

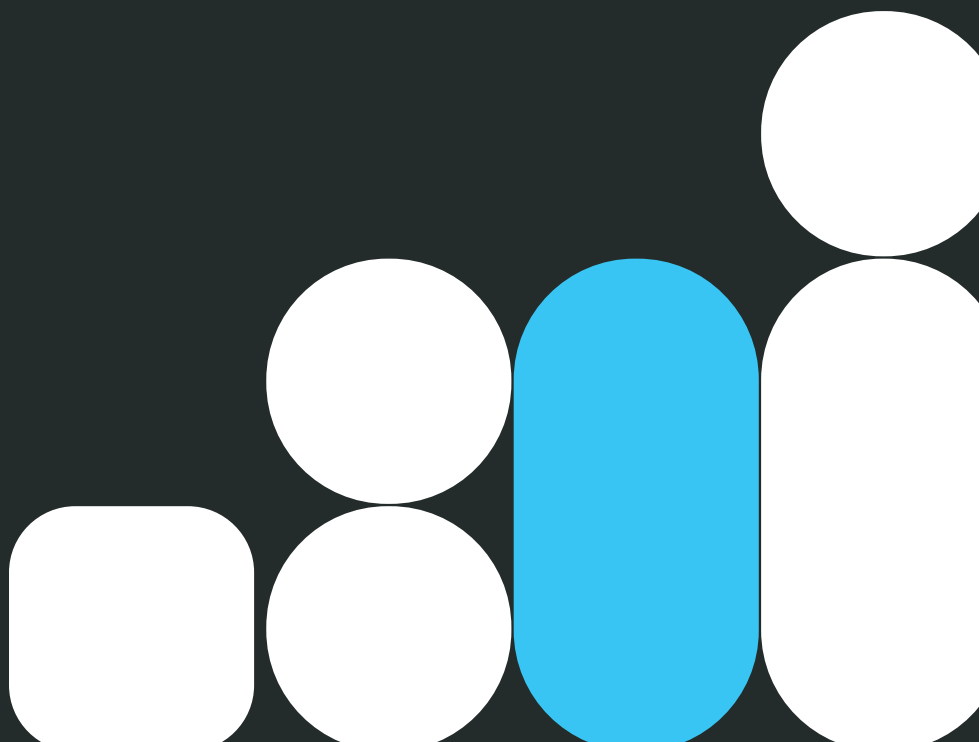


Puro.earth Certification Framework

Puro.earth CCS+ Program

Module D – CO₂ Storage in Saline Aquifers and Depleted Hydrocarbon Reservoirs

Edition 2026 V1.1 | Approved | 30 September 2026





CCS+ initiative

CCS+ Module D

CO₂ STORAGE IN SALINE AQUIFERS AND DEPLETED HYDROCARBON RESERVOIRS

Version 1.1, 30 September, 2026

Version 1.0 of this module was developed by the CCS+ Initiative, a collaboration of 48 member companies. Perspectives Climate Group GmbH and South Pole Carbon Asset Management Ltd. served as secretariat and consultants.

The CCS+ methodology framework is owned by the CCS+ Association, which acts as the secretariat of the CCS+ Initiative.



CONTENTS

1	SUMMARY DESCRIPTION	3
2	SOURCES	3
3	DEFINITIONS	4
4	APPLICABILITY CONDITIONS	4
5	PROCEDURES.....	5
5.1	Module Boundary	5
5.2	Quantification of Project Emissions	7
5.3	Quantification of Leakage	13
5.4	Uncertainty.....	14
6	DATA AND PARAMETERS	14
6.1	Data and Parameters Available at Validation	14
6.2	Data and Parameters Monitored	17
6.3	Description of the Monitoring Plan	30
	DOCUMENT HISTORY	33
7	REFERENCES	34

1 SUMMARY DESCRIPTION

This module provides procedures and requirements for project activities that store CO₂ in saline aquifers or depleted hydrocarbon reservoirs for eligible carbon capture and storage (CCS) project activities under the CCS+ Methodology *Carbon Capture and Storage*.

Project emissions from storage ($PE_{Sto,y}$) are calculated in Equation (1).

Leakage emissions from storage ($LE_{Sto,y}$) are calculated in Equation (10).

2 SOURCES

This module is used in combination with the most recent versions of the CCS+ Methodology *Carbon Capture and Storage* and the following methodologies, modules, and tools:¹

Capture Modules

- *A - CO₂ Capture from Air (Direct Air Capture)*
- *B - CO₂ Capture from Bioenergy Combustion* (not yet adopted under the Puro.earth CCS+ Program)
- *X - CO₂ Capture from Bioproduction Processes* (not yet adopted under the Puro.earth CCS+ Program)

Transport Module

- *C - CO₂ Transport for CCS Projects*

Other Modules, Tools, and Requirements

- *E - Differentiating Reductions and Removals in CCS Projects*
- *F - Accounting CO₂ in CCS Projects Using Shared Infrastructure*
- *Puro.earth CCS+ Program Annex*
 - *Section 8, Permanence Framework to assess Non-permanence risk*
 - *Section 9, Requirements for geological storage*
- *Puro.earth CCS+ Program Emissions from Electricity Consumption*

¹ The modules or tools indicated with “X” are yet to be developed.

3 DEFINITIONS

In addition to the definitions set out in the rules and requirements of Puro.earth and in the *CCS+ Methodology Carbon Capture and Storage*, the following definitions apply to this module.

Conformance

The degree of agreement among reservoir model predictions, current measurement data, and performance for the storage reservoir in a geologic carbon storage project

Depleted hydrocarbon reservoir

A subsurface reservoir that holds residual hydrocarbons (e.g., oil or gas) and has been produced by drilling of legacy wells

Legacy wells

Wells that have been drilled prior to the project activity in the storage site. They must be included in the site characterisation and monitoring plan.

Saline aquifer

An underground water source with total dissolved solids greater than 3000 mg/L

Storage site

Refers to all of the components within the storage module boundary.

4 APPLICABILITY CONDITIONS

This module applies to project activities that store CO₂ safely and permanently in saline aquifers or depleted hydrocarbon reservoirs per the criteria and procedures established in the most recent version of the *CCS+ Methodology Carbon Capture and Storage*.

This module is applicable when all of the following conditions are met:

- 1) The project activity injects a CO₂ stream for permanent storage into a saline aquifer or depleted hydrocarbon reservoir.
- 2) The project activity has mandatory monitoring point(s) for CO₂ injection downstream of all intermediate storage, compression, and other CO₂ stream conditioning (per Section 6.3).
- 3) The project activity has at least one isolation valve on each wellhead or within 10 m of the point where the CO₂ stream enters the subsurface by run-of-pipe to isolate the surface and subsurface.

This module is not applicable under the following conditions:

- 4) The project activity consists solely of upgrades to existing CCS storage facilities or changes in operational practices leading to improved storage efficiency.

Note - For storage projects already registered under the Puro.earth CCS+ Program, such improvements may occur and are considered in calculating the baseline and project emissions over the crediting period.

- 5) The project activity includes injection of CO₂ for enhanced oil recovery (EOR) or enhanced gas recovery (EGR).
- 6) The project activity intentionally extracts CO₂ from the reservoir for purposes unrelated to operation and maintenance of the storage site.

5 PROCEDURES

5.1 Module Boundary

The module boundary includes the surface facilities and subsurface equipment at the injection site, including the injection and monitoring wells and all monitoring equipment. The boundary also includes the area of review and the extent of the CO₂ plume within the geological storage complex. Projects with a point of custody transfer may use that as the upstream extent of the module boundary.

