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# Methodology for In Situ Sequestration of GHG Emissions from Planned Production of Carbon-Intensive Oil

Version 1.0

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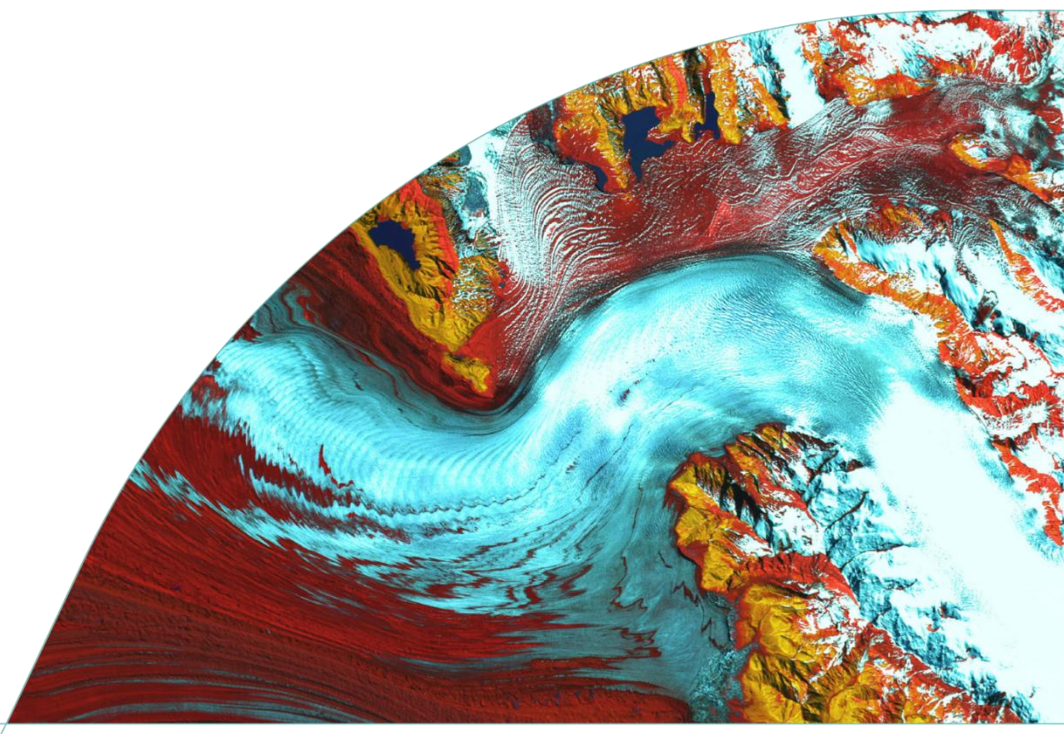

Prepared by:

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THEAUS GLOBAL

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## Acronyms

| | |
|---|---|
| **.kml** | Keyhole Markup Language file format |
| **.shp** | Geographic information system shapefile |
| **API** | American Petroleum Institute |
| **BAU** | Business-as-usual |
| **boe** | Barrel of oil equivalent |
| **CBDP** | Credible Business Development Plan |
| **CGE** | Computable General Equilibrium |
| **$CH_4$** | Methane |
| **CI** | Carbon Intensity |
| **CIO** | Carbon-Intensive oil |
| **$CO_2$** | Carbon Dioxide |
| **$CO_2e$** | Carbon Dioxide equivalent |
| **COS** | Carbon-intensive Oil Substitute |
| **CSS** | Cyclic Steam Stimulation |
| **ER** | Emission Reduction |
| **FID** | Final Investment Decision |
| **GHG** | Greenhouse Gas |
| **GREET** | Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies model |
| **IPCC** | International Panel on Climate Change |
| **IRR** | Internal Rate of Return |
| **ISO** | International Organization for Standardization |
| **kg** | Kilogram |

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| **LCA** | Life-Cycle Assessment |
| **LCFS** | Low Carbon Fuel Standard |
| **MRV** | Monitoring, Reporting, and Verification |
| **$N_2O$** | Nitrous Oxide |
| **NPV** | Net Present Value |
| **$OCI^+$** | Oil Climate Index Plus Gas |
| **OPEC** | Organization of the Petroleum Exporting Countries |
| **OPEM** | Oil Products Emissions Module |
| **OPGEE** | Oil Production Greenhouse Gas Emissions Estimator |
| **PA** | Project Activity |
| **PDD** | Project Design Document |
| **PE** | Partial Equilibrium |
| **PoA** | Program of Activities |
| **PP** | Project Proponent |
| **PRELIM** | Petroleum Refinery Life Cycle Inventory Model |
| **PVC** | Production Volume Certifier |
| **QA** | Quality Assurance |
| **QC** | Quality Control |
| **RMI** | Rocky Mountains Institute |
| **SAGD** | Steam-Assisted Gravity Drainage |
| **SCD** | Sequestered CIO Deposit |
| **SFI** | Suitable Financial Instrument |
| **SSR** | Source, Sink, and Reservoir |
| **t** | Metric ton |

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| **U.S.** | United States |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **VVB** | Validation and Verification Body |

## Definitions

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| **American Petroleum Institute (API) Gravity** | A measure of how light or heavy a petroleum liquid is compared to water. If the API gravity of a liquid is greater than 10, the petroleum liquid floats on water. If less than 10, the liquid is heavier and sinks in water. The API gravity of a liquid is directly correlated to its density and is a key factor in establishing the market value and GHG emissions related to crude oil. |
| **Barrel of Oil Equivalent** | The barrel of oil equivalent (boe) is a unit that allows for a single value to represent the sum of all hydrocarbon products forecasted as resources. It is commonly used in the oil and gas industry to standardize diverse types of hydrocarbons into a comparable unit. Typically, condensate, oil, bitumen, and synthetic crude barrels are considered equal (1 barrel = 1 boe). Carbon Intensity (CI) values for hydrocarbon production are often reported in kilograms of carbon dioxide ($CO_2$) equivalent per barrel of oil equivalent (kg $CO_2$e/boe). |
| **Carbon-Intensive Oil (CIO)** | For this methodology, crude oil with an API gravity of 12.0 or heavier as produced, before any blending or upgrading. In addition to the API threshold, CIO is intended to have a higher CI than the substitute oil (at least 5% higher). The methodology does not fix an absolute value as a threshold for CI, and the PP shall demonstrate that the GHG Project's Baseline Scenario CIO has a higher CI than the identified substitute oil intensity in each period. |
| **Carbon-Intensive Oil Substitute (COS)** | An oil volume sourced from a single field, or different slates (including oil sands, light oil, or renewables), intended to meet the same demand as the prevented CIO production. The substitute oil shall have a lower CI than the CIO, typically at least 5% lower in CI, and shall be economically viable under prevailing market conditions. |
| **CIO Volume Developer** | The entity that has entered into a contractual agreement with the CIO Volume Owner to extract CIO from a deposit of CIO. The CIO Volume Developer may also contract with a PP to implement a GHG Project for the PP to claim associated GHG benefits.<br><br>The CIO Volume Developer may itself serve as the PP, provided it holds the legal authority and responsibility for implementing and complying with the GHG Project's methodology. |
| **CIO Volume Owner** | The entity that holds legal title to a deposit of CIO and enters into a contractual agreement with a CIO Volume Developer to extract CIO from that deposit. |

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| **Credit Type** | Category of carbon credits issued under this methodology, representing validated (ex-ante) or verified (ex-post) prevention of GHG emissions achieved through the in situ Sequestration of planned CIO production. These credits are generated by preventing the extraction, processing, and combustion of CIO that would have otherwise occurred in the Baseline Scenario. Reconciliation between ex-ante and ex-post issuance follows the applicable procedures established by the Registry or GHG program. The resulting GHG mitigation constitutes an avoidance activity, not a removal activity, and therefore does not involve the capture or storage of atmospheric $CO_2$. |
| **Downstream** | The final stage of the oil supply chain begins at the refinery exit gate and includes the distribution, sale, and end-use combustion of petroleum products. In this methodology, Downstream emissions refer specifically to GHG emissions from the combustion of refined products derived from CIO or its substitutes. These emissions are quantified using life-cycle assessment (LCA) tools such as the Oil Products Emissions Module (OPEM) or the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies model (GREET). The Downstream boundary is illustrated in Figure 1, which delineates it as the segment following Midstream refining operations through to the final combustion of end-use fuels. |
| **Extraction[1]** | Part of the Upstream portion of the oil supply chain entails drilling, fracturing, mining, or otherwise accessing oil resources. For the purposes of this methodology, extraction includes drilling, gathering systems, and production facilities construction, as well as operations up to the point where processed oil and gas exit the oilfield processing facilities. |
| **Ex-ante** | Refers to the quantification and issuance of GHG emission mitigation outcomes before they have occurred, based on validated projections derived from a Credible Business Development Plan (CBDP) and baseline CIO production forecasts. Ex-ante credits represent anticipated GHG emission reductions or avoidance that have been validated but not yet verified. These credits may be issued to facilitate early project financing or market participation. Still, they cannot be retired or used for offsetting purposes until their underlying emission mitigations have been verified. Upon verification, the ex-ante credits are reconciled and converted to ex-post issuance in accordance with the applicable Registry or GHG program procedures for issuance and conversion. |

[1] Carnegie Endowment for International Peace. (n.d.). Oil Climate Index Plus (OCI+): Glossary. Retrieved February 10, 2025, from https://oci.carnegieendowment.org/#glossary.

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| **Ex-post** | Refers to the quantification and issuance of GHG emission reductions or avoidance that, by the time of verification, would have occurred under the Baseline Scenario, as established by the CBDP and planned CIO Production Volume forecast.<br><br>Ex-post credits represent verified emission reductions or avoidance outcomes achieved within a given monitoring period. These credits may be retired or transacted in accordance with the applicable Registry or program rules, following confirmation that the project has maintained the undeveloped status of the certified CIO volume and met all conditions of Permanence and verification. |
| **Government** | Sovereign or sub-sovereign public authority (at the national, provincial, or state level) recognized by applicable law within the project jurisdiction, which owns or has legal title to a Carbon-Intensive Oil (CIO) deposit, where such ownership is vested in the public domain.<br><br>In jurisdictions where CIO deposits may be privately owned (e.g., the United States), this definition does not apply to private owners or concessionaires; those entities are instead referred to as Project Proponents or Private Entities as appropriate.<br><br>Municipal, local, and Indigenous Governments are excluded from this definition unless they explicitly hold the legal title to the CIO deposit under applicable law. |
| **GHG Project** | A planned set of activities implemented by the PP to reduce greenhouse gas emissions relative to a defined baseline scenario. In this methodology, a GHG Project refers specifically to preventing CIO Extraction from identified undeveloped reserves.<br><br>The terms “GHG Project” and “Project” are used interchangeably throughout this methodology. |
| **Market Leakage** | Market leakage refers to the unintended increase in GHG emissions outside the Project Boundary resulting from changes in global or regional supply-demand dynamics. Specifically, it occurs when the prevention of planned CIO production from the Project Area leads to partial or full displacement of that production elsewhere, thereby negating emission reductions achieved by the project.<br><br>Under this methodology, Market Leakage is treated using one of two options, at the discretion of the PP: a model-based rate derived from peer-reviewed econometric models, or the PP may assume a fixed 100% leakage rate. See Section 8.3 for full details. |

