



Expectations for Prepurchase deliveries

Requirements to process and accept carbon removal deliveries for Frontier prepurchases

Last updated Jun 21, 2024

Introduction

This document outlines the requirements for delivery of carbon removal for Frontier prepurchases.

The focus of Frontier's prepurchase program is to accelerate the early deployments of promising removal technologies. At the same time, we want to be confident that prepurchases result in the intended carbon removal from the atmosphere, and that companies are on the path to providing what's required to deliver removal confidently at larger scales. As a result, Frontier requests a number of pieces of evidence of net removal and conducts an external scientific review process to determine whether to accept delivery.

Please note: For low-volume prepurchases, we do not require that credits are issued by a third party credit issuer on a registry, while we do for offtake deliveries. A more detailed discussion of requirements for responsible verification of CDR at-scale is available in our [Delivery Expectations for Offtakes](#).

Delivery acceptance process overview

Below is the process we will follow and the information we are looking for to confirm and accept carbon dioxide removal (CDR) as delivered:

- (1) **Supplier provides evidence of net carbon removal sequestered** to Buyers and Frontier
 - We can flexibly kick off this process as you deliver tons (partial or full deliveries) and have the substantiating data (see below).
- (2) **Frontier reviews delivery information**
 - For the first delivered tons, Frontier will send the protocol and data (treated as confidential under NDA) to Frontier's external scientific team for review.
 - We may follow-up with questions or requests for additional or missing data; Supplier provides any missing information.
- (3) **Buyer accepts or rejects delivery**
 - If some or all of a delivery is rejected, Frontier will flag any issues or additional data required before re-review.
- (4) **Frontier lists delivered tons on public CDR Delivery Tracker**
 - Frontier will regularly update a [public dashboard](#) of contracted and delivered tons from the Frontier portfolio as deliveries are reviewed and accepted.



Data requested for prepurchase tons delivered to Frontier buyers

To confidently accept delivery, we expect to receive:

Data	Description	When provided
Carbon removal delivery certificates	<p>Certificate of delivery¹ which includes:</p> <ul style="list-style-type: none"> • Issuer • Issue date • Protocol issued against • Certificate # • Recipient • Net CO2 delivered • Total price per ton (USD) of tons delivered, including the portion of that price specific to MRV 	With each delivery
Summary Delivery Report with quantification data	<p>A report providing evidence of the number of net tons of removal delivered per the protocol, with on-the-ground data substantiating net removal claims.</p> <p>A self-produced report is acceptable for prepurchases, though suppliers may also choose to work with a Frontier-qualified credit issuer or other third-party validation and verification body (VVB).</p> <p><i>Note: It may be strategic to look ahead to Frontier's expectations for offtakes when considering your early VVB partner.</i></p>	With each delivery
Protocol and/or Project Design Document (PDD)	<p>A copy of the protocol and PDD describing the approach to quantify net carbon removal for the project.</p> <p>Should include:</p> <ul style="list-style-type: none"> • Name of the protocol developer (if external) • How the protocol was developed, reviewed and approved • The quantification methodology, inclusive of the relevant components for the pathway, which details what data is measured versus modeled, LCA boundaries, monitoring frequency, key assumptions, and treatment of uncertainties • Accounting for the discount to net removal (when applicable) associated with the relevant pathway uncertainty components • Standard the protocol was validated against and name of VVB conducting the protocol validation, if applicable* 	With or prior to first delivery, and an annual summary of protocol changes for subsequent deliveries

¹For prepurchases, we are explicitly **not** requiring use of an independent, Frontier-qualified third party credit issuer, though we do require a 3P reviewed protocol. Note: these verification expectations differ for larger offtakes.