Commonly used processes to be considered in determining project emissions under this module are:

- Intermediate storage of CO₂
- Final compression and/or conditioning of CO₂ before injection
- Injection pipelines and wells, legacy wells, wellhead piping, valves, and monitoring instrumentation
- Supervisory control and data acquisition (SCADA)/communication equipment
- Injection well workovers or other maintenance operations
- CO₂ booster pumps, seal losses, and electricity consumption
- CO₂ compression with interstage cooling, valve/seal losses, and electricity consumption or fuel use
- Dehydration units (e.g., tri-ethylene glycol (TEG), desiccants, refrigeration) and associated reboilers or regeneration units

Section 5 of the most recent version of the CCS+ Methodology *Carbon Capture and Storage* provides further details on determining the module boundary. The project proponent must ensure that equipment is not omitted or double counted.

This module calculates the total emissions from the sources listed in Table 1. In cases where non-Project² CO₂ flows through the project boundary, the most recent version of *F - Accounting CO₂ in CCS Projects using shared infrastructure* must be used to calculate the proportion of emissions from project sources associated with that non-Project CO₂.

² Non-project CO₂ is defined as "Carbon dioxide that flows through a carbon capture and storage (CCS) project boundary and does not generate credits under the Puro.earth CCS+ Program" in *F - Accounting CO₂ in CCS Projects Using Shared Infrastructure*.

The boundary for this module is shown in Figure 1.

Figure 1: Module boundary for CO₂ storage in saline aquifers or depleted hydrocarbon reservoirs

Emission sources, including both primary and secondary effects included in this module, are shown in Figure 2.

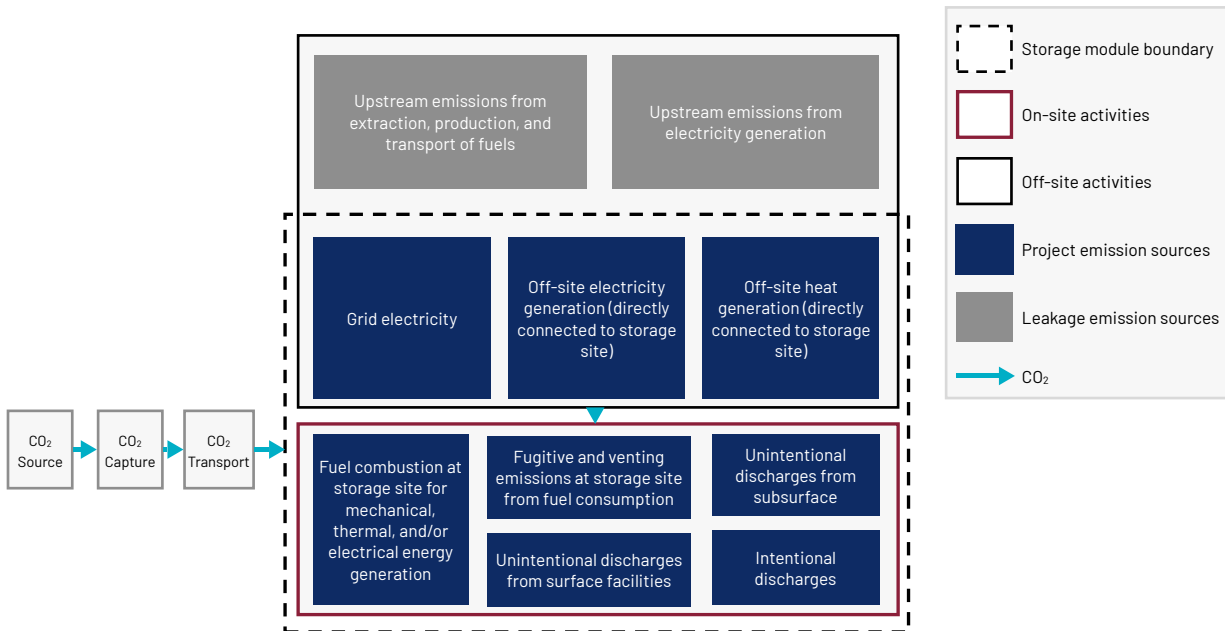


Figure 2: Included greenhouse gas sources

The greenhouse gases (GHGs) included in or excluded from the module boundary are detailed in Table 1. This module assumes that no storage of CO₂ relevant to the project activities took place in the baseline scenario. As such, no emissions sources associated with the baseline scenario are included in Table 1.

Table 1: GHG sources included in or excluded from the module boundary

Source	Gas	Included?	Justification/Explanation
Project	CO ₂	Yes	Major emission source
	CH ₄	Yes	Included for completeness
	N ₂ O	Yes	Included for completeness
	Other	No	Excluded for simplicity; emissions are considered negligible.
	CO ₂	Yes	Major emission source
	CH ₄	Yes	Included for completeness

Source		Gas	Included?	Justification/Explanation
		N ₂ O	Yes	Included for completeness
		Other	No	Excluded for simplicity; emissions are considered negligible.
	Fugitive and venting emissions from CO ₂ stream processing	CO ₂	Yes	Included. Any loss of CO ₂ due to fugitive emissions or venting during storage is inherently deducted from the overall calculation of GHG emission reductions since only injected CO ₂ volumes are quantified as the baseline emissions.
		CH ₄	No	Excluded as not considered under the baseline scenario.
		N ₂ O	No	Excluded as not considered under the baseline scenario.
		Other	No	Excluded for simplicity; emissions are considered negligible.
	Leaks of CO ₂ from the storage site (intentional and unintentional discharge from surface and subsurface)	CO ₂	Yes	Major emission source
		CH ₄	No	Excluded as not considered under the baseline scenario.
		N ₂ O	No	Excluded as not considered under the baseline scenario.
		Other	No	Excluded for simplicity; emissions are considered negligible.
	Fugitive and venting emissions from on-site fuel use	CO ₂	No	Excluded for simplicity; emissions are considered negligible.
		CH ₄	Yes	Significant emission source
		N ₂ O	No	Excluded for simplicity; emissions are considered negligible.

5.2 Quantification of Project Emissions

Project emissions are calculated as follows:

$$\begin{aligned}
 PE_{Sto,y} = & PE_{Comb_Fuel,y} + PE_{Elec,y} + PE_{Fuel_FV,y} + ID_{Surface,y} + UD_{Surface,y} \\
 & + ID_{Subsurface,y} + UD_{Subsurface,y} - PE_{nonProject\ CO_2,y}
 \end{aligned}
 \tag{1}$$

Where:

$$PE_{Sto,y} = \text{Project emissions from storage in year } y \text{ (t CO}_2\text{e)}$$

$PE_{Comb_Fuel,y}$	=	Project emissions from fuel combustion to operate the on-site and/or third-party (for off-site heat/steam supply) equipment for storage processes in year y (t CO ₂ e)
$PE_{Elec,y}$	=	Project emissions from electricity consumption to operate equipment in the storage facility in year y calculated using the <i>Puro.earth CCS+ Program Emissions from Electricity Consumption</i> (tCO ₂ e)
$PE_{Fuel_FV,y}$	=	Fugitive and venting from on-site fuel use (e.g., natural gas) at storage facilities in year y (t CO ₂ e)
$ID_{Surface,y}$	=	Intentional discharges of CO ₂ from surface equipment downstream from mandatory monitoring points in year y (t CO ₂ e)
$UD_{Surface,y}$	=	Unintentional discharges of CO ₂ from surface equipment downstream from mandatory monitoring points in year y (t CO ₂ e)
$ID_{Subsurface,y}$	=	Intentional discharges of CO ₂ from subsurface storage in year y (t CO ₂ e)
$UD_{Subsurface,y}$	=	Unintentional discharges of CO ₂ from subsurface storage in year y (t CO ₂ e)
$PE_{nonProject\ CO_2,y}$	=	Project emissions from processes and equipment related to non-Project CO ₂ in year y determined using the most recent version of <i>F - Accounting CO₂ in CCS Projects Using Shared Infrastructure</i> ; equal to zero for projects with no non-Project CO ₂ (t CO ₂ e)