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| **Midstream** | The middle portion of the oil supply chain that entails refining crude oil or otherwise transforming hydrocarbons into petroleum products. The boundary between the Midstream and Downstream is the point at which petroleum products exit the refinery, as illustrated in Figure 1. |
| **Permanence** | In the context of Project Activities (PAs), Permanence refers to the long-term retention and durability of GHG reductions achieved by the project. It ensures that the undeveloped SCD remains intact and CIO Sequestration is not reversed over time, providing lasting climate benefits. Permanence is a key principle for project integrity, reflecting the commitment to maintaining emissions reductions for a minimum of 50 years, beyond the GHG Project's lifespan or over a defined monitoring period, thereby addressing risks of reversal due to natural, human, or system-related factors. |
| **Planned Production** | The planned activity of commercial production of CIO that would result in releasing significant GHG emissions into the atmosphere. |
| **Production Period** | The estimated operational lifespan during which the Planned Production of CIO from an SCD would have occurred in the absence of the GHG Project. In the context of sequestered CIO Production Volumes, this period is calculated based on analog analysis of similar oil developments, incorporating expected start-up, plateau, and decline phases derived from comparable geologic formations, Extraction techniques, and baseline project designs. |
| **Production Volume** | The volume of CIO produced in the Baseline Scenario, as calculated by a Production Volume Certifier (PVC). |
| **Production Volume Certifier (PVC)** | A professional petroleum engineering firm responsible for calculating in compliance with its standards for professional practice the volume of CIO that would be produced in the Baseline Scenario if the CIO Production Volume is not sequestered.<br><br>The PVC shall also prepare and/or confirm in compliance with its standards for professional practice the CBDP that the projected CIO Production Volume and associated assumptions are technically and economically sound, consistent with standard industry practices, and suitable for use in Baseline Scenario quantification. |
| **Project Boundaries** | The spatial, temporal, and operational limits of a GHG Project defining the area within which the PAs are conducted and for which emissions Sequestration is quantified. |

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| **Project Proponent (PP)** | The individual or legal entity that has overall responsibility for the design, implementation, and monitoring of the GHG Project. The PP shall demonstrate authority to control or influence the Baseline Scenario, implement the GHG mitigation activity, and claim the resulting emission reductions in accordance with this methodology and the ISO 14064-2:2019. A Project Proponent may be:<br>• Government, where legal ownership or control of the CIO deposit is vested in the public domain under national, provincial, or state law; or<br>• a Private Entity, where legal title, mineral rights, or contractual control of the CIO deposit is held privately.<br>In all cases, the Project Proponent shall demonstrate clear, uncontested ownership or control rights over the Project Activity and their associated GHG emission mitigation. |
| **Private Entity** | Any legally registered individual, corporation, partnership, or consortium that holds legal title, mineral rights, or contractual control over a Carbon-Intensive Oil (CIO) deposit under the applicable laws of the Baseline Scenario jurisdiction, where such ownership or control is not vested in a Government.<br>This includes entities operating under private ownership, concession, lease, or production-sharing agreements, provided that the rights to develop, suspend, or forego development of the CIO deposit are clearly established. |
| **Registry or GHG Program** | The governing system, platform, or GHG Program under which the PP registers, validates, verifies, and issues GHG emission reduction or avoidance credits in accordance with the applicable Registry criteria and this Methodology.<br>It establishes the rules for credit issuance, retirement, tracking, and transparency, and may impose additional requirements concerning validation, verification, Permanence, and project eligibility.<br>For this Methodology, a Registry includes any recognized national, subnational, or voluntary GHG Program that aligns with ISO 14064-2:2019 principles and accepts projects developed under this framework. |
| **Sequestered CIO Deposit (SCD)** | A quantity of CIO that is to remain undeveloped and contained underground for the duration defined in this methodology (refer to Permanence definition) to prevent GHG emissions as would occur in the Baseline Scenario. |

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| **Sequestered CIO** | CIO that remains undeveloped and securely contained within its original geologic formations as a deliberate and verifiable climate mitigation measure. This approach prevents greenhouse gas emissions that would otherwise result from CIO Extraction, processing, and combustion. |
| **Sequestration** | Refers to the geological containment of CIO in its natural, unproduced state, involving the active stewardship of subsurface rights, verification of in situ hydrocarbon volumes, and financial mechanisms that ensure the CIO remains securely contained for the duration of the defined undeveloped/permanent period (minimum 50 years). |
| **Suitable Financial Instrument** | Advanced assurance instruments protect i) the GHG emissions of the Project; or ii) the credit buyer in the event of a reversal; and include third-party insurance, project-level bonding, or third-party financial guarantees. |
| **Steam-Assisted Gravity Drainage (SAGD)** | An Extraction technique used for recovering heavy or ultra-heavy crude oil that is too deep or otherwise inaccessible for surface mining. SAGD involves injecting steam to reduce the oil's viscosity, making it easier to produce to the surface. |
| **Undeveloped Period** | The period during which the PP commits to leaving the SCD undeveloped. This shall be for at least 50 years, as specified in this methodology. |
| **Upgrading** | An Upstream process that converts extra-heavy oil or bitumen into synthetic crude oils or dilutes it with condensate. |
| **Upstream** | The beginning of the oil supply chain that includes Extraction, production, surface processing and upgrading, waste disposal, and other miscellaneous operations, as well as transporting oil to the refinery.[2] The boundary between the Upstream and Midstream value chain components is the entrance to the oil refinery, as illustrated in Figure 1. |

[2] Although the conventional oil and gas industry categorizes the transportation of crude oil to refineries as part of the midstream sector and reserves the term Downstream for refining and end-use activities, this methodology adopts a different boundary definition. The approach is consistent with life-cycle assessment (LCA) models such as Stanford's OPGEE the University of Calgary's PRELIM and the Rocky Mountain Institute's OPEM, as well as the Oil Climate Index Plus Gas (OCI+), which define upstream activities to include Extraction, production, surface processing, Upgrading, and transportation to the refinery gate. This definition establishes a clear and consistent system boundary for quantifying the carbon intensity of oil and gas resources. Under this framework, the upstream boundary concludes at the refinery entrance, as illustrated in Figure 2. Emissions associated with refining and Downstream use are excluded from the upstream scope. See: https://oci.carnegieendowment.org/#glossary.

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| **Well Production Forecasting** | It refers to the use of historical production data from geologically and operationally comparable oil projects (analogs) to estimate the expected production profile of an undeveloped oil project. In the context of Sequestered CIO Production Volumes, where no production history exists, projections are developed using analog well performance from similar reservoirs, Extraction techniques, and development scenarios. Decline curve models (e.g., exponential, hyperbolic, harmonic) may be used where suitable analogs exhibit decline behavior, particularly in cold heavy oil production. However, for thermal recovery projects like SAGD, production profiles are influenced more by operational strategies (e.g., steam injection schedules) than by natural reservoir energy decline, and analog-based forecasting becomes the primary method. |

# EcoEngineers Legal Note for All Methodologies

In this document, EcoEngineers applies the approach under ISO 14064-2:2019 (Specification with Guidance at the Project Level for Quantification, Monitoring and Reporting of Greenhouse Gas Emission Reductions or Removal Enhancements) for quantification, monitoring, and reporting of Greenhouse Gas (GHG) projects to propose possible guidelines for measurement, monitoring, reporting, and validation (MMRV) of In Situ Sequestration of GHG Emissions from Planned Production of Carbon-Intensive Oil.

The ISO 14064-2:2019 standard provides an approach for quantifying, monitoring, reporting, and validating or verifying GHG emissions and removals. It specifies principles and requirements and provides guidance for project-level quantification, monitoring and reporting of activities intended to cause greenhouse gas (GHG) emission reductions or removal enhancements. It includes requirements for planning a GHG Project, identifying and selecting GHG sources, sinks, and reservoirs (SSRs) relevant to the project and the baseline scenario, monitoring, quantifying, documenting, and reporting GHG Project performance, and managing data quality. In this document, this framework is applied to In Situ Sequestration of GHG Emissions from Planned Production of Carbon-Intensive Oil.

This document refers to third-party data, assumptions, and analytical methods, where appropriate, to evaluate the potential for GHG emission reductions arising from in situ Sequestration of the emissions associated with the planned production of Carbon-Intensive Oil. The data sources, assumptions, and analytical methods, among other things, address specific issues related to oil Market Leakage, emissions intensity benchmarking, project additionality, and quantification of prevented Upstream, Midstream, and Downstream GHG emissions. These data sources were generally provided by Theaus Global or were obtained through research conducted by EcoEngineers' staff. To EcoEngineers' actual knowledge at the time of this document's issuance, all third-party data used in this document were obtained from reliable sources. Should any such third-party source be erroneous, misleading, or incomplete, in whole or in part, same may impact any conclusions outlined in this document.

While choosing to include a data source or an analytical method, EcoEngineers employed diligence to follow the principles of Completeness, Consistency, Accuracy, Transparency, and Conservativeness as required by the ISO 14064-2:2019 standard. To the best of EcoEngineers' actual knowledge at the time of this document's issuance, all third-party data used in this document were obtained from reliable sources. However, despite such diligence, the authenticity, accuracy, and completeness of third-party research, data, and analytics cannot be guaranteed by EcoEngineers, and should any such third-party source be erroneous, misleading, or incomplete, in whole or in part, the same may impact any conclusions outlined in this document.

This methodology document outlines the general requirements for Theaus Global or other Project Developers (PP) to comply with the ISO 14064-2:2019 standard. It establishes specific project criteria and procedures aligned with ISO 14064-2:2019, which are applicable independently of any governing or monitoring authority or carbon Registry. Such authorities may impose additional requirements related to additionality, specific quantification tools or models, project baselines, and other metrics. In such cases, the project may also need to meet those requirements to be eligible to generate GHG credits or other credits, certifications, or other designations.

# Summary

The purpose of this methodology is to prevent GHG emissions associated with the planned Extraction, processing, transportation, refining, and end-use combustion of CIO by causing CIO deposits to remain undeveloped, using carbon credit revenues to prevent the Extraction of these high-emission oil projects. The Project Activity (PA) involves substituting planned CIO Extraction projects with less carbon-intensive alternatives, thereby preventing GHG emissions across the entire life-cycle that would have occurred had the Extraction project not been prevented.

This life-cycle spans from the Upstream phase (including well drilling, Extraction, and initial processing) through the Midstream phase (encompassing processing at the refinery gate), to the Downstream phase (covering product distribution and combustion). In this way, the methodology delivers emission reductions from "wells-to-wheels."

This methodology provides a comprehensive framework for quantifying, monitoring, and issuing carbon credits for prevented GHG emissions that would have resulted from CIO production. It incorporates carbon intensities, detailed calculations, and referenced best practices (outlined in Section 7. Baseline Scenario and Section 8. Project Scenario) to ensure transparency, accuracy, and integrity of emission reduction claims. The methodology is particularly suited to nations like Canada, which hosts significant CIO deposits, such as oil sands, and is applicable exclusively within G7 jurisdictions.

The Baseline Scenario describes the prevented CIO Extraction projects that would otherwise proceed under standard market and operational conditions, generating significant GHG emissions across their entire life-cycle. Emissions shall be quantified using suitable LCA models such as the Oil Climate Index plus Gas (OCI$^{+}$) tool, which provides a detailed analysis of oil production and processing emissions. The Baseline Scenario emissions represent a Business-as-Usual (BAU) case, capturing the Baseline Scenario's defined carbon footprint that would occur without the project's intervention.