	<i>*Note: For prepurchases, this can be a proto-protocol, as long as details on the scientific review process are provided.</i>	
Life cycle assessment (LCA) for delivery ²	<p>A detailed LCA breakdown that specifies:</p> <ul style="list-style-type: none"> ● Gross removal for Frontier credits (per tCO₂) ● Emissions caused by delivering Frontier credits (per tCO₂) ● LCA boundary conditions <p>Including, but not limited to:</p> <ul style="list-style-type: none"> ● Embodied emissions from construction and in materials used (equipment, sorbent, etc.) (tCO₂) ● Transport and electricity emissions with <ul style="list-style-type: none"> ○ Energy resource mix; power and/or liquid fuel (list) ○ Carbon intensity of energy resource mix (unit of power/tCO₂) 	Upon first delivery, with a an updated LCA provided on an annual basis for subsequent deliveries
Discussion of uncertainty discount ²	<p>Quantification of net tons delivered which appropriately discounts volume to account for pathway uncertainties and points of leakage identified in CarbonPlan's CDR Verification Framework.</p> <p>A list or table of uncertainties and their relative contribution to the overall discount should be included.</p>	Upon first delivery, updated as uncertainties are reduced
Select operational data	<p>Relevant operational data to substantiate that you have done the activities necessary to remove carbon durably. These will vary by pathway, but may include:</p> <ul style="list-style-type: none"> ● Capture dates ● Injection/application dates ● Injection/application locations ● Data demonstrating system's functional stability and durability ● Feedstock or biomass sourcing details 	With each delivery

Note: The information above will remain confidential under our NDA.

Note: Ongoing reporting against interim milestones and of other operational data will be requested/collected separately through quarterly meetings and via an annual portfolio survey.

Note on credit issuer and verifier eligibility

We will accept prepurchase deliveries that have not been reviewed by a Frontier-qualified credit issuer, and we do not require an independent registry. However, to build relevant partnerships from the start, we suggest looking ahead to Frontier's [Delivery Expectations for Offtakes](#) when considering your early credit issuing partner(s).

² May be included as part of the PDD.



Reporting format

We ask that you do your best to adhere to a concise, simple format in your reporting that makes it easy for our external reviewers to understand your project and claims.

- No more than five separate files that include all data requested in the table above, e.g.:
 - Delivery certificate
 - Summary delivery report report (no more than 5 pages)
 - Protocol or Project Design Document
 - Supplemental or raw data
- Include necessary information within the documents themselves, and limit the use of hyperlinks to other documentation except where necessary (e.g., scientific references) or if the linked information is truly supplemental and not necessary for the verification of your claims
- Email all documents in a single ZIP folder

Renewal requirements for eligible suppliers

For suppliers who have delivered all contracted tonnage and are eligible to be considered for a renewal purchase, we ask that, in addition to the above, you provide a summary report outlining:

- A narrative description of Company's progress and challenges to completing the Project, and why this is the right time for a follow-on purchase.
- A description of future plans demonstrating a decline in future process emissions, improved net-negativity, and cost improvements
- Evidence of ongoing responsible community engagement and efforts to achieve the highest standards of safety, compliance, and local environmental outcomes
- Evidence of the achievement of any contract-specific renewal milestones



Appendix

Delivery expectations for Prepurchases vs Offtakes

Element	Prepurchase requirement	Offtake requirement
Standard	n/a	Credits must be issued against a program Standard with one of Frontier's qualified credit issuers
Protocol	A proto-protocol is acceptable	Approved protocol validated by a VVB & approved by Frontier is required
Project Design Document (PDD)	PDD required	PDD validated by a VVB is required
Validation & verification body (VVB)	Use an independent, third party verifier, ideally accredited (preferred) Conduct internal review and reporting and engage scientific community for input (acceptable)	Use an accredited, independent, third party validation and verification body confirmed by one of Frontier's qualified credit issuers
Credit issuance & registry listing	Credits are publicly listed by Frontier, or by supplier if issuing high volumes to multiple buyers. No independent registry required	Credits are issued by a third-party registry that meets Frontier buyers' needs and is confirmed by Frontier

