitoring program of non-negligible CO_2 loss

CCS Monitoring Program Results

3.4.5 The project proponent shall summarize monitoring program results for each monitoring period in the monitoring report including at least the following elements:

1) Results of monitoring program activities, performance metrics, and confirmation of containment or assertion of leak volume
2) Uncertainties in measured data and performance metrics from the monitoring program
3) A description of deviations or departures from the monitoring program
4) Responsibilities of key personnel involved in the implementation of the monitoring program, including their names and roles for the reporting period
5) Updated results from the reservoir model and geologic evaluations as per each task in Section 3.3.5
6) Commentary on concerns and vulnerabilities identified in the monitoring program or from the reservoir model and geologic evaluations
7) Modifications to the monitoring program going forward, including justification
8) Storage site closure conditions that have been met (for monitoring program reports that cover closure periods)

3.4.6 The project proponent shall:

1) document CCS monitoring program results at least annually after the entire project crediting period has ended for post-injection monitoring (including closure and post-closure).
2) include each of the elements in Section 3.4.5 and where applicable 3.5.3.
3) accompany post-injection monitoring program results with an opinion from a VCS approved third-party verifier affirming the confirmation of containment or assertion of leak volume.

3.5 Storage Site Closure

Concept

The closure plan describes the storage site closure activities, sets conditions for progression through the steps to close the storage site(s), and ensures that no CO_2 will leak after storage site closure.

Requirements

Closure Plan

3.5.1 The storage site operator shall create and maintain a closure plan document. The closure plan document shall include the following elements:

1) Closure conditions required by regulators as set out in Section 3.1.3(4)
2) Any additional closure conditions specified by other stakeholders including the project proponent, pore space tenure holder(s), and storage site operator(s)

3) The duration of the PISC period

4) A description of each of the PISC period activities (e.g., monitoring, abandonment of wells and facilities, corrective actions, site remediation)

5) Cost estimates for activities in the PISC period, discounted to present value and noting the following:

   a) PISC costs include monitoring program costs (from the end of injection to site closure), site closure costs, remediation costs, any corrective action costs, and post-closure monitoring costs.

   b) The discount rate applied shall be the most recently available headline consumer price index inflation for the country in which the storage site(s) is/are located, as defined by the most recent World Bank Global Database of Inflation.[2]

3.5.2 The closure plan shall be updated:

1) upon identification of non-negligible CO_2 loss by the monitoring program.

2) upon project crediting period renewal.

Storage Site Closure Conditions

3.5.3 The following conditions shall be met prior to storage site closure and shall be documented in the CCS monitoring program results for the post-injection reporting periods prior to closure:

1) Containment is confirmed at the storage site(s).

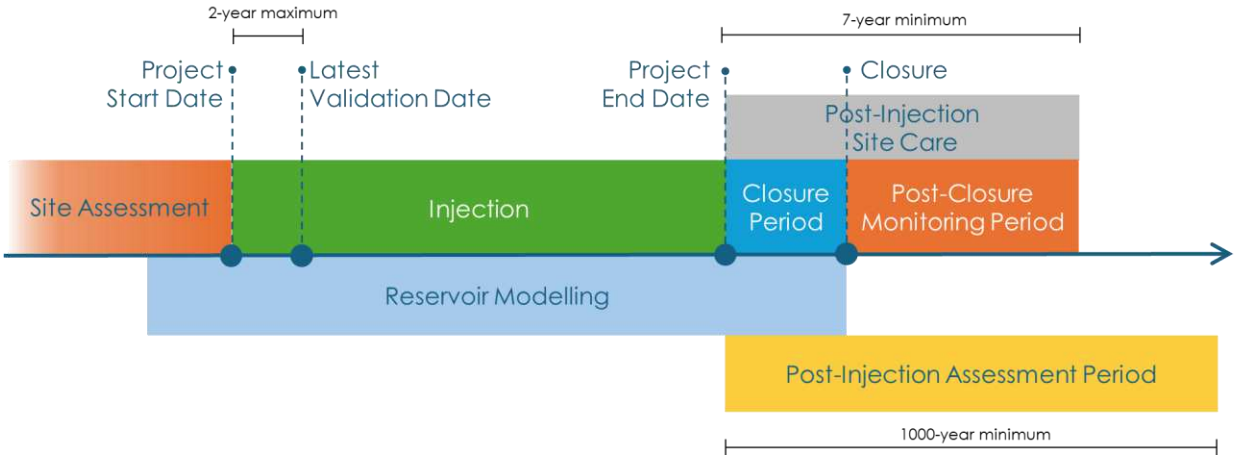
2) All closure conditions in the closure plan are met.

3) The future CO_2 plume extent and pressure front evolution through the PIAP is predicted using the reservoir model and geologic evaluations, and the risk of CO_2 loss does not increase.

[2] Available at: https://www.worldbank.org/en/research/brief/inflation-database

APPENDIX 1: GCS PROJECT TIMELINES

Figure 1. An overview of the milestones, phases, and timelines associated with a GCS project



DOCUMENT HISTORY

Version	Date	Comment
v5.0	16 Dec 2025	Updated version released under VCS Version 5

ABOUT VERRA

Verra sets the world's leading standards for climate action and sustainable development. We build standards for activities as diverse as reducing deforestation, improving agricultural practices, addressing plastic waste, and achieving gender equality. We manage programs to certify that these activities achieve measurable high-integrity outcomes. We work with governments, businesses, and civil society to advance the use of these standards, including through the development of markets. Everything we do is in service of increasingly ambitious climate and sustainable development goals, and an accelerated transition to a sustainable future.

Verra's certification programs include the Verified Carbon Standard (VCS) Program and its Jurisdictional and Nested REDD+ (JNR) framework, the Climate, Community & Biodiversity Standards (CCBS) Program, the Sustainable Development Verified Impact Standard (SD VISta) Program, and the Plastic Waste Reduction Program.

VERRA

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Reduction Standard