The Project Scenario describes the in situ Sequestration of GHG emissions, achieved through preventing the Planned Production of CIO and substituting such Extraction of high-CI with lower-CI alternatives (COS).[3]

To ensure environmental and market credibility, this methodology incorporates robust criteria, requiring a PP to demonstrate that:

- The PA is not mandated by regulatory frameworks.
- The Baseline Scenario Production Volume is economically viable, as calculated by an independent, third-party PVC, and would otherwise have been developed without the Project intervention.

[3] This applies in cases where project developers implement multiple mitigation activities, such as those listed in Section 3.1:, including prevention of surface mining or in situ Extraction (e.g., SAGD or cyclic steam stimulation, CSS), adoption of renewable energy systems, energy efficiency upgrades, and substitution with alternative fuels like hydrogen or bio-based energy. These activities may be governed by different methodologies but must be coordinated under a broader climate strategy or jurisdictional plan. When implemented under a unified Program of Activities (PoA), each activity must adhere to the specific methodological requirements applicable to its scope, while the PoA must comply with the overarching principles and procedures of this methodology for preventing CIO production.

- The project meets rigorous additionality standards, ensuring that the prevented, planned CIO production represents genuinely incremental GHG reductions beyond "business-as-usual" practices.
- The project meets rigorous Permanence standards, ensuring that the CIO within the SCD remains in the ground for the entire Undeveloped Period of at least 50 years.

## Section 1: Introduction

The extraction, processing, transportation, and refining of CIOs are major contributors to GHG emissions. These activities typically generate emissions ranging from 30 to 300 kilograms of carbon dioxide equivalent per barrel of oil equivalent (kg $CO_2$e/boe), depending on oil density (API gravity) and Extraction methods, with combustion adding another ~400 kg $CO_2$e/boe.[4] On average, such oils' full life-cycle emissions (wells-to-wheels) are approximately 515 kg $CO_2$e/boe. In extreme cases, such as Canada's oil sands, emissions can exceed 729 kg $CO_2$e/boe,[5] highlighting the significant GHG emissions of these CIOs.

The methodology presented herein addresses the urgent need to mitigate the climate impacts of CIO Extraction by promoting activities that prevent their Extraction and financially incentivizing the substitution of lower-carbon alternatives through the sale of carbon credits. By quantifying and accrediting emissions reductions achieved through preventing the Planned Production of these CIOs, this methodology provides a robust framework to guide PPs and ensure credible, measurable climate benefits. It is structured to incentivize the replacement of CIO with less Carbon-Intensive Oil and other energy sources. The activity type, Extraction method, or modality is not an exclusion.

Serving as an essential tool for supporting global decarbonization goals, particularly in the context of minimizing the climatic impacts of a fossil-fuel-dominated energy sector. It equips stakeholders with a consistent approach to evaluating and implementing mitigation activities that reduce reliance on CIO sources. Furthermore, this methodology fosters transparency and ensures alignment with international best practices, enabling the creation of high-integrity carbon credits while addressing Market Leakage and associated uncertainties. This comprehensive framework is useful for driving the transition toward cleaner energy systems and achieving meaningful GHG emission reductions at scale.

## Section 2: Principles

The design and implementation of this methodology shall be guided by the principles outlined in the International Organization for Standardization (ISO) 14064-2:2019 standard to ensure that all of the sequestered GHG emissions are real, measurable, transparent, conservative, and verifiable.

[4] IHS CERA. (2010). Oil sands, greenhouse gases, and US oil supply: Getting the numbers right. IHS CERA Special Report. Cambridge, MA: IHS CERA Inc.
[5] https://oci.carnegieendowment.org/#supply-chain

These principles also underpin the management of environmental, social, and governance risks across the GHG Project life-cycle. PPs shall document and demonstrate adherence to the following:

- **Relevance**: Only GHG sources, sinks, and reservoirs (SSRs) and data that materially influence the quantification of GHG emissions and removals shall be included. Relevance also applies to identifying risks, impacts, and stakeholders affected by the project's implementation or omission.
- **Completeness**: All significant SSRs and PAs that influence the GHG baseline or project emissions/removals shall be accounted for. This includes direct and indirect SSRs, and Upstream, Midstream, or Downstream effects that may constitute leakage. Where exclusions are made, clear justifications and conservativeness in estimation shall be demonstrated.
- **Consistency**: Methods, assumptions, and criteria used in Baseline Scenario determination, Project Scenario quantification, and performance monitoring shall be applied consistently across time periods and sites. Any methodological updates or parameter changes shall be clearly disclosed, with justification based on improved accuracy or best available science.
- **Accuracy**: Quantification of GHG emissions shall strive for precision while reducing bias and uncertainty to the extent practical. Conservative assumptions, default factors, and estimation methods shall be used where precision is limited.
- **Transparency**: The Project design, Baseline Scenario assumptions, emission factors, data sources, monitoring plans, and stakeholder consultation processes shall be disclosed with sufficient detail to allow reproducibility and third-party validation and verification. Records shall be retained and made available for audit upon request.
- **Conservativeness**: When uncertainty or incomplete information exists, conservative assumptions shall be used to avoid overestimating emission reductions. Baselines, emission factors, and performance thresholds shall be set to not favor credit generation in the face of ambiguity.

## Section 3: Objectives and Application Fields

This methodology is designed to be applicable and utilized under any GHG Program or standard that aligns with ISO 14064-2:2019 requirements for project-level GHG quantification and verification. It may be applied by any entity intending to implement a GHG mitigation project to sequester CIO in situ by preventing its Planned Production.

This methodology focuses on GHG Projects that prevent the extraction of CIO, such as heavy oil and bitumen. By substituting less carbon-intensive alternatives for these high-emission energy sources, it aims to reduce the average global emissions per unit of energy produced.

Projects using this methodology are allowed under the following modalities:

- **Unit Projects**: Individual programs designed to prevent planned CIO production within a specific geographical or operational boundary.

- **Grouped Projects**: Aggregated activities implemented by multiple participants or across different sites, provided they follow consistent methodologies and meet grouping criteria.
- **Programs of Activities (PoAs)**: Coordinated initiatives that allow for the inclusion of multiple independent activities over time if they adhere to the principles and procedures established by this methodology.[6]

Scenarios utilized in this methodology shall comply with all applicable legal and regulatory requirements, including those related to environmental permitting, land tenure, and resource development rights in the jurisdiction where the physical CIO resource is located. This includes, where relevant, the obligation to demonstrate legal access, rights to withhold production, or ownership of avoidance rights in accordance with Section 3.3: of this methodology.

Furthermore, PPs shall identify and comply with any additional monitoring, reporting, and verification (MRV) requirements imposed by the applicable GHG Program or subnational law where the emission reductions or credits will be claimed and verified. At the project design document (PDD) and verification stages, proponents shall provide a regulatory compliance matrix detailing the relevant statutes, authorizations, and reporting obligations (whether environmental, land use, or corporate) supporting the legal and operational basis for preventing CIO Extraction.

This methodology is applicable exclusively to GHG Projects located in G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) that are aimed at preventing planned CIO production, regardless of the CIO Extraction technology (e.g., surface mining, in situ methods like SAGD) or the CI of the CIO source. The following criteria and considerations apply:

- **Technological Scope**: Includes projects involving innovative or traditional methods to reduce reliance on CIO production, including using alternative, lower-carbon energy sources.
- **Geographical Scope**: Applicable exclusively to activities within G7 countries that possess CIO deposits, such as Canada and the United States.
- **Emission Reduction Focus**: Quantifies and supports verification of sequestered emissions across the full life-cycle of the CIO, including Upstream, Midstream, and Downstream stages.

## 3.1: Scope

This methodology covers a wide range of technologies, facilities, and scenarios that contribute to preventing planned CIO production. The scope is defined as follows: these activities—including preventing surface mining or in situ Extraction (e.g., SAGD or CSS), substitution with

[6] This applies in cases where the Project Proponent implements multiple mitigation activities that may be governed by different methodologies but are grouped under a broader climate action strategy or regional policy framework. For example, a jurisdictional or subnational climate plan may include both preventing oil production and above-ground land use activities (e.g., afforestation or renewable energy deployment), each following a distinct methodological approach. When these activities are coordinated under a unified PoA, they may be included over time, so long as they conform to the overarching principles and procedural requirements of this methodology for the components relevant to preventing CIO production.

lower-carbon energy sources, and implementation of energy efficiency measures—are the primary drivers expected to create a measurable difference in carbon intensity (CI) between the Sequestered CIO and its substitute (COS). While certain interventions, such as renewable energy deployment, may displace only a small fraction of the energy represented by a single barrel of oil, this methodology provides two options for addressing Market Leakage.

Project Proponents may determine a project-specific leakage rate using the approach outlined in Section 8.3.1:, which requires the application of at least one peer-reviewed econometric or market simulation model to derive a transparent, repeatable, evidence-based leakage factor reflective of specific local or regional market conditions. The types of activities and systems eligible under this methodology are categorized as follows:

1. **Extraction Technologies**: Includes methods to prevent surface mining or in situ Extraction techniques such as SAGD or CSS.
2. **Substitution Technologies**: Supports the adoption of lower-carbon energy sources, such as renewable energy systems (solar, wind, geothermal) or energy efficiency measures that replace CIO in energy generation.
3. **Innovative Processes**: Encourages deploying innovative technologies to reduce dependency on CIO, including hydrogen- or bio-based fuels or potentially small modular nuclear reactors as substitutes for petroleum products.
4. **Oil Production Sites**: Includes oil sands, bitumen Extraction facilities, and other CIO deposits located within G7 countries, with a focus on high-CI regions such as Canada and the United States.
5. **Substitution Facilities**: These may include renewable energy generation sites, industrial installations implementing energy-efficient technologies, or facilities integrating alternative fuels to displace CIO use.
6. **LCA Boundaries**: The methodology has a well-to-wheels approach, including the Upstream (exploration, Extraction, and initial processing), Midstream (transportation, refining, and additional processing), and Downstream (product distribution, fuel combustion, and end-use) components of the value chain, ensuring that all significant GHG emissions along the entire value chain are thoroughly accounted for and accurately quantified.

Alternatively, instead of determining a project-specific leakage rate, PPs may utilize a simplified approach and assume a fixed 100% leakage rate (i.e., that any prevented CIO production is fully replaced by additional production elsewhere in the global market). Under this approach, credits are issued only for the net reduction in CI between the Sequestered CIO and substitute COS.

## 3.2: Compliance with Technical, Legal, and Regulatory Frameworks

The PA implemented under this methodology shall demonstrate full compliance with applicable technical, environmental, and legal frameworks in the jurisdiction where the prevented CIO Extraction would otherwise occur. This includes, but is not limited to:

- Environmental laws and permitting requirements (e.g., exploration and development authorizations, emissions reporting obligations, and site closure requirements)

- Land use and resource rights, including tenure, mineral rights, and rights to access, develop, or prevent resource Extraction
- Corporate and commercial law considerations, such as contractual arrangements related to lease agreements, joint ventures, or indigenous land use agreements
- Applicable jurisdictional frameworks for GHG accounting, reporting, or MRV, where such frameworks exist at national, subnational, or regional levels

PPs shall identify all relevant legal and regulatory provisions applicable to the Baseline Scenario and demonstrate that the CIO production activity being prevented is legally permissible, commercially viable, and not otherwise restricted or prohibited by law.[7]

At the design stage, proponents shall include a regulatory compliance matrix in the PDD, summarizing all applicable local, regional, and national requirements, as well as evidence of project rights and obligations. This may include leases, permits, notices of non-objection, mineral ownership records, or equivalent documentation demonstrating legal access to or control over the CIO deposit and the right to prevent its extraction.