5.2.1 Project Emissions from Fuel Combustion

Project emissions from fossil fuel combustion for mobile equipment, and power and heat generation are calculated as follows:

$$\begin{aligned}
 PE_{Comb_Fuel,y} = & \sum_d (Q_{Fuel,d,y} \times EF_{Fuel,CO_2,d}) \\
 & + \sum_d (Q_{Fuel,d,y} \times EF_{Fuel,CH_4,d}) \times GWP_{CH_4} \\
 & + \sum_d (Q_{Fuel,d,y} \times EF_{Fuel,N_2O,d}) \times GWP_{N_2O}
 \end{aligned} \tag{2}$$

Where:

$Q_{Fuel,d,y}$	=	Quantity of fuel type d used to operate on-site and/or third-party (for off-site heat/steam supply) equipment in year y (m ³ or kg or GJ)
$EF_{Fuel,CO_2,d}$	=	CO ₂ emission factor for combustion of fuel d (t CO ₂ /m ³ or t CO ₂ /kg or t CO ₂ /GJ); equal to zero for fuels derived from biomass ³
$EF_{Fuel,CH_4,d}$	=	CH ₄ emission factor for combustion of fuel d (t CH ₄ /m ³ or t CH ₄ /kg or t CH ₄ /GJ)
$EF_{Fuel,N_2O,d}$	=	N ₂ O emission factor for combustion of fuel d (t N ₂ O/m ³ or t N ₂ O/kg or t N ₂ O/GJ)
GWP_{CH_4}	=	Global warming potential for CH ₄ (t CO ₂ e/t CH ₄)
GWP_{N_2O}	=	Global warming potential for N ₂ O (t CO ₂ e/t N ₂ O)

³ Sustainable biomass is defined in the most recent version of *E - Differentiating Reductions and Removals in CCS Projects*.

Where no separate information on combustion emissions and upstream emissions is available for a given fuel, a combined emissions factor may be used as $EF_{Fuel,d}$ in Equation (2).

Off-site Fuel Consumption

The quantity of power or heat supplied from a directly connected off-site facility, $Q_{Fuel,d,y}$, is determined using Equation (3).

$$Q_{Fuel,d,y} = Q_{Cogen,d,y} \times \frac{(Heat_{Sto,y}/\eta_{Heat,y} + Electricity_{Sto,y}/\eta_{Elec,y})}{(Heat_{Cogen,y}/\eta_{Heat,y} + Electricity_{Cogen,y}/\eta_{Elec,y})} \quad (3)$$

Where:

$Q_{Cogen,d,y}$	=	Quantity of fuel type d used by the cogeneration unit to generate electricity and/or heat in year y (m^3 or kg or GJ)
$Heat_{Sto,y}$	=	Quantity of useful thermal energy supplied to the storage facility by the cogeneration unit in year y (MWh)
$Electricity_{Sto,y}$	=	Quantity of electricity supplied to the storage facility by the cogeneration unit in year y ; equal to zero where only heat is supplied to the storage facility (MWh)
$Heat_{Cogen,y}$	=	Total quantity of useful thermal energy produced by the cogeneration unit in year y (MWh)
$Electricity_{Cogen,y}$	=	Total quantity of electricity produced by the cogeneration unit in year y (MWh)
$\eta_{Heat,y}$	=	Efficiency of thermal energy production from cogeneration unit determined in year y using the most recent version of CDM TOOL09
$\eta_{Elec,y}$	=	Efficiency of electricity production from cogeneration unit determined in year y using the most recent version of CDM TOOL09

Waste Heat

Project emissions from the consumption of waste heat may be assumed to be zero for heat sources that meet the definition of waste heat in the CCS+ Methodology *Carbon Capture and Storage*. The emissions associated with the generation of heat that does not meet the definition of waste heat must be accounted for in Equation (2) or (3) as appropriate.

5.2.2 Fugitive and Venting Emissions from On-site Fuel Use

Project activities using natural gas must quantify fugitive and venting emissions during facility operations. Quantification is based on component counts and respective emission factors, fugitive emissions are quantified following the approach in the US Environmental Protection Agency's *Electronic Code of Federal Regulations*, Title 40, Part 98, Subpart W, § 98.233 (r).⁴

⁴ Available at: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-W/section-98.233>

Examples of emission sources for fugitive emissions include components such as valves, pipe fittings/connectors, open-ended pipes, pressure relief valves, flanges, meters, and instruments.

$$PE_{Fuel_FV,y} = (\sum_n Count_{n,y} \times EF_n \times T_{n,y} \times 0.001 + \sum_m V_m) \times GWP_{CH_4} \quad (4)$$

Where:

$Count_{n,y}$	=	Total number of components n in natural gas service at the facility during year y (unitless)
EF_n	=	Emission factor for fugitive emissions for component n (kg CH ₄ /hr/unit)
$T_{n,y}$	=	Pressurised time of component n in year y (hours)
V_m	=	Vented CH ₄ emissions for venting event m (t CH ₄ /event)
0.001	=	Conversion from kg to t

5.2.3 Project Emissions from Intentional Discharges

Project emissions from intentional discharges are a result of venting that is downstream of mandatory monitoring points. Venting events can be differentiated by whether they originate from surface facilities ($ID_{Surface}$) or the subsurface ($ID_{Subsurface}$).

Surface venting includes activities resulting from operator intervention (e.g., blowdown of piping and/or pigging operations) or an automated system response to process conditions (e.g., pressure safety valve releasing in response to high pressure as per design). These activities must be related to the operation and maintenance of the storage site. Extraction of CO₂ from the reservoir for utilisation or other commercial interests is not allowed.

For surface venting, the project proponent must measure the quantity of CO₂ according to the conditions given in Approaches 1, 2, or 3 below.

Subsurface venting includes activities related to injection well maintenance. For subsurface venting, the project proponent must determine the quantity of CO₂ according to Approach 1.

The project proponent must actively monitor and report intentional discharge emissions using the approaches below. Please refer to Section 8.1 of the CCS+ Methodology *Carbon Capture and Storage* to determine CO₂ flow, density, and concentration.

Note - For projects registering under the Puro.earth CCS+ Program, emissions from intentional discharges may be assumed to be zero in the project description template.

Approach 1: Measurement of Venting

Under this approach intentional discharges in year y must be calculated using either mass flow or volumetric flow.

