TOOL FOR ACCOUNTING NON-VCS CO_2 IN CCS PROJECTS

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1 SOURCES

This module is used in combination with the latest version of the following methodologies, modules and tools:

- *VM00XX Methodology for Carbon Capture and Storage*

Capture Modules

- *VMD00XX Module for CO_2 Capture from Air (Direct Air Capture)*
- *VMD00XX Module for CO_2 Capture from Bioenergy Combustion*
- *VMD00XX Module for CO_2 Capture from Bioproduction Processes*
- *VMD00XX Module for CO_2 Capture from Post combustion Flue Gases in Fossil Fuel Power and Heat Generation*
- *VMD00XX Module for CO_2 Capture from Industrial Processes*
- *VMD00XX Module for CO_2 Capture from Oil and Gas Production and Processing*
- *VMD00XX Module for CO_2 Capture from Precombustion Processes in Fossil Fuel Power and Heat Generation*
- *VMD00XX Module for CO_2 Capture from Oxyfuel Combustion in Fossil Fuel Power and Heat Generation*

Transport Module

- *VMD00XX Module for CO_2 Transport*

Storage Module

- *VMD00XX Module for CO_2 Storage in Saline Aquifers and Depleted Hydrocarbon Reservoirs*

Other Modules/Tools

- *VT00XX Tool for Differentiating Reductions and Removals in CCS Projects*
- *Geologic Carbon Storage (GCS) Non-Permanence Risk Tool*

VCS Program Requirements/Tool(s)

- *GCS Requirements*

2 SUMMARY DESCRIPTION OF THE TOOL

This tool establishes criteria and procedures for quantifying the allocation of project emissions ($PE_{non\text{-}VCS\ CO2,y}$) and leakage emissions ($LE_{non\text{-}VCS\ CO2,y}$) for projects where CO_2 that is not eligible for crediting in the VCS (non-VCS CO_2) flows through the project boundary. This tool is intended for use in conjunction with *VM00XX Methodology for Carbon Capture and Storage* and associated modules.

3 DEFINITIONS

In addition to the definitions set out in the *VCS Program Definitions*, the following definitions apply to this methodology:

Non-VCS CO_2
CO_2 that flows through a CCS project boundary that is not eligible for crediting in the VCS

Segment
A defined section within a project activity system where VCS and non-VCS CO_2 streams are jointly processed, transported, or stored that is equipped with metering devices that monitor the VCS and non-VCS CO_2 streams.

4 APPLICABILITY CONDITIONS

This tool is applicable to project activities that comply with *VM00XX Methodology for Carbon Capture and Storage*.

This tool is applicable under the following conditions:

1) Non-VCS CO_2 streams must enter or leave the project boundary.

5 PROCEDURES

5.1 Determining Quantity of Non-VCS CO_2 Injected

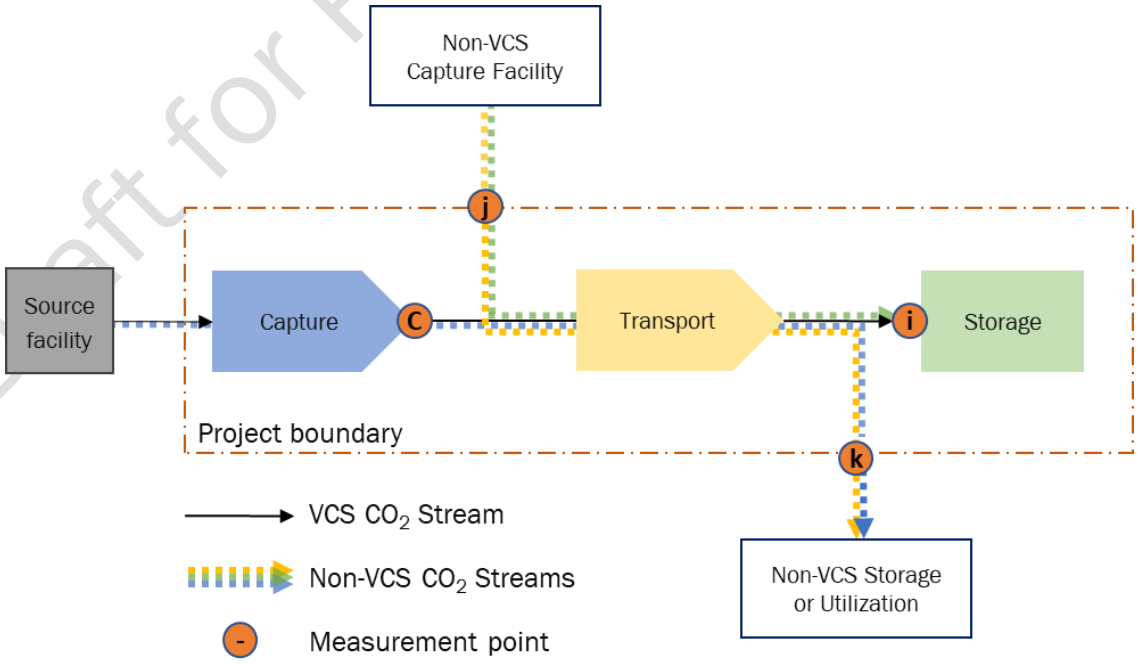
Three types of non-VCS CO_2must be accounted for to determine the quantity of non-VCS CO_2 injected, as described below.