## 3.3: LCA and GHG Quantification Tools

The PPs employ recognized life-cycle assessment (LCA) or GHG quantification models that capture emissions across the full oil and gas value chain. According to the ISO 14064-2 (clause A.3.4), the selection of quantification tools shall consider scientific validity, transparency, and representativeness of the data and methods applied. The tools used should enable the calculation of life-cycle GHG emissions that are relevant to oil and gas sector activities. The objective is to ensure that emission estimates derived under this methodology framework are conservative, credible, and real.

The tools listed in this methodology are provided as illustrative examples. PPs are not limited to these tools and may propose alternative LCA or GHG quantification models. However, any tool used shall be open-source, transparent in its methodology, and have undergone peer review in a recognized scientific or technical forum. PPs shall also demonstrate that the tool provides a credible, conservative estimate of life-cycle GHG emissions consistent with this methodology's boundary conditions and objectives.

- **OCI$^{+}$**: It is an open-source analytical tool designed to estimate and compare the life-cycle GHG emissions of individual oil volumes worldwide. It evaluates emissions across various stages, including production, refining, and petrochemical processing, gathering, storage, transport, and end uses.
- **Argonne National Laboratory's GREET Model**: The model is a specialized adaptation of the GREET model tailored to assess life-cycle GHG emissions associated with oil production, transportation, refining, distribution, and end-use combustion. This model ensures precise and standardized emissions accounting across the full oil value chain (from Extraction to final use), referred to as "wells-to-wheels." By incorporating region-specific data and regulatory frameworks, the GREET model provides a comprehensive tool for evaluating the environmental

[7] This aligns with ISO 14064-2:2019, Clause 6.2(l), which requires project documentation to include all information relevant to project eligibility, including legislative, technical, environmental, and site-specific requirements.

impacts of petroleum-related activities across Upstream, Midstream, and Downstream stages.

- **Oil Production Greenhouse Gas Emissions Estimator (OPGEE) Model**: The OPGEE is an engineering-based LCA tool designed to estimate GHG emissions from crude oil production, processing, and transport. Its system boundary extends from initial exploration to the refinery entrance gate. It systematically quantifies emissions from different production pathways, providing a detailed modeling framework for assessing CI across various Extraction and processing scenarios.
- **Petroleum Refinery Life Cycle Inventory Model (PRELIM)**: PRELIM is an engineering-based LCA tool designed to estimate GHG emissions from crude oil upgrading and refining, focusing specifically on Midstream and refinery operations. It models energy use, emissions, and product yields across various refinery configurations, enabling detailed LCAs of different crude types and refinery designs. The model operates at a process unit level, incorporating mass and energy balances, and allows users to assess energy consumption, emissions intensity, and process efficiencies. PRELIM also enables scenario analysis for refining different crude qualities, providing insights into emissions and refining efficiencies.
- **OPEM**: OPEM is an LCA tool developed as part of the OCI$^+$ framework to estimate GHG emissions from the Downstream phase of the oil supply chain, specifically refining, fuel distribution, and end-use combustion. It quantifies emissions from refined product pathways using emission factors and energy balances derived from refinery configurations, fuel properties, and consumption scenarios. OPEM is designed to complement Upstream and Midstream tools such as OPGEE and PRELIM by capturing the Downstream (post-refinery gate) emissions, ensuring a full well-to-wheel analysis. This tool is particularly useful for modeling product-specific combustion emissions and for comparing life-cycle emissions across different oil types and end-use markets.

# Section 4: Eligibility and Inclusion Requirements

This methodology applies to GHG Projects that meet the following criteria:

- **Ownership:** The PP is the default holder of the sequestered GHG emissions rights associated with the project, unless a signed agreement, attestation, or other legally binding document explicitly cedes these rights to another party.
- **Geographic Restriction**: GHG Projects utilizing this methodology shall be located within the jurisdictions of the Group of Seven (G7) countries[8] (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States).
- **Baseline Scenario**: The PP shall demonstrate the following for the baseline scenario:
  a. Only economically feasible projects based on a full-field development plan or Credible Business Development Plan (CBDP) are eligible to use this methodology. The Baseline Scenario shall be considered financially attractive if the integrated financial analysis yields economic indicators, such as net present value (NPV), internal rate of return (IRR), and payback period, which are equal to or exceed standard industry benchmarks for comparable oil and gas development projects (see Section 5:). The PP shall also demonstrate that the projected Production Volume can be assessed with rigorous professional standards and that extraction is technically feasible using standard, industry-accepted methods, as calculated by a PVC. The Production Volume of a GHG Project shall be determined once per crediting period.
  b. The PP shall demonstrate that all major regulatory, legal, and environmental approvals are in place as required to advance the CIO production project to the final investment decision (FID) stage. This includes all major permits and regulatory clearances typically necessary for commencing the first phase of a multiple-phase Baseline Scenario. However, at this final stage – just before financing is arranged and project execution is commenced – the Baseline Scenario activity is discontinued to enable the implementation of the GHG PA.
  c. Sufficient data shall be available to calculate life-cycle emissions from the Baseline Scenario.
  d. The PP shall demonstrate full control over the baseline scenario CIO extraction activities. This includes legal authority to access, manage, or prevent the development of the CIO in question. Control may be established through ownership of mineral rights, lease agreements, operator status, or other contractual or statutory rights that authorize or obligate the PP to execute (or prevent) the development of the CIO.
  e. The Project shall complete third-party validation within five years of the determined project start date (see Section 6:, and Section 6.2:).

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[8] By restricting the methodology to G7 countries, the risk of generating poor-quality credits in jurisdictions with unreliable regulatory systems is minimized. This is particularly important to prevent the issuance of credits based on dubious or easily manipulated environmental licenses or approvals.

# Section 5: Additionality

This section outlines the procedures for demonstrating that the GHG emission reductions resulting from the PA are additional to what would have occurred in the absence of the project. PPs shall apply the following stepwise approach, adapted from the United Nations Framework Convention on Climate Change's (UNFCCC's) *Tool for the Demonstration and Assessment of Additionality* (Version 07.0.0 or later), to substantiate additionality.

## 5.1: Regulatory Surplus – Legal and Institutional Conditions

The PP shall demonstrate that the PA is not required by any law, regulation, or enforceable policy applicable in the jurisdiction where the project is located. This includes confirming that there are no environmental restrictions, land use designations, protected status, moratoria, or other legal instruments that prohibit or restrict CIO extraction at the Project site.

The Project site shall meet the following conditions:

- Extraction of CIO shall be legally permitted under current national, subnational, or local regulations.
- The Project area shall not be subject to conservation designations or regulatory frameworks that independently prevent or restrict CIO development.
- The PP shall demonstrate that the Baseline Scenario (i.e., CIO extraction) could legally occur without the GHG Project.

The PP shall provide supporting evidence, such as land tenure records, mineral or subsurface rights, exploration or development permits, and documentation of regulatory compliance.

## 5.2: Baseline Scenario – Financial Feasibility and Technical Viability

If the Baseline Scenario activity is legally permissible, the PP shall demonstrate that it is economically and technically feasible based on a full-field Credible Business Development Plan (CBDP).

The following criteria apply:

- The Baseline Scenario shall be financially attractive. This shall be demonstrated through an integrated financial analysis in the CBDP, which includes standard indicators such as NPV, IRR, and/or payback period, benchmarked against industry norms for Upstream oil development.
- The Baseline Scenario financial model shall exclude revenue from carbon credits and reflect realistic input assumptions (e.g., oil prices, capital and operational costs, tax structures, discount rates).
- Sensitivity analysis shall be included to demonstrate the robustness of the Baseline Scenario's financial viability under reasonable changes in key parameters.

In addition, the PP shall demonstrate that:

- The projected Production Volume of CIO is technically feasible using commercially available and industry-standard methods (e.g., surface mining, SAGD, CSS, or other in situ recovery techniques).

- The Production Volume has been independently assessed with professional accuracy by a qualified independent PVC.
- The Production Volume shall be determined once per crediting period and documented in the PDD.

# Section 6: Project Boundaries

The Project Boundaries define the spatial and temporal limits within which all relevant GHG SSRs associated with the project are identified, quantified, and monitored. The specific elements are described below.

## 6.1: Spatial Limits

The project spatial limits refer to the physical location of the CIO deposit. A CIO deposit is a three-dimensional subsurface body with an areal extent and thickness. The areal extent can be defined by a shapefile or polygon projected to the ground surface. The thickness is determined by specifying the top and base of the reservoir, which usually vary over the areal extent of the deposit. The top can be a geologic marker or structural surface and is defined by a structure map. The deposit's base can be a geologic marker, structural surface, or fluid contact and is defined by a structure map. The thickness is defined by the vertical distances between the two surfaces to make an isochore map.

The spatial extent of the GHG Project includes the physical boundaries of monitoring activities and pipeline injection points (in the Baseline Scenario of CIO Extraction). These boundaries include the location of the CIO deposit, Extraction infrastructure, and all related systems that would have been used for oil Extraction, processing, and initial transportation.

The site where the Baseline Scenario CIO deposit is located shall be specified at the country-, second- (state, department, province, or similar), and third-level (municipality or similar) political subdivisions, including geographical coordinates using the official reference system for the country where the project is located. The location and extent of the deposit shall be included in the PDD in a .shp (geographic information system shapefile) or .kml (Keyhole Markup Language) file format.

Figure 1: GHG Project Boundaries

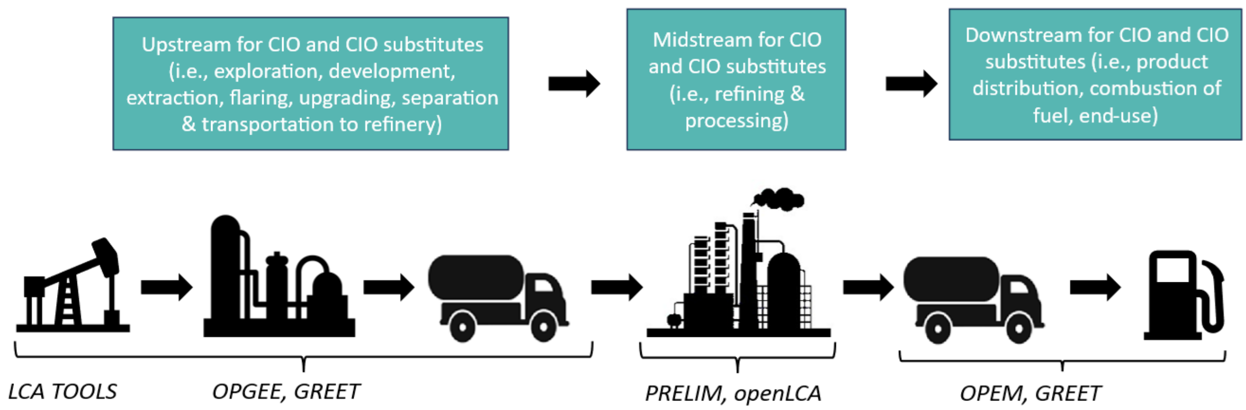


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Figure 1 illustrates the life-cycle stages for CI quantification of CIO and COS, including Upstream (exploration, Extraction, flaring, Upgrading, separation, and transportation to refinery), Midstream (refining and processing), and Downstream stages (product distribution and oil product combustion). Relevant emissions are quantified across stages using established LCA tools such as OPGEE, PRELIM, and OPEM or other LCA modeling tools.