Option 1: Mass flow

$$ID_{Surface,y} \text{ or } ID_{Subsurface,y} = \sum_h FR_{mass,h} \times \%CO2_{mass,h} \times T_h \quad (5)$$

Where:

$ID_{Surface,y}$	=	Intentional discharges of CO ₂ from the surface in year y (t CO ₂ e)
$ID_{Subsurface,y}$	=	Intentional discharges of CO ₂ from the subsurface in year y (t CO ₂ e)
$FR_{mass,h}$	=	Mass flow rate for discharge event h (tonnes/hour)
$\%CO_{2mass,h}$	=	CO ₂ concentration in the mass flow for discharge event h (% mass)
T_h	=	Venting time for discharge event h (hours)

Option 2: Volumetric flow

$$ID_{Surface,y} \text{ or } ID_{Subsurface,y} = \sum_h FR_{vol(STP),h} \times \%CO_{2vol(STP),h} \times \rho CO_{2(STP)} \times T_h \quad (6)$$

Where:

$FR_{vol(STP),h}$	=	Volumetric flow rate for discharge event h measured at actual conditions and converted to standard temperature and pressure (STP) conditions (m ³ /hour)
$\%CO_{2vol(STP),h}$	=	Volumetric fraction of CO ₂ in flow for discharge event h at STP conditions (% volume)
$\rho CO_{2(STP)}$	=	Density of CO ₂ at STP conditions (t CO ₂ /m ³)

Approach 2: Estimation of Surface Venting for Isolated Volumes

Where any part of an isolated section of pipe is downstream of the mandatory monitoring point and is depressurised, project proponents must estimate the vented mass of CO₂ using the volume of the isolated pipe and Equation (7).

$$ID_{Surface,y} = \sum_m \sum_n v_{n,m(STP)} \times \%CO_{2vol(STP)} \times \rho CO_{2(STP)} \quad (7)$$

Where:

$v_{n,m(STP)}$	=	The actual internal volume of each pipe, pipe fitting, and component n in the isolated vent section for venting event m , converted to a STP volume based on actual process conditions (m ³)
----------------	---	--

Approach 3: Estimation of Surface Venting for Non-Isolated Volumes

Where Approaches 1 and 2 are not applicable for surface venting (e.g., where the volume of the isolated pipe cannot be determined or the venting event was from a non-isolated and flowing pipe), use Approach 3.

The project proponent must determine the quantity of vented CO₂ ($ID_{Surface,y}$) by transient flow rate calculations for compressible fluids appropriate for the expected evolving conditions in the pipeline or component (e.g., gaseous, dense, super-critical fluids using a critical flow model) based on the approximate geometry of the escaping flow and pipelines/components connected to the venting. The project proponent must justify the appropriateness of all calculations, models, correlations, or empirical relationships used and demonstrate the result is conservative.

5.2.4 Project Emissions from Unintentional Discharges at the Surface

The project proponent must actively monitor and report unintentional discharge emissions using the approaches below. The potential emission sources for unintentional discharges of CO₂ include components (e.g., valves, pipe fittings/connectors, open-ended pipes, pressure relief valves, flanges, meters, instruments) and pipelines.

Note - For projects registering under the Puro.earth CCS+ Program, emissions from unintentional discharges may be assumed to be zero in the project description template.

Two emission sources are considered for unintentional discharge of CO₂ at the surface.

Emission Source 1: Fugitive Emissions Downstream of the Mandatory Monitoring Point

In this scenario, $UD_{Surface,y}$ for pipelines and other components is determined as follows:

$$UD_{Surface,y} = \sum_p EF_p \times T_{p,y} \times b \times 0.001 + \sum_n EF_n \times T_{n,y} \times 0.001 \quad (8)$$

Where:

EF_p	=	Emission factor for pipeline p derived from nationally appropriate regulations or default value of 0.26 (kg CO ₂ /hr/km)
EF_n	=	Emission factor of fugitive emissions for component n (kg CO ₂ /hr)
$T_{p,y}$	=	Pressurised time of pipeline p in year y (hours)
$T_{n,y}$	=	Pressurised time of component n in year y (hours)
b	=	Length of pipeline from mandatory monitoring point to injection well (km)

Emission Source 2: Rupture or Line-Break Downstream of Mandatory Monitoring Point

A rupture or line-break failure is considered to have occurred where the flow rate through the failure is substantial enough to be considered a safety hazard as defined in local requirements off-site nuisance due to odour or noise. Failures that qualify as a safety hazard must be corrected in accordance with local requirements upon detection and ahead of the calculations that follow. Otherwise, the failure may be considered a fugitive emission.

Where a component or pipeline that is downstream of the mandatory monitoring point and upstream of the wellhead and reservoir suffers a rupture or line-break failure, the proponent must:

- 1) Isolate the failure; and
- 2) Quantify the loss of CO₂ ($UD_{Surface,y}$) through:
 - a) *Emissions before isolation:* Determine the quantity of lost CO₂ by estimating the flow rate through the failure using transient flow rate calculations for compressible fluids appropriate for the expected conditions in the pipeline or component (e.g., gaseous, dense, super-critical) based on the approximate geometry of the escaping flow and pipelines/components connected to the failure. The estimation must be for the approximate time between when the failure occurred and when the release was stopped. Where the approximate time at which the failure occurred is unknown, the leakage event

duration must be estimated conservatively by assuming the leakage event existed from the last known and documented regular operation (e.g., last inspection) until the release was stopped.

b) *Emissions after isolation*: Use Approach 3 in Section 5.2.3 to calculate leaked emissions.

5.2.5 Project Emissions from Unintentional Discharges from Subsurface Storage

Project emissions from unintentional discharges from the subsurface are CO₂ leaks (loss event) from the geological storage complex. They are calculated according to the following equation.

$$UD_{Subsurface,y} = \sum_a (Q_{LE,a}) + Q_{Threshold,y} \quad (9)$$

Where:

- $Q_{LE,a}$ = Quantity of CO₂ released from the storage reservoir during leak event a (tonnes)
- $Q_{Threshold,y}$ = Maximum undetected quantity of CO₂ that may have leaked, as defined in the monitoring plan (tonnes)

Section 6.3 provides guidance on determining $Q_{LE,a}$ and $Q_{Threshold,y}$.

5.3 Quantification of Leakage

Equation (10) accounts for leakage emissions in this module.

$$LE_{Sto,y} = LE_{Fuel,y} + LE_{Elec,y} - LE_{nonProject CO2,y} \quad (10)$$

Where:

- $LE_{Sto,y}$ = Leakage emissions from storage in year y (t CO₂e)
- $LE_{Fuel,y}$ = Leakage emissions from upstream fuel consumption for storage processes in year y (t CO₂e)
- $LE_{Elec,y}$ = Leakage emissions from electricity consumption to operate equipment in the storage facility in year y calculated using the *Puro.earth CCS+ Program Emissions from Electricity Consumption* (tCO₂e)
- $LE_{nonProject CO2,y}$ = Leakage emissions from processes and equipment related to non-Project sources in year y determined using the most recent version of *F - Accounting CO₂ in CCS Projects Using Shared Infrastructure*; equal to zero for projects with no non-Project CO₂ (t CO₂e)

5.3.1 Leakage Emissions from Fuel Consumption

Upstream emissions from the production and transportation of fuel to the storage site and directly connected off-site facilities are calculated using Equation (11).

Equation (11) is not required if an emissions factor covering both fuel combustion ($EF_{Fuel,d}$) and upstream emissions ($EF_{Upstream_Fuel,d,y}$) was used in Equation (2).

$$LE_{Fuel,y} = \sum_d (Q_{Fuel,d,y} \times EF_{Upstream_Fuel,d,y}) \quad (11)$$

Where:

- $Q_{Fuel,d,y}$ = Quantity of fuel type d used to operate on-site and/or third-party (for off-site heat/steam supply) equipment in year y (m^3 or kg or GJ)
- $EF_{Upstream_Fuel,d,y}$ = Emission factor for upstream sources related to fuel type d used in equipment in the storage module boundary in year y ($t\ CO_2e/m^3$ or $t\ CO_2e/kg$ or $t\ CO_2e/GJ$)

Where power and heat are supplied from an off-site facility, $Q_{Fuel,d,y}$ must be determined as a proportion of the total fuel used to generate the total electricity and heat at the directly connected facility using Equation (3).