Non-VCS CO_2 Streams Received: Non-VCS CO_2 is received from capture facilities outside the project boundary and stored inside the project boundary. This is shown in Figure 1 with a green dashed line. The VCS CO_2 stream is shown as a black solid line. This type of non-VCS CO_2 flows through measurement point *j* and measurement point *i*. At each measurement point *i,* it is measured together as a part of total injected CO_2.

Non-VCS CO_2 Streams Transported: Non-VCS CO_2 is transported through the project boundary. It is captured outside the project boundary and delivered outside the project boundary. This is shown in Figure 1 where a non-VCS CO_2 stream (yellow dashed line) flows into and out of the project boundary. This type of non-VCS CO_2 flows through measurement point *j* and measurement point *k*. When applicable, both received and transported non-VCS CO2 streams are measured together at each measurement point *j*.

Non-VCS CO_2 Streams Delivered: Non-VCS CO_2 is delivered for storage or utilization outside the project boundary and is captured in the project boundary. This is shown in Figure 1 where non-VCS CO_2 streams are shown with a blue dashed line. This type of non-VCS CO_2 stream flows through measurement points *c* and *k*. Non-VCS CO_2 delivered and VCS CO_2 are measured together at each measurement point *c*.

Figure 1: Non-VCS CO_2 Streams



Non-VCS CO_2 delivered outside the project boundary must be determined using Equation (1).

$$Q_{CO2,nonVCS,c,y} = (Q_{Total\ CO2,c,y}) \times (R_{nonVCS\ CO2,c,y}) \quad (1)$$

Where:

$Q_{CO2,nonVCS,c,y}$	=	Non-VCS CO_2 captured in the project boundary at measurement points *c* in year *y* (t CO_2)
$Q_{TotalCO2,c,y}$	=	Total carbon dioxide measured at each measurement point *c* in year *y* (t CO_2)
$R_{nonVCS\ CO2,c,y}$	=	Ratio of non-VCS CO_2 to total carbon dioxide at each measurement point *c* in year *y* (-)

The ratio of non-VCS CO_2 captured in the project boundary to the total captured CO_2 at each measurement point *c* must be defined by the proponent ex-ante. It may be defined as a fixed value, as a project specific variable that is determined based on a fixed cap, algorithmically, or as a variable dependent on other quantities.

The quantity of non-VCS CO_2 injected in the project boundary in year *y* is quantified using Equation (2).

$$Q_{CO2,nonVCS,injected,y} = \sum_{j} Q_{Total\ CO2,j,y} + \sum_{c} Q_{CO2,nonVCS,c,y} - \sum_{k} Q_{Total\ CO2,k,y} \quad (2)$$

Where:

$Q_{CO2,nonVCS,injected,y}$	=	Non-VCS CO_2 injected in the project boundary in year *y* (t CO_2)
$Q_{Total\ CO2,j,y}$	=	Total carbon dioxide measured at each measurement point *j* in year *y* (t CO_2)
$Q_{CO2,nonVCS,c,y}$	=	Non-VCS CO_2 captured in the project boundary at measurement points *c* in year *y* (t CO_2)
$Q_{Total\ CO2,k,y}$	=	Total carbon dioxide measured at each measurement point *k* in year *y* (t CO_2)

5.2 Determining Non-VCS CO_2 Project and Leakage Emissions

Proponents must apply the following three steps to allocate project and leakage emissions between VCS and non-VCS CO_2 streams.