## 6.2: Temporal Limits

The temporal boundary defines the duration over which the PA is implemented and GHG emission reductions are monitored, quantified, and reported. This includes the project start date, crediting period, and relevant monitoring intervals.

- **Project Duration**: The project duration refers to the period (in years) from the first (day.month.year) to the final (day.month.year) day during which the GHG Project prevents the CIO Extraction. For such projects, the planned operational lifetime shall involve keeping the CIO deposit undeveloped for a minimum of 50 years to ensure long-term climate benefits and alignment with Permanence expectations. Since the implementation of the Project results in non-Extraction rather than active development, no physical infrastructure or production technologies shall be installed in the Project Scenario.
- **Crediting Period**: The crediting period for projects under this methodology shall be: five years from the Project Start Date, renewable up to three times, for a maximum of 20 years total, subject to revalidation and confirmation of continued eligibility and enforceable project conditions.

This crediting structure aligns with the typical production horizon of CIO deposits, which are often exploited within a 15- to 20-year economic window. However, to maintain environmental and regulatory integrity, the following additional conditions apply:

- The crediting period shall not exceed the duration of the PP's legal authority to prevent the development of the CIO deposit.

- If the economic feasibility window for developing the CIO deposit (as demonstrated by Baseline Scenario financial modeling) is shorter than 20 years, then the crediting period shall be conservatively limited to that shorter window.
- The PP shall provide credible documentation demonstrating both the enforceability of development restrictions and the expected production period under baseline conditions.
- At the end of each five-year crediting period, the project shall undergo a renewal assessment, including revalidation of legal control, economic context, and baseline plausibility.

- **Project Start Date**: The start date of the GHG Project shall be defined as the earliest documented action taken of the Project to prevent the implementation of the Baseline Scenario credibly and demonstrably, following a pre-execution decision point or comparable project advancement milestone. This may include, but is not limited to, contract amendment, formal shelving of the development plan, or other legally binding decisions to halt forward motion on CIO extraction.

The selected start date shall fall within the expected window between FID and projected commercial production and shall be substantiated with clear documentation such as board resolutions, engineering schedules, regulatory filings, or signed contractual amendments.

The project shall complete initial third-party validation within five years of the determined project start date. Failure to do so shall render the project ineligible to claim GHG emission reductions from that start date unless justified under force majeure or exceptional circumstances and approved by the applicable program or Registry. This requirement applies to the GHG Project as a whole and does not preclude subsequent validation of individual phases or PDDs.

# Section 7: Baseline Scenario

The Baseline Scenario represents the business-as-usual case where a business decision is made to extract the CIO. The Production Volume for the Baseline Scenario shall be determined through Well Production Forecasting conducted by the PVC, using the Credible Business Development Plan (CBDP) and analog-based production profiling. The forecasting shall consider the extent and characteristics of the SCD, suitable Extraction methods, expected start-up, plateau, and decline phases, market conditions, projected oil prices, and other relevant inputs. The Baseline Scenario determination shall clearly state all key underlying assumptions under which a rational business decision would be made to extract the CIO Production Volume.

The credible business development plan and feasibility assessment shall reasonably consider that extraction technologies may become more efficient over time, which could affect both production economics and emissions intensity.

This methodology leverages LCA models such as the GREET3.0 and other recognized models to establish consistent boundaries, emission sources, and calculations. The CI of various oil types is well-established, as defined by geography and Extraction methods.[9] To determine the CI for the Baseline and Project Scenarios, the PP may use public information from relevant entities, such as the OCI+ or other peer-reviewed sources, provided it is demonstrated to accurately reflect the GHG Project. Alternatively, the PP may independently calculate the CIs for the Baseline and Project Scenarios by aligning with the principles outlined in ISO 14044, ensuring methodological rigor and comparability. The CIs of the Baseline and Project Scenarios shall be evaluated comparably to establish a representative CI differential.

The Baseline Scenario’s financial viability shall be demonstrated for its lifespan, including initial development, planned expansions, and end-of-life closure. To maintain environmental integrity, credits shall only be issued for emission reductions that remain real and additional throughout the Crediting Period. The validity of Baseline Scenario assumptions shall be reassessed and renewed in accordance with the requirements of Section 6.2:, at least every five years or at the start of each new crediting period, or sooner if significant regulatory or market changes occur that would materially alter the business case for Extraction.

If, at any point during the Crediting Period, due to shifts in energy markets, technological advancements, or other considerations, Ex-ante calculations indicate that the planned CIO production would have ceased or been interrupted, credits shall not be issued for such periods.

The description of the Baseline Scenario shall include the following:

- Production trends for oil produced in the same region or market via similar extraction techniques.
- Marketing or offtake agreements typical for CIO in the region.
- Volume commitments typical for CIO in the region.
- Transportation, processing, refining, and chains of custody typical for CIO in the region.

Table 1: SSRs Included in the Baseline Scenario

| SSR in the Scenarios | | Controlled/ Related/ Affected | GHG | Included? | Justification/ Explanation |
|---|---|---|---|---|---|
| Baseline | CIO Deposit | Controlled | $CO_2$ | Yes | The CIO is meant to be left undeveloped as part of the PA. |
| | | | Methane ($CH_4$) | | |
| | | | Nitrous oxide ($N_2O$) | | |
| | CIO Extraction | Controlled | $CO_2$ | Yes | |

[9] RESO 18-34 LCFS Attachment A Final Reg Order.

| SSR in the Scenarios | | Controlled/ Related/ Affected | GHG | Included? | Justification/ Explanation |
|---|---|---|---|---|---|
| | | | $CH_4$ | | The Baseline Scenario emissions resulting from extraction of the CIO are calculated using the GREET or OPGEE model within the OCI⁺ tool. |
| | | | $N_2O$ | | |
| | CIO Flaring and Venting | Controlled | $CO_2$ | Yes | GHG emissions resulting from flaring in the light- to medium-sized hydrocarbons of the CIO, which serve as preventive or corrective safety measures at a facility, are considered by the quantification model. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | CIO Processing and Refining | Affected | $CO_2$ | Yes | GHG emissions resulting from the processing of CIO's hydrocarbons at refineries or similar facilities are identified as significant by the PRELIM model within the OCI⁺ tool or the openLCA tool. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | CIO Transportation | Affected | $CO_2$ | Yes | GHG emissions resulting from the movement of the CIO from Extraction sites to processing facilities. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | CIO Refined Product Distribution and End-Use Combustion | Affected | $CO_2$ | Yes | GHG emissions resulting from transportation and end-use combustion of all refined products after the refinery exit gate are quantified using the OPEM model within the OCI⁺ tool or other GREET. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |

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Table 1 presents the GHG SSRs associated with the Baseline Scenario, where CIO extraction proceeds without the PA intervention. It identifies the GHG types and their sources, such as emissions from CIO reservoirs, extraction activities, flaring, Midstream processing, and Downstream combustion. Each entry in the table categorizes these sources as controlled, related, or affected while justifying whether they are included within the Project Boundaries. The table is complemented by Figure 1, which visually illustrates the Project Boundaries and the GHG sources relevant to the Baseline Scenario, emphasizing the Upstream and Midstream emissions of CIO production and the definitions of Upstream and Midstream, and Downstream stages of the CIO production, as defined in the Definitions section of this methodology.

The GHG emission sources in the baseline scenario of Table 1 shall be consistent with the LCA model used in compliance with applicable regulations.

## 7.1: Baseline Scenario GHG Emissions Calculations

The Baseline Scenario GHG emissions will be calculated using Equation 1 as follows:

Equation 1: Baseline Emissions

$$BE_y = R_y \times CI_{CIO,y}/1000$$

| Variable | Description | Units |
|---|---|---|
| **$BE_y$** | Total baseline emissions in year *y*. | Metric tons of carbon dioxide equivalent (t $CO_2$e) |
| **$R_y$** | The volume of CIO production prevented in year *y*, based on a credible business development plan and the production profile. This parameter reflects the CIO that would have been extracted without the GHG Project. | boe |
| **$CI_{CIO,y}$** | The CI of the prevented CIO Production Volume in year *y*, expressed in kg $CO_2$e per barrel of CIO. This value accounts for life-cycle emissions, including Extraction, processing, and transportation. | kg $CO_2$e/boe |

To estimate the $CI_{CIO,y}$ term, the following approach can be used:

1. **Peer-Review-Based Estimates**: Use peer-reviewed studies, industry reports, and Government datasets to identify average CI values for different oil types and Extraction technologies appropriate to the project. Resources such as the Rocky Mountain Institute

(RMI)'s OCI+,[10] IPCC emission factors, or historical LCA studies in similar geological formations or regions.

The selected CI value shall:

- Be specific to the oil type (e.g., bitumen, oil sands, light, medium, heavy).
- Align with the extraction technology for the CBDP (e.g., SAGD, CSS, conventional drilling, in situ mining, hydraulic fracturing).

2. **LCA Modeling**: This approach uses project-specific modeling to determine GHG emissions per unit of oil produced (kg $CO_2$e/boe), incorporating project-specific parameters into an LCA framework. Key models applicable could include:
    - **OPGEE**: A well-to-refinery model developed by Stanford University, commonly used for Upstream oil Extraction emissions.
    - **GREET**: Developed by Argonne National Laboratory, primarily used for crude oil refining and transportation emissions.
    - **PRELIM**: Focuses on refining emissions (Midstream emissions), complementing Upstream assessments.
    - **OPEM**: An engineering-based tool in the original OCI that uses emission factors and operating assumptions to calculate GHG emissions from the transport and combustion of oil products.
    - **openLCA**: A flexible, open-source tool adaptable to project-specific conditions.

[10] RMI. (n.d.). *Oil Climate Index plus Gas (OCI+)*. https://ociplus.rmi.org/

# Section 8: Project Scenario

## 8.1: GHG Emissions in the Project Scenario

GHG emissions to be considered in the Project Scenario are described in Table 2.

Table 2: SSRs of the Project Scenario

| SSR in the Scenarios | | Controlled/ Related/ Affected | GHG | Included? | Justification/ Explanation |
|---|---|---|---|---|---|
| Project | COS Deposit | Affected | $CO_2$ | Yes | The COS is meant to replace the CIO, which is being left undeveloped as part of the Project. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | COS Extraction | Affected | $CO_2$ | Yes | Emissions related to the Extraction of the COS are calculated using the GREET or OPGEE model within the OCI$^+$ tool. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | COS Flaring and Venting | Affected | $CO_2$ | Yes | GHG emissions resulting from flaring in the light-to-medium-sized COS hydrocarbons, which serve as preventive or corrective safety measures at a facility, are considered by the quantification model. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | COS Processing and Refining | Affected | $CO_2$ | Yes | GHG emissions resulting from the processing of COS hydrocarbons at refineries or similar facilities are identified as significant by the PRELIM model within the OCI$^+$ tool or the GREET tool. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |
| | COS Transportation | Affected | $CO_2$ | Yes | GHG emissions resulting from the movement of the COS from Extraction sites to processing facilities. |
| | | | $CH_4$ | | |
| | | | $N_2O$ | | |

| SSR in the Scenarios | | Controlled/ Related/ Affected | GHG | Included? | Justification/ Explanation |
|---|---|---|---|---|---|
| | COS Refined Product Distribution and End-Use | Affected | $CO_2$ | Yes | GHG emissions resulting from the distribution and combustion of refined products derived from the COS are accounted for using the OPEM model within the OCI⁺, which captures Downstream emissions beyond the refinery gate, including product transport and final end-use. Other tools, like openLCA or GREET, that cover this segment inside the value chain can be used instead. |

- *EcoEngineers*

Table 2 outlines the GHG SSRs associated with the Project Scenario, focusing on emissions related to the substitution or prevention of CIO Extraction. It details the emissions from reservoirs and substitution processes and evaluates the potential for leakage due to market shifts. The table comprehensively assesses the project's contribution to GHG mitigation by clearly defining the included emissions and explaining their significance. As with the Baseline Scenario, the Project Scenario table refers to Figure 1, which visually depicts the Project Boundaries and highlights the GHG emissions included. Together, Table 1, Table 2, and Figure 1 provide a clear framework for understanding and quantifying the emissions reductions achieved through the GHG Project.