5.4 Uncertainty

The main source of uncertainty identified for the project activities covered in this module is measurement error. Significant uncertainty may exist in the project-specific monitoring programme for unintentional discharges (i.e., leaks from the reservoir) but is discounted through the conservative deduction $Q_{Threshold}$ (see Section 6.3) and may be ignored. All other potential sources of uncertainty are either considered de minimis or accounted for in the conservativeness of the default factors.

Uncertainty of measurement error related to project emissions from fuel combustion for storage activities is considered de minimis where the metering equipment used for determining fuel volumes, $Q_{fuel,d,y}$, uses a custody transfer meter or fiscal metering for a transaction.

Uncertainty of measurement or estimation error from intentional discharges at the storage site is considered de minimis where the magnitude of the emissions from venting is less than 2% of the net emission reduction or removal benefit of the project.

Proponents whose projects do not meet the above conditions for a source of uncertainty must include that source of uncertainty in their uncertainty assessment.

6 DATA AND PARAMETERS

Additional data and parameters are defined in the *CCS+ Methodology Carbon Capture and Storage* and related tools (Puro.earth documents and CDM tools) as applicable.

6.1 Data and Parameters Available at Validation

Data/Parameter	GWP_{CH_4}
Data unit	$t\ CO_2e/t\ CH_4$

Description	Global warming potential for CH ₄
Equations	(2), (4)
Source of data	Version of IPCC Assessment Report required by Puro.earth Common Criteria.
Value applied	See the most recent version of the Puro.earth Common Criteria.
Justification of choice of data or description of measurement methods and procedures applied	Required by the Puro.earth Common Criteria
Purpose of data	Calculation of project emissions
Comments	N/A

Data/Parameter	GWP_{N2O}
Data unit	t CO ₂ e/t N ₂ O
Description	Global warming potential for N ₂ O
Equations	(2)
Source of data	Version of IPCC Assessment Report required by Puro.earth Common Criteria.
Value applied	See the most recent version of the Puro.earth Common Criteria.
Justification of choice of data or description of measurement methods and procedures applied	Required by the Puro.earth Common Criteria
Purpose of data	Calculation of project emissions
Comments	N/A

Data/Parameter	b
Data unit	km

Description	Length of pipeline from mandatory monitoring point to injection well
Equations	(8)
Source of data	Manufacturer specifications, part lists, measurement
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of data	Calculation of project emissions
Comments	N/A

Data/Parameter	EF_p
Data unit	kg CO ₂ /hr/km
Description	Emission factor for pipeline p
Equations	(8)
Source of data	<p>Derived from US Environmental Protection Agency (EPA). Mandatory Greenhouse Gas Reporting, Subpart W and converted to CO₂ emission factors on a mass basis using a conversion factor of 0.6 (CH₄ to CO₂) and a CO₂ density of 0.0526 kg/ft³ (US EPA) at standard conditions (15 °C, 1 atm).</p> <p>The CH₄ to CO₂ conversion factor used is taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 5 Carbon Dioxide Transport, Injection and Geological Storage, Box 5.1. Deviation of Default emission factors for CO₂ pipeline transport (https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_5_Ch5_CCS.pdf)</p>
Value applied	Factor from nationally appropriate regulations or default value of 0.26. Projects using the default value must ensure that the assumptions and underlying conversion factors taken from the above data sources are current.

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of data	Calculation of project emissions
Comments	N/A

Data/Parameter	EF_n
Data unit	kg CO ₂ /hr
Description	Emission factor of fugitive emissions for component n
Equations	(4), (8)
Source of data	<p>Derived from US Environmental Protection Agency (EPA). Mandatory Greenhouse Gas Reporting, Subpart W and converted to CO₂ emission factors on a mass basis using a conversion factor of 0.6 (CH₄ to CO₂) and a CO₂ density of 0.0526 kg/ft³ (US EPA) at standard conditions (15 °C, 1 atm).</p> <p>The CH₄ to CO₂ conversion factor used is taken from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 5 Carbon Dioxide Transport, Injection and Geological Storage, Box 5.1. Deviation of Default emission factors for CO₂ pipeline transport (https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_5_Ch5-CCS.pdf)</p>
Value applied	Use the most recent data published by the above sources at the time of reporting project emissions.
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of data	Calculation of project emissions
Comments	N/A

6.2 Data and Parameters Monitored

Data/Parameter	$Q_{Fuel,d,y}$
----------------	----------------

Data unit	m ³ or kg or GJ
Description	Quantity of fuel type <i>d</i> used to operate on-site and/or third-party (for off-site heat/steam supply) equipment in year <i>y</i>
Equations	(2), (11)
Source of data	Fuel receipts/invoices or flow meter readings
Description of measurement methods and procedures to be applied	Measured from flow meters or calculated from fuel receipts/invoices.
Frequency of monitoring/recording	Aggregated annually
QA/QC procedures to be applied	Measuring equipment (e.g., flow meters, weighing scale) must operate within the manufacturer's specified operating conditions and must be routinely calibrated, inspected, and maintained according to the manufacturer's specifications.
Purpose of data	Calculation of project and leakage emissions
Calculation method	Volumetric gas flow meter readings must be corrected for temperature and pressure.
Comments	N/A

Data/Parameter	$EF_{Fuel,CO_2,d}$
Data unit	t CO ₂ /m ³ or t CO ₂ /kg or t CO ₂ /GJ
Description	CO ₂ emission factor for combustion of fuel <i>d</i>
Equations	(2)
Source of data	<p>The following data sources may be used:</p> <ol style="list-style-type: none"> 1) Emission factor from IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change 2) Emission factors published by US EPA https://www.epa.gov/climateleadership/ghg-emission-factors-hub or similar source 3) Data provided by the fuel supplier or manufacturer where the data used is consistent with that reported to a regulatory body.

Description of measurement methods and procedures to be applied	Use the most recent data published by the above sources at the time of reporting project emissions.
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	$EF_{Fuel, CH_4, d}$
Data unit	t CH ₄ /m ³ or t CH ₄ /kg or t CH ₄ /GJ
Description	CH ₄ emission factor for combustion of fuel <i>d</i>
Equations	(2)
Source of data	<p>The following data sources may be used:</p> <p>1) Emission factor from IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change</p> <p>2) Emission factor from US EPA https://www.epa.gov/climateleadership/ghg-emission-factors-hub or a similar source</p> <p>3) Data provided by the fuel supplier or manufacturer where the data used is consistent with that reported to a regulatory body.</p>
Description of measurement methods and procedures to be applied	Use the most recent data published by the above sources at the time of reporting project emissions.
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions

Calculation method	N/A
Comments	N/A

Data/Parameter	$EF_{Fuel,N_2O,d}$
Data unit	t N ₂ O/m ³ or t N ₂ O/kg or t N ₂ O/GJ
Description	N ₂ O emission factor for combustion of fuel <i>d</i>
Equations	(2)
Source of data	<p>The following data sources may be used:</p> <p>1) Emission factor from IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change</p> <p>2) Emission factor from US EPA https://www.epa.gov/climateleadership/ghg-emission-factors-hub or a similar source</p> <p>3) Data provided by the fuel supplier or manufacturer where the data used is consistent with that reported to a regulatory body.</p>
Description of measurement methods and procedures to be applied	Use the most recent data published by the above sources at the time of reporting project emissions.
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	N/A
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	$Q_{Cogen,d,y}$
Data unit	m ³ or kg or GJ
Description	Quantity of fuel type <i>d</i> used by the cogeneration unit to generate electricity and/or heat in year <i>y</i>

Equations	(3)
Source of data	Fuel receipts/invoices or flow meter readings, as applicable
Description of measurement methods and procedures to be applied	Measured from flow meters or calculated from fuel receipts/invoices.
Frequency of monitoring/recording	Continuous or for every invoice, aggregated annually
QA/QC procedures to be applied	Measuring equipment (e.g., flow meters, weighing scale) must operate within the manufacturer's specified operating conditions and must be routinely calibrated, inspected, and maintained according to manufacturer specifications.
Purpose of data	Calculation of project emissions
Calculation method	Monthly fuel consumption is determined by summing the quantities from calibrated device readings or fuel receipts/invoices.
Comments	Invoices and/or contracts with the third party must be in place to allow proper data collection.