- **Step 1:** Identify segments.
- **Step 2:** Identify Emissions and CO_2 Flows in Segments.

- **Step 3:** Select an option to allocate project emissions.
- **Step 4:** Calculate total project and leakage emissions from VCS and non-VCS CO_2 streams.

5.2.1 Step 1: Identify Segments

Proponents must identify segments of the project in the project description. Segments allow allocation of project and leakage emissions between VCS and non-VCS CO_2 streams. The proponent should aim to maximize the accuracy and simplicity of both measurement and quantification activities when defining segments.

When identifying segments, the following requirements apply:

1) All activities within the project boundary must be included in one and only one segment;
2) Segments must not straddle module boundaries; and
3) Descriptions of each segment and its boundaries must be included in the project description.

5.2.2 Step 2: Identify Emissions and CO_2 Flows in Segments

For each segment *x*, the proponent must identify:

1) CO_2 flows entering and exiting the segment, and whether they are VCS, non-VCS or commingled flows, defining $Q_{nonVCS\ CO2,x,y}$ and $Q_{Total\ CO2,x,y}$
2) Project and leakage emission sources (as described in each of the applicable module boundaries for the project) arising from project activities in the segment, defining $PE_{Total,x,y}$ and $LE_{Total,x,y}$ or $PE_{VCS\ CO2,x,y,D}$, $LE_{VCS\ CO2,x,y,D}$, $PE_{nonVCS\ CO2,x,D}$, and $LE_{nonVCS\ CO2,x,y,D}$ (presented below in section 5.2.3),

5.2.3 Step 3: Select an Option to Allocate Project Emissions

Proponents must choose one or a combination of the following options to allocate corresponding project emissions and leakage for each segment.

5.2.3.1 Option 1: Assign All Project and Leakage Emissions to VCS CO_2 stream

This option is applicable to all projects. Equations (3) and (4) assign all project and leakage emissions from a given segment to the VCS CO_2 stream. This is the most conservative option.

$$PE_{VCS\ CO2,x,y} = PE_{Total,x,y} \quad (3)$$

$$LE_{VCS\ CO2,x,y} = LE_{Total,x,y} \quad (4)$$

Where:

$PE_{VCS\ CO2,x,y}$ = Project emissions from segment *x* in year *y* associated with VCS CO_2 streams (t CO_2)

$PE_{Total,x,y}$ = Total project emissions generated from segment *x* in year *y*, calculated as per Equation (7) in the most recent version of *VM00XX Methodology for Carbon Capture and Storage* (t CO_2)

$LE_{VCS\ CO2,x,y}$ = Leakage emissions from segment *x* in year *y* associated with VCS CO_2 streams (t CO_2)

$LE_{Total,x,y}$ = Total leakage emissions generated from segment *x* in year *y*, calculated as per Equation (8) in the most recent version of *VM00XX Methodology for Carbon Capture and Storage* (t CO_2)

As all project and leakage emissions are assigned to VCS CO_2 streams in this option, project and leakage emissions for non-VCS CO_2 streams are zero for the segment, as given in Equations (5) and (6).

$$PE_{nonVCS\ CO2,x,y} = 0 \quad (5)$$

$$LE_{nonVCS\ CO2,x,y} = 0 \quad (6)$$

Where:

$PE_{nonVCS\ CO2,x,y}$ = Project emissions from segment *x* in year *y* associated with non-VCS CO_2 streams (t CO_2)

$LE_{nonVCS\ CO2,x,y}$ = Leakage emissions from segment *x* in year *y* associated with non-VCS CO_2 streams (t CO_2)

5.2.3.2 Option 2: Differentiation Method

This option is applicable when CO_2 streams can be categorized entirely as VCS or non-VCS streams based on equipment or temporal differentiation. Equipment differentiation means that equipment involved in the processing of captured CO_2 has individual metering and the resulting emissions can be directly attributed to each CO_2 stream. Temporal differentiation means captured CO_2 streams flow at different times and equipment meters have a time resolution sufficient to resolve and attribute the emissions from each period accordingly.