- **Geographical Consideration**: The PP shall justify the selection of the substitute oil source(s) based on regional market conditions, infrastructure availability, and refinery compatibility.
- **Regulatory Compliance**: The selected substitute shall adhere to national and international environmental regulations, including emission control standards.

## 8.2: GHG Emissions Calculation in the Project Scenario

The Project Scenario GHG emissions calculation will be established using an LCA model appropriate for the regulatory framework governing the prevented Extraction of CIO (See Section 3.3:).

Equation 2: Project Emissions

$$PE_y = R_y \times CI_{COS,y} \times L_y / 1000$$

| Variable | Description | Units |
|---|---|---|
| **$PE_y$** | Total Baseline Scenario emissions in year *y*. | t $CO_2e$ |
| **$R_y$** | The volume of CIO production prevented in year *y*, based on a credible business development plan and the Production Volume profile. This parameter reflects the CIO that would have been extracted without the GHG Project. | boe |
| **$CI_{COS,y}$** | The CI of the COS in year *y*, expressed in kg $CO_2e$ per barrel. This value reflects the life-cycle GHG emissions (Upstream, Midstream, and Downstream) associated with the oil supply that substitutes for the prevented production of CIO. The $CI_{COS,y}$ may be derived based on a sole source if the substitution originates from a single alternative production system, or a mix of substitute oils. In the latter case, the weighted average CI shall be determined based on the contribution of each substitute type to the overall substitute supply. The calculation of $CI_{COS,y}$ will follow the guidelines outlined in Equation 3. | kg $CO_2e$/boe |

| Variable | Description | Units |
|---|---|---|
| $L_y$ | Leakage in year y ($L_y$) accounts for the portion of CIO emissions offset by the COS. PPs may apply a model-based approach using peer-reviewed econometric methods or opt for a simplified approach, assuming a fixed leakage rate of 1. Further details are provided in Section 8.3:. | Dimensionless |

Equation 3: Weighted Average CI of the COS

$$CI_{COS,y} = \sum_{i=1}^{n} CI_{COSi,y} \times x_{i,y}$$

| Variable | Description | Units |
|---|---|---|
| $CI_{COS,y}$ | The weighted average CI of the COS in year *y* ensures that the emissions impact of different substitute oil sources is appropriately accounted for. | kg $CO_2e$/boe |
| $CI_{COSi,y}$ | The CI of each COS in year *y* represents the life-cycle emissions of each substitute oil option *i*. | kg $CO_2e$/boe |
| $x_{i,y}$ | The fraction contribution of oil substitute *i* in year *y* represents the share of each substitute oil type in the total substitute mix used to replace the sequestered CIO. The sum of all $x_{i,y}$ values shall be equal to 1. | Dimensionless, a fraction between 0 and 1 |
| n | Total number of different oil substitutes used to replace the sequestered CIO. | N/A |

To ensure reasonable accuracy and contextual relevance in each project, the following guidelines shall apply when determining the appropriate COS ($CI_{COSi,y}$):

- **Geographical Consideration**: The substitute oil source(s) shall be justified based on local or regional infrastructure, market accessibility, and logistical feasibility. The PP shall demonstrate that the substitute oil is a realistic alternative, given its proximity to refining facilities, transportation networks, and historical energy market conditions.
- **Regulatory Compliance**: The selected oil substitute source(s) shall adhere to applicable national and international environmental regulations and agreements, including emission control standards and market restrictions applicable to the region(s) where the source(s) supply chain is. Compliance shall be verified using historical data, industry reports, or Government regulatory frameworks. For example, in the Organization of the Petroleum Exporting Countries (OPEC) or non-OPEC jurisdictions, certain oil substitutes may face trade barriers or market acceptance challenges depending on the producing country's export policies and the receiving region's import policies. Additionally, oil with high sulfur content or other inherent pollutants may be restricted from entering environmentally stringent markets, such as the European Union or California's Low Carbon Fuel Standard (LCFS), which impose strict limits on sulfur levels, heavy metal content, or GHG intensity. Similarly, CIO, which is not permitted to be developed due to such considerations, is not eligible for crediting.

Like the determination of $CI_{CIO,y}$ the $CI_{COSi,y}$ can be quantified using the following two methods described in Section 7.1:

- **Peer-Reviewed Estimates**: Rely on published studies, industry reports, and Government datasets to determine CI values specific to oil types and Extraction technologies; or
- **LCA Modeling**: Calculates project-specific emissions per unit of oil produced by integrating project-specific parameters into established models listed in Section 3.3:

## 8.3: Leakage

In the context of this methodology, leakage represents indirect GHG emissions caused by market dynamics. For example, reducing CIO production may increase extraction elsewhere to meet global supply demands. To ensure the integrity of emission reduction claims, the leakage rate shall be reassessed periodically to reflect changes in Production Volume, oil prices, and supply-demand conditions, unless the fixed rate of 100% is applied, in which case it remains constant throughout the crediting period.

- **Model-Based Leakage Estimation**: PP may opt to determine leakage using analysis of at least one peer-reviewed econometric or simulation model, as detailed in Section 8.3.1:. In this case, the leakage rate shall be recalculated once per crediting period using updated input data to ensure continued accuracy.
- **Fixed Leakage Rate Percentage**: Simplified approach, assuming a fixed leakage rate of 100% ($L_y$ = 1), requiring no annual reassessment.

### 8.3.1: Selection of Leakage Rate Based on Econometric Modeling

This section outlines the approach for PPs that choose to develop a tailored, yet still conservative leakage factor derived through the utilization of one or more econometric or market-based models that have been used in peer-reviewed scientific articles. The selected articles include complete references and provide the supplemental information, datasets, and assumptions required to ensure methodological transparency and full reproducibility of results. Given the dynamic nature of key inputs (such as Production Volumes, oil prices, and global supply-demand conditions), the selected leakage factor shall be reassessed periodically using updated data to maintain accuracy and environmental integrity.

#### 8.3.1.1: Econometric and Market Simulation Model Requirements

To preserve the environmental integrity of credits issued, the following requirements apply:

- All models shall be no more than ten (10) years old from their original publication date.
- Each model shall be specifically applied to assess carbon or Market Leakage in oil production scenarios. General leakage models for unrelated sectors are not eligible.
- The source article for each model shall include sufficient supplemental data, parameters, and methodological description to allow independent reproduction of leakage estimates.
- All models should explicitly address international leakage, and capture temporal dynamics (e.g., intertemporal substitution or the Green Paradox),[11] unless these elements do not apply to the specific project context or geographic market conditions. In such cases, the PP shall justify the exclusion based on credible market evidence or regulatory limitations.
- The models shall support or be adaptable to barrel-level or field-level applications or provide a clear methodology to derive leakage per unit of prevented production. Acceptable methodological approaches include:
    - **Computable General Equilibrium (CGE) Models**: These simulate the entire economy, including multiple interacting markets (e.g., oil, gas, labor, trade) and how they respond to shocks like supply restrictions.
    - **Partial Equilibrium (PE) Models**: These simulate how one market (e.g., global oil) responds to changes in supply/demand, holding other markets constant.
    - **Econometric Simulation Models**: These are based on regression-derived parameters (e.g., elasticity of supply/demand) and simulate market behavior using historical relationships.

[11] When future climate policies signal that fossil fuel Extraction will become more restricted or taxed, producers may accelerate Extraction today to avoid future losses — increasing near-term emissions. See: Holtsmark, K. (2018). Supply-side climate policy in Norway. University of Oslo, Department of Economics.

Moreover, the same values for Baseline Scenario Production Volume ($R_y$), Baseline Scenario CI ($CI_{CIO,y}$), and Project Scenario CI ($CI_{COS}$)[12] shall be applied. The price elasticities of supply and demand, substitution coefficients, and oil price scenarios shall be clearly stated and harmonized.[13] Additionally, all assumptions regarding market behavior (e.g., the role of OPEC as a coordinated supply-managing entity versus a competitive market structure) shall be transparently documented.

For the model, the following shall be included in the documentation annex:

- Full article citation and direct link to the publication
- Model equations and summary of assumptions
- All input values and their sources
- Output leakage factor ($L_y$), with corresponding uncertainty range
- Explanation of how the model was adapted or applied to the project scale

### 8.3.1.2: Conservative Model Selection

The project's leakage value ($L_y$) for use in Equation 2 shall be determined by selecting the highest leakage factor produced among the applied econometric or market simulation models. No upper cap is imposed on the leakage factor, as values greater than 1.0 may reflect real-world market dynamics where substitute oil production exceeds the Sequestered CIO volume during specific periods. In such cases, the CI differential between the CIO and the COS may still result in net emission reductions depending on extraction, transportation, and processing emissions differences.

### 8.3.1.3: Verification Assessment

The entire modeling process, including scripts, calculation sheets, and source references, shall be submitted to the validator/verifier.

The validation and verification body (VVB) shall assess:

- That the models were sourced from peer-reviewed publications.
- The supplemental data enabled the reproduction of results.
- That the final selected leakage factor was appropriately derived and appropriately conservative.

All documentation shall be made available for Registry review and potential public access (IP-specific redactions may be acceptable, if required. Sufficient detail shall be made public to reproduce results).

The selected leakage factor shall be re-evaluated before each vintage and issuance, or before each new crediting period, or in response to major market changes (e.g., shifts in global oil

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[12] Ideally, the $CIO_{COS,y}$ should be disaggregated and applied to each component (where applicable) of the CIO substitute blend to reflect the full composition and ensure accuracy.
[13] It refers to using the same values for key parameters (e.g., oil demand elasticity, baseline emissions per barrel, production volumes) across all three leakage models during comparative analysis.

prices, production trends, or regulatory frameworks). Reassessment shall use updated input data and may use updated or newly published models, provided they meet the same criteria outlined above.

### 8.3.2: Fixed Leakage Rate Percentage

This section outlines the approach for PPs that choose the simplified approach, which assumes 100% leakage—that each barrel of oil prevented from Extraction due to Project intervention is extracted elsewhere. The net difference in CI between the substituted energy source and the CIO is the value credited under this version of the methodology.