Data/Parameter	$Heat_{Sto,y}$
Data unit	MWh
Description	Quantity of useful thermal energy supplied to the storage facility by the cogeneration unit in year y
Equations	(3)
Source of data	Utility receipts/invoices or metered data for heat usage
Description of measurement methods and procedures to be applied	Measured from calorimeters or calculated from receipts/invoices.
Frequency of monitoring/recording	Aggregated annually
QA/QC procedures to be applied	The calorimeter must be routinely calibrated, inspected, and maintained according to manufacturer specifications.

Purpose of data	Calculation of project emissions
Calculation method	Monthly supplied heat is determined by summing the quantities from calibrated device readings or fuel receipts/invoices.
Comments	Invoices and/or contracts with the third party must be in place to allow proper data collection.

Data/Parameter	$Electricity_{Sto,y}$
Data unit	MWh
Description	Quantity of electricity supplied to the storage facility by the cogeneration unit in year y
Equations	(3)
Source of data	Utility receipts/invoices or metered data for electricity use
Description of measurement methods and procedures to be applied	Measured from electricity meters or calculated from receipts/invoices.
Frequency of monitoring/recording	Aggregated annually
QA/QC procedures to be applied	Electricity meters must be routinely calibrated, inspected, and maintained according to manufacturer specifications.
Purpose of data	Calculation of project emissions
Calculation method	Monthly supplied electricity is determined by summing the quantities from calibrated device readings or fuel receipts/invoices.
Comments	Invoices and/or contracts with the third party must be in place to allow proper data collection.

Data/Parameter	$Heat_{Cogen,y}$
Data unit	MWh
Description	Total quantity of useful thermal energy produced by the cogeneration unit in year y
Equations	(3)

Source of data	Utility receipts/invoices or metered data for heat produced
Description of measurement methods and procedures to be applied	Direct measurement of steam flows (or other heat transfer fluid) and characteristics at the cogeneration facility, taking into consideration energy content in steam and condensate return
Frequency of monitoring/recording	Aggregated annually
QA/QC procedures to be applied	Calorimeters must be routinely calibrated, inspected, and maintained according to manufacturer specifications.
Purpose of data	Calculation of project emissions
Calculation method	Monthly useful thermal energy produced by the energy facility is determined by summing the quantities from calibrated device readings or fuel receipts/invoices.
Comments	Invoices and/or contracts with the third party must be in place to allow proper data collection.

Data/Parameter	<i>Electricity_{Cogen,y}</i>
Data unit	MWh
Description	Total quantity of electricity produced by the cogeneration unit in year y
Equations	(3)
Source of data	Utility receipts/invoices or metered data
Description of measurement methods and procedures to be applied	Measured from electricity meters or calculated from receipts/invoices.
Frequency of monitoring/recording	Aggregated annually
QA/QC procedures to be applied	Invoices and/or contracts with the third party
Purpose of data	Calculation of project emissions
Calculation method	Monthly electricity produced by the energy facility is determined by summing the quantities from calibrated device readings or fuel receipts/invoices.

Comments	Invoices and/or contracts with the third party must be in place to allow proper data collection.
----------	--

Data/Parameter	$Count_{n,y}$
Data unit	Unitless
Description	Total number of components n in natural gas service at the facility during year y
Equations	(4)
Source of data	Records of storage facility (e.g., pipe and instrument drawing, parts lists)
Description of measurement methods and procedures to be applied	Counting based on facility records as per US EPA Electronic Code of Federal Regulations Title 40, Chapter I, Subchapter C, Part 98, Subpart W § 98.233. Available at: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-W/section-98.233#p-98.233(a)(1)
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	Use the most recent data available from the storage facility.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	T_y
Data unit	hours
Description	Venting time in year y
Equations	(5), (6)
Source of data	Measurement on-site

Description of measurement methods and procedures to be applied	Venting time must be recorded.
Frequency of monitoring/recording	Monitored continuously
QA/QC procedures to be applied	Use the most recent data available from the storage facility.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	V_m
Data unit	t CH ₄ /event
Description	Vented CH ₄ emissions for venting event m
Equations	(4)
Source of data	Data from the storage facility
Description of measurement methods and procedures to be applied	<p>Option 1: Direct measurement of venting</p> <p>Option 2: Estimated based on isolated volumes of pipes and equipment</p> <p>Option 3: Estimated based on non-isolated volumes of pipes and equipment. The project proponent must determine the quantity of vented CH₄ by transient flow rate calculations for compressible fluids appropriate for the expected evolving conditions in the pipeline or component based on the approximate geometry of the escaping flow and pipelines/components connected to the venting.</p>
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	Cross-checked based on energy balance related to metered fuel use.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	$V_{n,m(STP)}$
Data unit	m^3
Description	Internal volume of each pipe, pipe fitting, and component n in the isolated vent section for venting event m , at STP conditions
Equations	(7)
Source of data	Manufacturer specifications, engineering calculations, and geometric data for the pipeline and components
Description of measurement methods and procedures to be applied	The internal volume is determined through engineering calculations that use geometric data (e.g., length, diameter) and manufacturer specifications for each pipe, pipe fitting, and component within the isolated vent section. The volume is calculated for each vent event m .
Frequency of monitoring/recording	Recorded for each vent event m and aggregated annually
QA/QC procedures to be applied	Manufacturer specifications should be cross-checked with as-built documentation and verified for accuracy. Any deviations or assumptions used in the calculation must be documented and justified.
Purpose of data	Calculation of project and leakage emissions
Calculation method	The volume is calculated by applying geometric formulae to the dimensions of the pipeline and components, using the specified internal diameters and lengths as provided by the manufacturer or engineering drawings.
Comments	N/A

Data/Parameter	$T_{p,y}$
Data unit	hours
Description	Pressurised time of pipeline p in year y
Equations	(8)
Source of data	Measurement on-site

Description of measurement methods and procedures to be applied	The operating time of the monitored pipeline or component must be recorded.
Frequency of monitoring/recording	Monitored continuously
QA/QC procedures to be applied	Use the most recent data available from the storage facility.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	$T_{n,y}$
Data unit	hours
Description	Pressurised time of component n in year y
Equations	(4), (8)
Source of data	Measurement on-site
Description of measurement methods and procedures to be applied	The operating time of the monitored pipeline or component must be recorded.
Frequency of monitoring/recording	Monitored continuously
QA/QC procedures to be applied	Use the most recent data available from the storage facility.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data/Parameter	$Q_{LE,a}$
Data unit	tonnes

Description	Quantity of CO ₂ released from the storage reservoir during leak event <i>a</i>
Equations	(9)
Source of data	Estimated
Description of measurement methods and procedures to be applied	Use the reservoir model, and monitoring data available to estimate a quantity of CO ₂ released from the reservoir
Frequency of monitoring/recording	At each loss event
QA/QC procedures to be applied	Dependent on the method(s) used
Purpose of data	Calculation of project emissions
Calculation method	Calculated based on procedures provided in Section 6.3.
Comments	N/A