Equations (7), (8), (9) and (10) assign the differentiated portion of project and leakage emissions to either VCS or non-VCS CO_2 streams.

$$PE_{VCS\ CO2,x,y} = \sum_{D} PE_{VCS\ CO2,x,y,D} \quad (7)$$

$$LE_{VCS\ CO2,x,y} = \sum_{D} LE_{VCS\ CO2,x,y,D} \quad (8)$$

$$PE_{nonVCS\ CO2,x,y} = \sum_{D} PE_{nonVCS\ CO2,x,y,D} \quad (9)$$

$$LE_{nonVCS\ CO2,x,y} = \sum_{D} LE_{nonVCS\ CO2,x,y,D} \quad (10)$$

Where:

$PE_{VCS\ CO2,x,y}$	=	Project emissions from segment *x* in year *y* associated with VCS CO_2 streams (t CO_2)
$PE_{VCS\ CO2,x,y,D}$	=	Project emissions from segment *x* in year *y* in differentiated equipment *D* or with temporal differentiation *D*, associated with VCS CO_2 streams (t CO_2)
$LE_{VCS\ CO2,x,y}$	=	Leakage emissions from segment *x* in year *y* associated with VCS CO_2 streams (t CO_2)
$LE_{VCS\ CO2,x,y,D}$	=	Leakage emissions from segment *x* in year *y* in differentiated equipment *D* or with temporal differentiation *D*, associated with VCS CO_2 streams (t CO_2)
$PE_{nonVCS\ CO2,x,y}$	=	Project emissions from segment *x* in year *y* associated with non-VCS CO_2 streams (t CO_2)
$PE_{nonVCS\ CO2,x,D}$	=	Project emissions from segment *x* in year *y* in differentiated equipment *D* or with temporal differentiation *D*, associated with non-VCS CO_2 streams (t CO_2)
$LE_{nonVCS\ CO2,x,y}$	=	Leakage emissions from segment *x* in year *y* associated with non-VCS CO_2 streams (t CO_2)
$LE_{nonVCS\ CO2,x,y,D}$	=	Leakage emissions from segment *x* in year *y* in differentiated equipment *D* or with temporal differentiation *D*, associated with non-VCS CO_2 streams (t CO_2)

5.2.3.3 Option 3: Mass Balance

This option is applicable under the following conditions:

1) Available measurements for CO_2 streams in a segment can resolve the quantity of VCS and non-VCS CO_2 streams; and
2) Measurement is available for both project and leakage emissions arising from activities or processes in a segment.

Equations (11) and (12) allocate project and leakage emissions, respectively, from a segment based on the fraction of the CO_2 stream that qualifies as VCS CO_2.

$$PE_{nonVCS\ CO2,x,y} = PE_{total,x,y} \times R_{nonVCS\ CO2,x,y} \quad (11)$$

$$LE_{nonVCS\ CO2,x,y} = LE_{total,x,y} \times R_{nonVCS\ CO2,x,y} \quad (12)$$

Where:

$PE_{total,x,y}$	=	Total project emissions generated from segment *x* in year *y*, calculated as per Equation (7) in the most recent version of *VM00XX Methodology for Carbon Capture and Storage* (t CO_2)
$LE_{total,x,y}$	=	Total leakage emissions generated from segment *x* in year *y*, calculated as per Equation (8) in the most recent version of *VM00XX Methodology for Carbon Capture and Storage* (t CO_2)
$R_{nonVCS\ CO2,x,y}$	=	Ratio of VCS CO_2 to total CO_2 processed, transported or stored in the segment

Equation (13) calculates the ratio of non-VCS CO_2 to the total CO_2 that is processed, transported or stored in the segment.

$$R_{nonVCS\ CO2,x,y} = \left(\frac{Q_{nonVCS\ CO2,x,y}}{Q_{total\ CO2,x,y}}\right) \quad (13)$$