### 8.3.2.1: Calculation of Leakage

Leakage emissions are calculated as a percentage of Baseline Scenario emissions, ensuring simplicity and a high degree of conservativeness:

Equation 4: Leakage Default Value

$$L_y = 1$$

| Variable | Description | Units |
|---|---|---|
| $L_y$ | Total leakage rate of the substitute oil or slate of substitute oil in year *y*. | Dimensionless |

Adopting a standardized leakage rate of 1 simplifies the quantification process for PPs, eliminating the need for complex market modeling. Recognizing that market conditions and further studies may provide refined insights into leakage dynamics, the fixed Market Leakage rate of 100% may be revised in future methodology versions to better reflect evolving economic and environmental factors.

### 8.3.2.2: Verification Assessment

The entire modeling process, including scripts, calculation sheets, and source references, shall be submitted to the validator/verifier.

The validation and verification body (VVB) shall assess:

- That the models were sourced from peer-reviewed publications.
- The supplemental data enabled the reproduction of results.
- That the final selected leakage factor was appropriately derived and appropriately conservative.

All documentation shall be made available for Registry review and potential public access (IP-specific redactions may be acceptable, if required. Sufficient detail shall be made public to reproduce results).

The selected leakage factor shall be re-evaluated before each vintage and issuance, or before each new crediting period, or in response to major market changes (e.g., shifts in global oil prices, production trends, or regulatory frameworks). Reassessment shall use updated input data and may use updated or newly published models, provided they meet the same criteria outlined above.

# Section 9: GHG Emissions Reductions

### Equation 5: Emissions Reductions

$$ER_y = BE_y - PE_y$$

| Variable | Description | Units |
| --- | --- | --- |
| $ER_y$ | Emission reductions of the project in year *y*. | t $CO_2$e/y |
| $BE_y$ | Baseline Emissions in year *y*. | t $CO_2$e/y |
| $PE_y$ | Project Emissions in year *y*. | t $CO_2$e/y |

Equation 5 ensures that emission reductions are calculated conservatively by accounting for the leakage effect, which represents the increase in unintended emissions caused by the market or carbon leakage.

The CIO Production Volume sequestered in situ (R) quantifies the volume of CIO that will be left undeveloped, and its estimation shall be validated and approved by an independent PVC.

The determination of the $CI_{COS}$ shall incorporate the following criteria:

- **Economic Feasibility**:[14] The oil substitute shall be economically viable under prevailing market conditions, determined by analysis considering metrics such as NPV, IRR, and breakeven oil prices.
- **Geography**: Substitute oil will be assessed as sourced from one or more geographic locations, based on market conditions, transportation infrastructure, and refinery configurations. The PP shall provide justification for the geographic area assessed.
- **Regulatory Compliance**: Substitute sources shall adhere to national and international climate regulations and practices for emissions control (e.g., non-OPEC countries generally adhere to more stringent environmental regulations, such as the U.S. Environmental Protection Agency regulation under the Clean Air Act,[15] which imposes emission standards on Upstream operations).[16]

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[14] This requirement for economic viability of the COS should not be confused with the concept of “financial additionality” used in carbon markets. In this context, economic feasibility ensures that the COS is a realistic market substitute by requiring it to be financially viable under prevailing market conditions, typically demonstrated through indicators such as NPV, IRR, or breakeven oil prices. This criterion is necessary for the COS to be included in the substitution matrix and reflects commercial competitiveness, not eligibility for carbon credit issuance based on lack of investment viability.

[15] U.S. Congress. (1990). Clean Air Act (42 U.S.C. §§ 7401-7671q). Retrieved from https://www.epa.gov/clean-air-act-overview

[16] Government of Canada. (2017). Pan-Canadian Framework on Clean Growth and Climate Change (Cat. No. En4-306/2017E-PDF, ISBN: 978-0-660-08506-7). Environment and Climate Change Canada. Retrieved from https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html.

- **CI Quantification**: The CI of the substitute oil shall be estimated using accepted LCA models (see Section 3.3:).

## 9.1: Uncertainty Scope

The uncertainty assessment shall address all key components of GHG quantification, as follows:

- Baseline Scenario emissions from the full LCA of the CIO
- Project Scenario assumptions related to sequestered emissions and the CI of the COS
- Emissions associated with indirect or market-based leakage
- Monitoring parameters that materially impact the quantification of GHG reductions
- Any third-party data inputs, default factors, or external service providers used in estimation

## 9.2: Quantification and Treatment of Uncertainty

To quantify and manage uncertainty, the PP shall:

- Apply statistically sound methods, including standard deviation, variance, and confidence intervals, to characterize uncertainty in measurement data, model outputs, and emission factors.
- Define the confidence level and minimum data quality thresholds to be met in accordance with the materiality of each parameter.
- Aggregate uncertainty using conservative propagation techniques (e.g., Monte Carlo simulation, error propagation formula) when combining multiple data sources.
- Integrate declared uncertainty ranges from third-party datasets or instruments into the overall uncertainty budget.

Where possible, Quantification should reflect a 95% confidence interval or other justifiable threshold aligned with ISO guidance and recognized good practice.

## 9.3: Minimization Strategies

The PP shall implement proactive measures to reduce uncertainty throughout the project crediting period by:

- Utilizing empirically supported models and region-specific emission factors for baseline CIO production and emissions.
- Selecting validated tools and calibrated measurement equipment where applicable.
- Ensuring robust quality assurance and quality control (QA/QC) procedures and regular data validation.
- Where applicable, training staff responsible for emissions estimation, monitoring, and reporting to minimize human error.

- Avoiding the use of overly conservative defaults where higher-quality, site-specific data is available.

## 9.4: Documentation and Reporting of Uncertainty

The uncertainty assessment shall be described in detail in both the PDD and the monitoring plan. The documentation shall include:

- A description of all significant sources of uncertainty associated with both the Baseline and Project Scenarios
- Quantification methods and any tools, models, or statistical assumptions applied
- Identification of data quality limitations and efforts taken to improve them
- Justification of the overall conservativeness of the emission reductions claimed
  - This assessment shall be reviewed and updated periodically, particularly when
    - New monitoring data becomes available
    - Methodological changes are made
    - Oil Extraction technologies or emission factors are updated
    - Relevant external conditions change (e.g., oil market conditions, production methods, regulatory changes)

Any revision to the uncertainty assessment shall be clearly documented, justified, and submitted for third-party validation or verification as applicable.

## Section 10: Permanence

Permanence is a key principle in the context of carbon credit projects, ensuring that the emission reductions or sequestered emissions resulting from a GHG Project are maintained for a minimum of 50 years. To ensure the integrity of the SCD and its continued lack of development, the Permanence of the deposit shall be evaluated at the start of every crediting period.

Each Permanence evaluation shall include a full review of the following:

- The physical security of the SCD and surrounding land to confirm that no SCD Extraction activities have occurred or are planned.
- Any potential risks to the SCD (e.g., SCD ownership changes or external threats).

### 10.1: Evaluation Process

- A third-party verifier accredited by a recognized body shall conduct the evaluation. This independent verification ensures that no illegal or unauthorized Extraction has occurred and that the SCD remains intact.
- The PP shall maintain records of each evaluation. This may include satellite imagery, geospatial data, Government data, and on-site inspections to confirm that the SCD has not been accessed or extracted.
- Every Permanence evaluation shall include a detailed report outlining the status of the SCD, which shall be submitted to the governing standards body for review.

### 10.2: Permanence Safeguards

The PP and the CIO Volume Developer shall legally commit to the GHG Project, and to maintaining the CIO deposit undeveloped for the full 50-year prevented-extraction period, or any longer period of time as determined in the project documentation.

In addition,

- the contracts between the CIO Volume Owner and CIO Volume Developer under which the CIO Volume Developer holds rights to extract CIO from the CIO deposit (for example, but not necessarily limited to, petroleum or bitumen leases and related documents)("Leases") shall have a provision whereby the CIO Volume Developer may continue the validity of the Leases without producing CIO from the Leases, for the duration of the prevented Extraction period, and the CIO Volume Developer shall declare its commitment to meeting the requirements of such provision and shall maintain or cause to be maintained all payments, filings, and other obligations required to keep leases in good standing; and shall explicitly declare its commitment to these duties, where the Leases have no such provision for continuation or the CIO Volume Developer shall ensure the continuation of the in situ sequestration even in the case of insolvency, bankruptcy, or other impediment by at least one of the following:
    - a statement of non-objection from the CIO Volume Owner; or

- a suitable independent written legal opinion confirming that the CIO Volume Developer (or its successor) retains the legal ability to elect to keep the SCD undeveloped for the entire Permanence period, without requiring any action, consent, or future obligations from the CIO Volume Owner; or
- a binding legal mechanism, such as a corporate-level agreement (e.g., board or director resolution and/or shareholder covenant), expressly structured to survive and remain fully enforceable in the event of any change in control, assignment, transfer, insolvency, or bankruptcy of the PP or the CIO Volume Developer, and to obligate the CIO Volume Developer (or its successor) to maintain the SCD in an undeveloped condition for the entire Permanence period.

These mechanisms may be more fully developed in a future version of the Methodology, as legal pathways and owner engagement evolve.

## 10.3: Financial Instruments or Insurance

The PP shall establish and maintain one or more Suitable Financial Instruments (SFIs). To safeguard the project against permanence and reversal risks. Each SFI shall, at a minimum, include:

- An initial eight-year guarantee covering early-stage permanence obligations before sufficient revenue accrual; and
- A reserve account funded by at least five percent of gross carbon credit sales, capitalized using the prevailing risk-free monetary policy rate (e.g., Federal Funds Rate, Bank of Canada Overnight Rate, or equivalent).

Buyer-level or transaction-level insurance products (e.g., reversal or non-performance insurance) may be used when requested by credit buyers, provided they supplement, and do not replace, the long-term project-level SFI structure described above.

The SFI framework may be updated in future versions of this methodology as legal mechanisms, registry guidance, and owner engagement evolve, including the potential addition of formal non-development easements, escrow structures, or other long-term legal assurance tools.

## 10.4: Monitoring Procedures

As GHG Projects demonstrate that preventing the extraction of the CIO results in sequestered carbon emissions, periodic monitoring to confirm Permanence shall be conducted. Permanence in this methodology requires demonstrating that the CIO shall not exit the defined CIO deposit by natural or artificial pathways. To uphold the principles of Permanence, the following measures shall be undertaken during monitoring:

- Assess whether any natural geological features or artificial factors lead to the migration of CIO from the CIO deposit.
- Confirm that current wells within the prevented CIO extraction project's geographic area do not serve as a leakage pathway from the CIO deposit.

- Confirm that no oil, other mineral extraction, or other activities occur within the prevented CIO Extraction project's geographic area or surrounding area that have compromised Permanence or could lead to a reversal of sequestered emissions.

# Section 11: Monitoring

The project shall include a comprehensive monitoring plan that ensures transparent, consistent, and verifiable collection and reporting of data relevant to GHG emissions reductions. The monitoring plan shall be designed and implemented in accordance with the requirements of ISO 14064-2:2019 and shall include the following elements:

- **Parameter Identification and Monitoring Boundaries**: The monitoring plan shall clearly identify and describe all parameters to be monitored throughout the crediting period. This includes, at a minimum:
    - Emissions associated with the Baseline Scenario (i.e., extraction, transport, and processing of CIO)
    - Emissions associated with the Baseline Scenario (i.e., extraction, transport, and processing of COS)
    - Any relevant Project Scenario indicators (e.g., confirmation of non-extraction)
    - Leakage risks or market displacement effects
    - Key data supporting additionality claims (e.g., financial benchmarks, development restrictions)

  For each parameter, the plan shall define:
    - Units of measurement
    - Monitoring frequency
    - Data sources and collection methods
    - Estimation or modeling approaches (where applicable)
    - Methods for managing uncertainty and ensuring conservativeness.