Data/Parameter	$Q_{Threshold,y}$
Data unit	tonnes
Description	Maximum undetected quantity of CO ₂ that may have leaked, as defined in the monitoring plan
Equations	(9)
Source of data	Calculated based on procedures provided in Section 6.3
Description of measurement methods and procedures to be applied	Calculated based on procedures provided in Section 6.3
Frequency of monitoring/recording	Updated in line with the updated monitoring plan
QA/QC procedures to be applied	Dependent on the method(s) used
Purpose of data	Calculation of project emissions
Calculation method	Calculated based on procedures provided in Section 6.3

Comments	N/A
Data/Parameter	$EF_{Upstream_Fuel,d,y}$
Data unit	t CO ₂ e/m ³ or t CO ₂ e/kg or t CO ₂ e/GJ
Description	Emission factor for upstream sources related to fuel type <i>d</i> used in equipment in the storage module boundary in year <i>y</i>
Equations	(11)
Source of data	<p>The value of this parameter may be obtained from the following sources:</p> <ol style="list-style-type: none"> 1) An LCA conducted by a qualified third party in accordance with the most recent versions of ISO 14040 and 14044, that uses either primary or published and peer-reviewed data⁵ 2) A compliance market-approved tool (e.g., such as CA-GREET⁶, GHGenius⁷); 3) Emission factors published in peer-reviewed literature⁸ that are representative of the fuels used at the storage site both temporally and geographically 4) Data provided by the fuel supplier or manufacturer where the data used is consistent with that reported to a regulatory body.
Description of measurement methods and procedures to be applied	Use the most recent data published by the above sources at the time of reporting project emissions.
Frequency of monitoring/recording	Annual
QA/QC procedures to be applied	<p>Use the most recent data published by the above sources at the time of reporting project emissions.</p> <p>Where peer-reviewed literature is used, it must have been published within a year of reporting project emissions. It must be temporally and geographically representative of the storage site.</p>
Purpose of data	Calculation of leakage emissions

⁵ State or national government data on a fuel's carbon intensity are also acceptable sources of data for determining emission factors for fuels used by the transport facility.

⁶ The Greenhouse Gases, Regulated Emissions and Energy use in Technologies (GREET) model. Available at: <https://greet.es.anl.gov/>

⁷ Model for Life Cycle Assessment of Transportation Fuels. Available at: <https://www.ghgenius.ca/>

⁸ Peer-reviewed literature must be indexed in the Web of Science: Science Citation Index (SCI; available at <https://mjl.clarivate.com>), as specified in the methodology requirements of the Puro.earth CCS+ Program.

Calculation method	N/A
Comments	N/A

6.3 Description of the Monitoring Plan

Each project must have a monitoring plan that supports the permanent storage of CO₂ injected by ensuring the containment of the plume over time. In addition to the rules and requirements of Puro.earth and the requirements in Sections 9.5, 9.1, and 9.3 of the Puro.earth CCS+ Program Annex, the monitoring plan must:

- 1) Outline the mandatory monitoring point(s) for CO₂ injection downstream of all intermediate storage, compression, or other CO₂ conditioning.
 - a) For onshore injection wells:
 - i) Where multiple injection wellheads are served by one mandatory monitoring point, it must be located 500 m or less by run-of-pipe from all injection wellhead(s).
 - ii) Where one injection wellhead is served by one mandatory monitoring point, it must be located 300 m or less by run-of-pipe from the injection wellhead.
 - b) For offshore injection wells:
 - i) Where offshore wells are connected by sub-sea pipeline to onshore facilities, the mandatory monitoring point must be located 500 m or less by run-of-pipe from the pipeline landfall point.
 - ii) Where offshore wells are connected to fixed or floating platforms, the mandatory monitoring point must be located 500 m or less by run-of-pipe from the submersion point.
- 2) Describe techniques used to detect, localise, and quantify subsurface CO₂ movement outside the geological storage complex of the project, including relevant parameters of each technique such as the detection threshold, probability of detection, resolution, and frequency.
- 3) Define a specific detection threshold to detect a loss of containment (e.g., t CO₂/year or t CO₂) for each monitoring technique.
- 4) Define the expected mean time to detect a loss of containment at the project-specific threshold for each intermittent monitoring technique (considering the planned frequency of use). The specific detection threshold to detect a loss of containment and the expected mean time to detection must also be specified in the project description.
- 5) Outline how the reservoir model and monitoring approaches are used to localise and quantify the loss of containment.
- 6) Define the maximum undetected leak ($Q_{Threshold,y}$) by considering all of the following:

- a) Leak estimations for each likely pathway (based on each unique loss of containment incident) and the summation of the emissions released from each pathway respectively (total sum);
- b) For continuous monitoring approaches, the threshold for detection as defined in the monitoring plan, and
- c) For discontinuous monitoring approaches, the threshold for detection and the expected mean time to detect a loss of containment as defined in the monitoring plan.

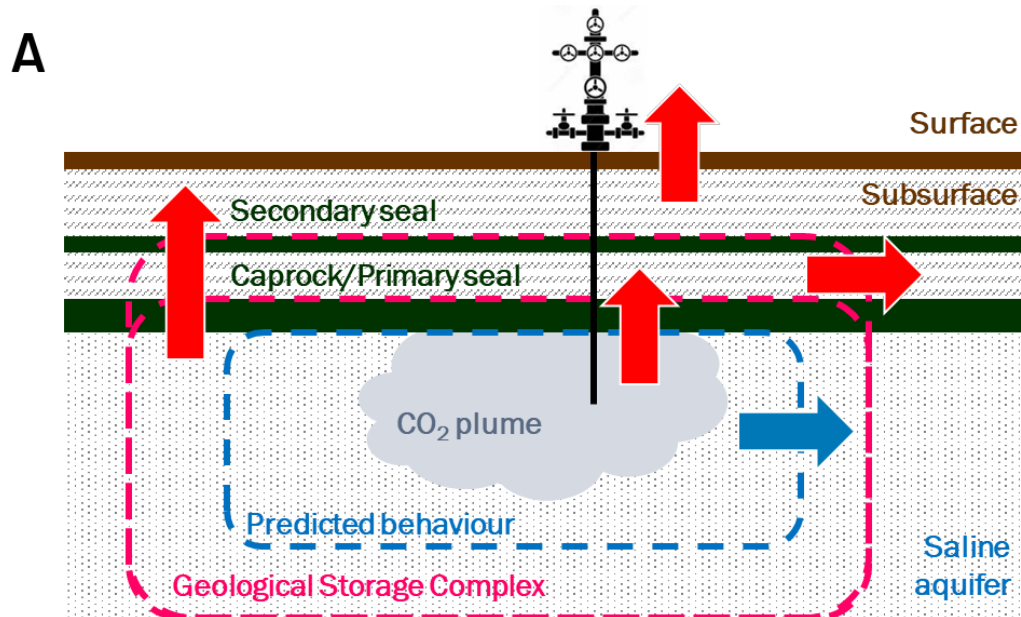
6.3.1 Loss of Conformance and Containment Events

The monitoring plan must be able to detect losses of conformance and containment.

A loss of conformance occurs where the injected CO_2 does not adhere to the predicted behaviour based on the reservoir model but remains within the target geological storage complex and does not migrate outside of a seal(s). A loss of conformance may lead to a loss of containment.