Where:

$R_{nonVCS\ CO2,x,y}$	=	Ratio of non-VCS CO_2 to total CO_2 captured, transported or stored in segment *x* in year *y*
$Q_{nonVCS\ CO2,x,y}$	=	Non-VCS CO_2 processed, transported or stored in segment *x* in year *y* (t CO_2)
$Q_{total\ CO2,x,y}$	=	Total CO_2 processed, transported or stored in segment *x* in year *y*, as per Section 8.1 of *VM00XX Methodology for Carbon Capture and Storage* (t CO_2)

5.2.4 Step 4: Calculate Total Project and Leakage Emissions from VCS and Non-VCS CO_2 Streams

Equation (14) calculates the total project emissions associated with VCS and non-VCS CO_2 flows as the sum the of emissions from all segments in a module boundary.

$$PE_{nonVCS\ CO2,y} = \sum_{x} PE_{nonVCS\ CO2,x,y} \quad (14)$$

Where:

$PE_{nonVCS\ CO2,y}$	=	Total project emissions in a module boundary in year *y* associated with non-VCS CO_2 flows (t CO_2)

The total amount of leakage emissions associated with non-VCS and VCS CO_2 flows are calculated as the sum of emissions from all segments in a module boundary as per Equation (15).

$$LE_{nonVCS\ CO2,y} = \sum_{x} LE_{nonVCS\ CO2,x,y} \quad (15)$$

Where:

$LE_{nonVCS\ CO2,y}$	=	Total leakage emissions in a module boundary in year *y* associated with non-VCS CO_2 flows (t CO_2)

$Q_{CO2,nonVCS,injected,y}$ as calculated in Equation (2), $PE_{nonVCS\ CO2,y}$ and $LE_{nonVCS\ CO2,y}$ as calculated in Equations (14) and (15) are used as described in *VM00XX Methodology for Carbon Capture and Storage* and in the capture, transport and storage modules relevant to the project.

6 DATA AND PARAMETERS

6.1 Data and Parameters Available at Validation

Data / Parameter	$R_{nonVCS\ CO2,\ c,y}$
Data unit	Dimensionless
Description	Ratio of non-VCS CO_2 to total captured CO_2
Equations	Equation (1)
Source of data	Proponent defined based on project design, agreements, or other contracts
Value applied	0 for projects that only have non-VCS CO_2 streams that are received or transported. For projects with non-VCS CO_2 streams that are delivered, the proponent must specify value in PD.
Justification of choice of data or description of measurement methods and procedures applied	This value defines the ratio of non-VCS CO_2 that is captured for projects where some CO_2 is non-VCS
Purpose of Data	Calculation of baseline emissions
Comments	Definition of this parameter must also include how metering imbalance, system vents and fugitive emissions are accounted and must be done in consideration of system design and the nature of each non-VCS CO_2 stream (i.e., received, transported or delivered)

6.2 Data and Parameters Monitored

Data/Parameter	$Q_{Total\ CO2,k,y}$; $Q_{Total\ CO2,c,y}$; and $Q_{Total\ CO2,j,y}$
Data unit	t CO_2
Description	Total carbon dioxide measured at each measurement point *k*, *c* or *j* in year *y*
Equations	Equation (1) and (2)
Source of data	Measured using either volumetric flow meters or mass flow meters
Description of measurement methods and procedures to be applied	Direct measurement of CO_2 stream as per Section 8 of *VM00XX Methodology for Carbon Capture and Storage* Measurements must be taken at the corresponding measurement point *k*, *c* or *j* where CO_2 enters or leaves the project boundary.
Frequency of monitoring/recording	Monitored continuously (i.e., one measurement at least every 15 minutes)
QA/QC procedures to be applied	Directly monitored parameters in Section 8 of *VM00XX Methodology for Carbon Capture and Storage* must use corresponding QA/QC requirements in Section 9 of the same methodology.
Purpose of data	Allocation of baseline and project emissions to VCS CO_2 and non-VCS CO_2
Calculation method	As described in Section 8 of *VM00XX Methodology for Carbon Capture and Storage*
Comments	

7 REFERENCES

This tool does not include any references.