Definitions

Term	Definition
Carbon credit	An economic unit representing one net metric tonne of carbon dioxide that has been avoided or removed from the atmosphere.
Credit Issuer <i>or credit issuing program</i>	An organization that establishes and operates a program with guidelines to generate and issue carbon credits. Issues credits against protocols compliant with their program rules ("Standard") and maintains a public ledger of issuances and retirements in-house or through a 3rd party. Note: Sometimes referred to loosely as "registries."
Monitoring, reporting and	Multi-step process of accounting for all the emissions, energy use, environmental and public health impacts associated with a carbon removal project to determine its net climate impact and then reporting these results to an accredited third party to



verification (MRV)	verify the outcomes.
Project design document (PDD)	A plan that details how a given project will deliver against the requirements of a protocol, including measurement process and tools, data to be collected, modeling approach, etc. With this document and the raw data required, someone could replicate the project's CDR claims. i.e. a document with procedures for Climeworks' Orca facility or Lithos' midwest deployments
Protocol	The specific procedures required to quantify and monitor the net amount of CO ₂ removed by a process. Sets the activity boundaries, calculation formulas, and evidence needed across each step to quantify net removal, along with ongoing removal monitoring and ecosystem safety procedures. Multiple companies with the same approach could use the same protocol. Sometimes referred to as "methodology." i.e. Verra's DAC methodology; Isometric's Bio-oil Geological Storage protocol
Quantification Standard	A set of requirements a protocol must meet to accurately quantify removals for a given pathway (Direct Ocean Removal) or approach (pH swing Direct Ocean Removal), ideally maintained outside individual credit issuers to uphold consistency. May include measurement requirements, modeling parameters, biomass feedstock screening guardrails, or other controls. i.e., ISO 14064-2, Cascade's Community Quantification Standard for Enhanced Weathering
Registry	An electronic ledger that transparently tracks and reports the issuance, trading, and retirement of carbon removal credits. This function is typically performed by Credit Issuers, and often Credit Issuers are referred to loosely as "Registries."
Validation	A systematic process conducted by an independent Verifier to evaluate whether a project has adhered to the criteria provided in the Protocol for the project's approach and the Credit Issuer's Standard. Project validation occurs up front, and is a prerequisite for CDR crediting.
Verification	The process of evaluating and assuring the claims of net removal and other key outcomes (financial additionality, safety) against the requirements in the project Protocol and PDD, using data and information collected from the project.
Verifier	A third-party entity with the expertise and experience to determine if a project meets the requirements in the Credit Issuer's Standard (validation) and to perform the verification functions required by the Protocol. May be called a Validation & Verification Body, or VVB.

Delivery expectation Q&A

What level of measurement reporting and transparency is Frontier looking for?

Transparency around both what is known and where uncertainties remain can build broader community trust in CDR claims. For all purchases facilitated by Frontier, we expect transparent communication of protocols, data reflecting a company's execution against that protocol, and reporting to the market of tons delivered.



What type of long-term durability monitoring does Frontier require?

We expect projects to actively monitor project deployments (storage systems, mineral amendment applications to land, etc.) until “functional stability,” a concept from landfill management, is reached. This is the point at which the system no longer poses serious reversal risk and doesn’t require any active control systems for continued storage.

For permanent carbon removal projects, we expect protocols to address durability by 1) developing monitoring processes and data requirements to track reversals or storage leakage, and 2) identify an appropriate threshold and what must be observed in order to confidentially assess that “functional stability” has been reached and monitoring can be discontinued. This point will vary based on the nature of the deployment (i.e., the stability timeline for basalt mineralization vs geologic storage of supercritical CO₂ vs biomass burial looks different).

How should protocols evolve as new information comes out? Will Frontier revise past vintages?

We ask that projects adopt conservative protocols that appropriately discount delivered volume based on uncertainties. In the case that significant learnings come to light that imply less carbon removal was completed than credits delivered (e.g., scientific consensus determines that geologic storage leakage is 10x our previous assumption), it is up to each Frontier buyer’s discretion whether they write off that carbon removal purchase and re-buy if the credit was retired. We would not retroactively claw back payments from companies.

We also ask that protocols be updated periodically: frequently enough to reflect the best available science, but not so quickly that it makes operationalizing the protocol impossible, recognizing that companies need time to set up the appropriate quantification (sensors, lysimeters, modeling, etc.) and reporting infrastructure.