A loss of containment occurs where the injected CO_2 migrates out of the geological storage complex and its respective seal(s). A loss of containment may occur in another subsurface layer or directly in the atmosphere. For example, this may occur along a wellbore or natural or induced fractures.

A simplified representation of the subsurface is provided in Figure 3. Acknowledging the complexity and heterogeneity of the subsurface, only one type of reservoir and several potential flow pathways are provided as examples.



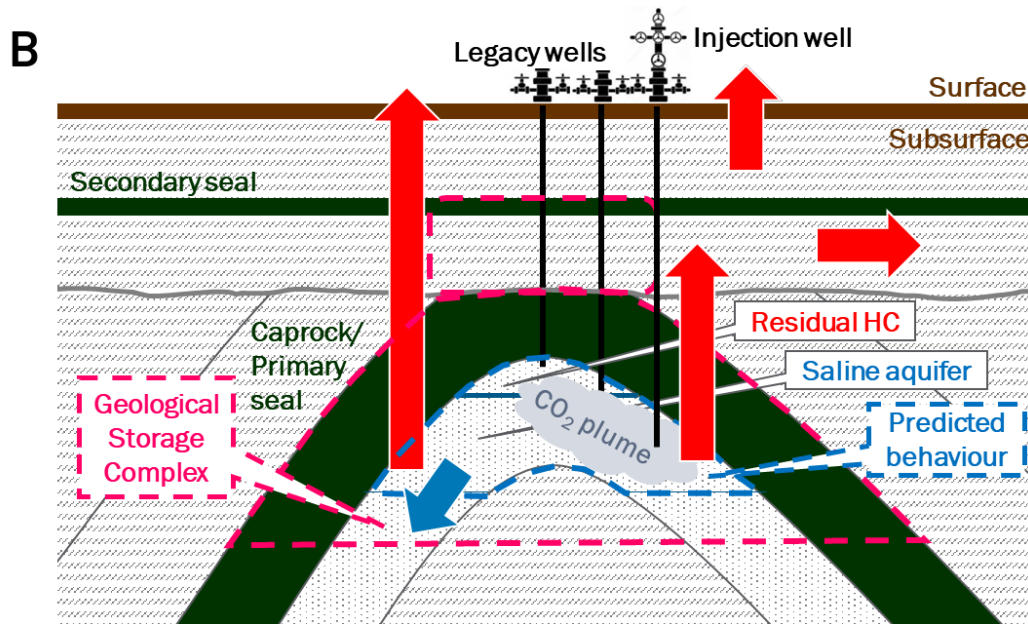


Figure 3: Simplified representation of losses of containment (red arrows) and conformance (blue arrow) examples for A) saline aquifers and B) depleted hydrocarbon reservoirs

Upon identification of a loss of CO₂ conformance, and prior to the subsequent verification, the project proponent must:

- 1) Evaluate the potential for current or future release to the atmosphere,
- 2) Identify the root cause(s) for the loss of conformance, and
- 3) Revise the monitoring plan to reflect the changed CO₂ migration.

Upon detecting a loss of containment, the project proponent must halt injection at the affected storage site.

Upon localising and quantifying a loss of containment, the project proponent must determine whether the loss of containment can be repaired. Injection at the concerned storage site must not resume until containment has been fully re-established.

At the concerned storage site, the project cannot generate emission reduction or removal credits until the following conditions are resolved:

- a) The loss of containment is stopped,
- b) Permanent storage is restored, and
- c) The loss of containment is quantified.

Projects are no longer eligible where the quantity of CO₂ lost is more than 10% of the total CO₂ injected in the project.

The Puro.earth Certification Procedures and the Puro CCS+ Program Annex Section 8, and Section 9.9 for reversal events, apply where a loss of containment occurs.

DOCUMENT HISTORY

Version	Date	Comment
v1.0	24 October 2024	Initial version
v1.1	30 September 2026	Addition of references to Puro.earth Certification Framework, Puro.earth CCS+ Program and related documentation. Alignment of documentary suite titles for consistency

7 REFERENCES

Alberta Government (2015). Quantification protocol for CO₂ capture and permanent storage in deep saline aquifers. Alberta Government. Available at: <https://open.alberta.ca/publications/9780778572213>

American Carbon Registry (2021). Methodology for the quantification, monitoring, reporting, and verification of greenhouse gas emissions reductions and removals from carbon capture and storage projects, v1.1. ACR at Winrock International. Available at: <https://acrcarbon.org/methodology/carbon-capture-and-storage-projects/>

Australian Government (2021). Carbon capture and storage method: Proposed new method under the Emissions Reduction Fund. Australian Government. <https://consult.industry.gov.au/cer/carbon-capture-and-storage-draft-method/>

California Air Resources Board (2018). Carbon capture and sequestration protocol under the Low Carbon Fuel Standard. California Air Resources Board. Available at: https://ww2.arb.ca.gov/sites/default/files/2020-03/CCS_Protocol_Under_LCFS_8-13-18_ada.pdf

European Commission (2022). Impact assessment report Part 1/2 and Part 2/2. Accompanying documents to Proposal for a regulation of the European Parliament and of the Council establishing a Union certification framework for carbon removals. European Commission Staff Working Document. European Commission.

European Parliament (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, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (1). Official Journal of the European Union 2009, L140/114–L140/135. Available at: <http://data.europa.eu/eli/dir/2009/31/oj>

Forbes, S. M., Verma, P., Curry, T. E., Friedmann, S. J., & Wade, S. M. (2008). Guidelines for carbon dioxide capture, transport and storage. World Resources Institute. Available at: https://files.wri.org/d8/s3fs-public/pdf/ccs_guidelines.pdf

IETA (2022). High-level criteria for crediting carbon geostorage activities, v1.0. PowerPoint Presentation. Available at: <https://www.jogmec.go.jp/content/300382139.pdf>

International Organization for Standardization (2017). ISO/TR27915:2017 Carbon dioxide capture, transportation and geological storage – Quantification and verification. International Organization for Standardization.

IPCC (2005). IPCC special report on carbon dioxide capture and storage. Prepared by Working Group III of the Intergovernmental Panel on Climate Change [Metz, B., Davidson, O., de Coninck, H. C., Loos, M., & Meyer, L. A (Eds.)]. Cambridge University Press. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_wholereport-1.pdf

IPCC (2006). 2006 IPCC guidelines for national greenhouse gas inventories. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston, H. S., Buendia, L., Miwa, K., Ngara, T., & Tanabe,

K. (Eds.). Institute for Global Environmental Strategies. Available at: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

IPCC (2019). 2019 refinement to the 2006 IPCC guidelines for national greenhouse gas inventories. Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P., & Federici, S. (Eds.). Intergovernmental Panel on Climate Change.

McCormick, M. (2012). A greenhouse gas accounting framework for carbon capture and storage projects. Center For Climate and Energy Solutions. Available at: <https://www.c2es.org/wp-content/uploads/2012/02/CCS-framework.pdf>

UNFCCC(2011). Carbon dioxide capture and storage in geological formations as CDM project activities. <https://cdm.unfccc.int/about/ccs/index.html>

US Environmental Protection Agency (EPA) (n.d.). Electronic Code of Federal Regulations (Title 40, Part 98, Subpart W, § 98.233(a)(1)). Available at: [https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-W/section-98.233#p-98.233\(a\)\(1\)](https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-W/section-98.233#p-98.233(a)(1))

US Environmental Protection Agency (EPA)(2010). General technical support document for injection and geologic sequestration of carbon dioxide: Subparts RR and UU greenhouse gas reporting program. Office of Air and Radiation. Available at: <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1010C7P.txt>