## 11.1: Description of the Monitoring Plan

The Project monitoring plan is designed to ensure systematic and comprehensive tracking of the PA, data collection, and GHG emissions reductions. This plan is tailored to the unique characteristics of GHG Projects that prevent the Extraction of CIO, and it integrates rigorous MRV processes.

The components of the monitoring plan include:

- Regular inspections and documentation of field conditions to confirm the absence of CIO extraction activities. Some of these elements may include the use of satellite imagery, aerial surveys, or similar remote sensing technologies to verify that no physical changes indicative of development have occurred, or reliable data from regulatory authorities, as well as site visits conducted by a VVB as part of the third-party audit process to confirm the status of the CIO deposit.

- Table 3 contains the required measurements for the Production Volume prevented (R), the CI of the prevented Production Volume ($CI_{CIO}$), the CI of the substitute oil ($CI_{LIO}$), and the Market Leakage adjustments (L).
- The monitoring frequency per parameter is specified in Table 3, and the verification periodicity is defined by the requirements of the GHG Program or the preference of the PP.
- All monitored data shall be archived for at least five years beyond the Crediting Period, securely stored with access controls for further availability to the GHG Program and other key stakeholders.

## 11.2: Monitored Data and Parameters

The monitored data parameters for projects shall be systematically collected and managed to ensure compliance with the MRV requirements outlined in this methodology. The parameters shall be recorded in a consistent, transparent, and auditable manner to support the quantification of GHG emissions reductions achieved by the project. The PP shall implement a monitoring plan that ensures high-quality data collection, considering the principles of accuracy, completeness, consistency, comparability, and transparency. The data shall be sourced from reliable and recognized sources, applying conservative approaches where uncertainties exist.

The PP shall possess all required information to demonstrate that the results and statements related to the GHG Project comply with all applicable principles and are aligned with the methodological requirements outlined in this document and relevant sections of ISO 14064-2:2019, specifically Annexes A.3.5, A.3.6, and A.3.8, or any subsequent revisions that address emissions reduction quantification, data quality management, and project documentation.

Table 3: Monitoring Parameters

| Variable/Parameter/ Data | | Units | Data Source | Measurement Procedure | Applied Value or Periodicity |
|---|---|---|---|---|---|
| $R_y$ | CIO Production Volume curtailed in year *y* | boe | Credible Business Development Plan, internal forecast | Counterfactual estimation process, type wells analogs | Readjusted every five years, assessed by a PVC |
| $CI_{CIO,y}$ | CI of CIO in year *y* | kg $CO_2$e/boe | $OCI^+$, OPGEE, PRELIM, GREET, peer-reviewed sources | LCA following ISO 14044 guidelines | Reviewed annually by the PP |

| Variable/Parameter/ Data | | Units | Data Source | Measurement Procedure | Applied Value or Periodicity |
|---|---|---|---|---|---|
| $CI_{COSi,y}$ | CI of each oil substitute in year *y* | kg $CO_2e$/boe | OCI+, OPGEE, PRELIM, GREET, peer-reviewed sources, refinery emissions report | LCA following ISO 14044 guidelines | Reviewed annually by the PP |
| $X_{i,y}$ | Fraction contribution of oil substitute in year *y* | Dimensionless, fraction between 0 and 1 | Market analysis reports, economic modeling | Sum of all $x_{i,y}$ shall be 1, representing the proportion of each substitute oil in the total mix | Reviewed annually by the PP |
| $L_y$ | Market leakage factor | Dimensionless | Market analysis reports, economic modeling | Project-specific via credible analysis under Section 8.3.1: (e.g., Prest). Alternatively, assumed 1.0 (100%) per Section 8.3.2: | Calculated or fixed at 1 |
| N/A | Permanence assurance | Qualitative (e.g., Low, Moderate, High) | Legal agreements, stakeholder commitment | Documentation review, remote sensing review, in-person site visits | According to the validation and verification procedures |

| Variable/Parameter/ Data | | Units | Data Source | Measurement Procedure | Applied Value or Periodicity |
|---|---|---|---|---|---|
| N/A | Remaining Ex-ante Credits to Reconcile | t $CO_2e$ | Verified monitoring reports | Calculated as cumulative Ex-ante issuance minus cumulative verified Ex-post issuance reconciled at each verification event and confirmed by the VVB | Periodically (e.g., annually), during a verification cycle until reconciliation is complete. |

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# Section 12: Information Management

The following provisions outline the mandatory requirements for information management.

## 12.1: QA/QC Procedures

All information and data related to the GHG Project shall be subject to robust QA/QC procedures to ensure accuracy, consistency, and reliability.

QA/QC procedures shall address:

- **Uncertainty Reduction**: Implement methods to minimize uncertainties in emissions quantification and related parameters.
- **Follow-up Criteria**: Establish and apply procedures for consistent monitoring, auditing, and data review.
- **PVC**: The third-party PVC shall have staff responsible for data collection and processing, and management shall ensure that:
  - Staff have the necessary qualifications and training.
  - Undergo periodic evaluations to ensure continued competence in their roles.

## 12.2: Documentation and Recordkeeping

All QA/QC activities, data measurements, uncertainty assessments, and follow-up actions shall be:

- Properly documented.
- Stored in a secure and accessible format for validation and verification purposes. Records shall be retained for at least seven years after the GHG Project crediting period ends.

## 12.3: Reference to Existing Systems

Organizations with existing information management systems may align the GHG Project information management requirements with their internal systems, provided these systems meet or exceed the standards described in this methodology.

Examples of acceptable systems include those based on ISO 9001 for quality management or ISO 14033 for environmental data quality management.

## 12.4: Accuracy and Traceability

Ensure all data, reports, and supporting documentation are traceable and verifiable.

Maintain clear audit trails for all activities and decisions related to the project implementation and monitoring.

## 12.5: Obligations

The PP is obligated to:

- Regularly review and update information management protocols to align with evolving best practices, regulations, and standards.
- Facilitate and cooperate with recurring site visits by the VVB as applicable, ensuring access to all relevant locations, records, subcontractors, and personnel.
- Provide all relevant information during validation and verification processes, ensuring transparency and accountability.

# Section 13: Project Documentation

It is mandatory to maintain all information and documentation related to the GHG Project, including:

1. **Emissions Calculations**: Complete records of GHG emissions calculations for both Baseline and Project Scenarios. Supporting data and methodologies used in emissions quantifications.
2. **Project Operation**: Documentation demonstrating that the GHG Project has been implemented according to its original design described in the PDD (e.g., records of operational activities, monitoring data, and compliance with methodology requirements).
3. **Retention and Accessibility**: PPs shall ensure that all records are securely stored and readily accessible for validation and verification purposes.

# Section 14: Validation and Verification

Validation and verification are critical components of ensuring the integrity and credibility of GHG Projects that prevent the development of CIO deposits. These processes shall be conducted in accordance with the requirements of ISO 14064-3:2019 (or latest updated version), including principles of impartiality, conservativeness, documentation, and evidence-based decision-making.

## 14.1: Validation Process

Validation confirms that the project is meticulously designed, additional, and consistent with ISO 14064-2:2019 requirements. At the validation stage, the VVB shall:

- Confirm the Project Boundary, Baseline Scenario, and GHG SSRs.
- Assess the reasonableness of the assumptions, limitations, and methods that support
- the Project's projected outcomes.
- Validate the selection and application of quantification methodologies, including the forecast of CIO volumes and associated emissions.

- Evaluate whether the Baseline Scenario is credible, conservative, and consistent with regulatory, technical, and financial expectations.

The validation shall include reviewing supporting documents, including legal instruments, the financial additionality demonstration, any documentation supporting a leakage rate not equal to 1, and the PDD. The validator shall issue a validation report and opinion that clearly states the basis for validation and the conclusion.

### 14.1.1: Special Validation Requirements

#### 14.1.1.1: Additionality and Volume Forecasts

The VVB shall assess the financial and technical assumptions used to justify additionality. This includes assessing the Production Volume forecast as determined by the PVC, ensuring that methods used for calculating NPV, IRR, and/or payback periods are conservative and appropriate. The VVB shall also confirm the qualifications and independence of the PVC.

## 14.2: Verification Process

Verification shall be conducted periodically (e.g., at the end of each crediting period or more frequently as specified in the monitoring plan). Its purpose is to confirm that the GHG Project continues to deliver real and measurable GHG emission reductions through the continued non-development of the CIO deposit.

At each verification stage, the VVB shall:

- Confirm that the GHG Project continues to comply with all technical and legal conditions set out in the validated PDD.
- Assess whether any changes in the regulatory status (e.g., zoning, permits, concession rights) affect the baseline scenario or increase the risk of reversal.
- Review monitoring data, third-party documentation, and remote sensing or on-site evidence to verify that no unauthorized development activities have occurred.
- Conduct site visits or equivalent remote assessments as necessary, based on risk to:
    - Visually confirm the undeveloped status of the CIO deposit
    - Validate consistency between observed conditions and reported monitoring data
    - Review monitoring systems and QA/QC procedures for accuracy and compliance
    - Evaluate whether the project has implemented measures to monitor and mitigate potential adverse social impacts due to non-Extraction.

## 14.3: Information Management and QA/QC

The verification shall include an assessment of the GHG Project's data management systems and internal QA/QC procedures. This includes checking:

- Data traceability and integrity from source documents
- Recordkeeping procedures for legal agreements, site status reports, and monitoring logs

- Procedures for handling missing data or revising prior assumptions.

## 14.4: Verification Frequency and Documentation

Verification shall occur at least once per crediting period, or more frequently if required by the monitoring plan or if material changes are identified.

Each verification engagement shall result in a Verification Report and Opinion, containing:

- A clear statement of conformity with the verification criteria
- A summary of findings and material observations
- Description of site inspections or remote review procedures conducted
- An account of any unresolved issues or corrective actions required

## Section 15: References


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## Section 16: Document History

| Version | Date | Comments or Changes |
|---|---|---|
| 1.0 | 23.06.2025 | First version of the methodology |

# Appendix A: Requirements of the PVC

The PVC shall be a professional petroleum engineering evaluation firm that is independent, impartial, and highly skilled at conducting evaluations of CIO-in-place and corresponding Production Volumes and developing or assessing technical and commercial business plans for the type of CIO project in the baseline scenario.

1. The PVC shall have at least 10 years of experience in CIO evaluation within the play types, reservoirs, exploration and development methods, and regulatory and legal regimes of the kind described in the baseline scenario. Evidence of such experience will include a proven history of similar assessments, supported by references from reputable, publicly traded industry clients, having passed applicable third-party audits or regulatory reviews, and employing at least one licensed Professional Engineer qualified to provide a professional attestation or opinion on reservoir and production-forecasting evaluation.
2. In its work under this methodology, the PVC shall:
    a. Operate within corporate professional practice standards of the PVC's jurisdiction, including strictly avoiding any real or apparent conflicts of interest.
    b. Utilize expert individual contributors with suitable professional qualifications and who, in key areas of the work, are qualified to function as a Competent Person or Qualified Person or the like under national guidelines in Canada, the U.S., or the United Kingdom.
    c. Ensure that any subconsultants fully comply with the requirements of this Appendix A.
3. Analogous requirements shall apply for work scope in the areas of crude oil marketing and supply, logistics, refining, emissions intensity, and leakage.

# Important Information

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