Frontier

Request for offtake proposals

2023

Frontier is an advance market commitment to accelerate the development of carbon dioxide removal (CDR) technologies.

To support technologies at different stages of development, we have two purchase tracks: prepurchases and offtakes. Each track has its own eligibility criteria, diligence process, and funding amounts. The bulk of Frontier's spend will go toward *offtakes*, larger multiyear agreements with companies preparing to start scaling their technologies. However, we believe we have not yet seen the full scope of promising carbon removal approaches. Our *prepurchase* track is designed to pressure-test the viability of novel CDR solutions, with an emphasis on expanding the number of carbon removal pathways and companies working on carbon removal.

This document is the request for proposals for Frontier's offtake track. As the first step in applying, please use the table below to understand our purchasing program and decide which track is the best fit for your company.

If you have any questions, please get in touch at suppliers@frontierclimate.com. For information about the prepurchase track, go here.

	Track 1: Prepurchases	Track 2: Offtakes
Summary	Low-volume prepurchase agreements to support early-stage suppliers piloting new technologies	Larger offtake agreements to support more mature suppliers preparing to scale
Purchase amount	$500K	~$10M - $50M
Purchase structure	Paid upfront, before tons have actually been delivered	Commitment to buy future tons at an agreed price if and when delivered
Frontier expectations and risk tolerance	Thorough diligence, higher risk tolerance than offtakes	More extensive diligence, lower risk tolerance than prepurchases
Application cadence	Once-per-year purchase cycle	Applications accepted on a rolling basis
Application deadline	Pre-applications due May 19, 2023	For consideration in 2023 and 2024, please express interest as early as possible
	Expected status across evaluation criteria	
Performance data	• There is lab-scale performance and preliminary stability data (preferably for days or more) showing proof of concept that the company's approach removes CO2 from the atmosphere.	• Tech has been validated, preferably at or beyond small pilot scale, with data establishing performance and stability baseline. Roadmap defined for how the company will narrow gaps between current data and techno-economic analysis (TEA) assumptions. • For larger offtakes: Tech has removed CO2 in the field, preferably 1 ton+ per day; minimal remaining technology risk.

Monitoring, reporting, & verification (MRV)	• Clear MRV approach outlined. • For CDR pathways with lower verification confidence levels (VCLs), risks are identified and a method presented for how new data will be generated to increase the VCL and/or reduce the VCL uncertainty.	• Company has a published protocol that addresses key pathway uncertainties and has responded to scientific community feedback. • Volume offered is discounted based on identified MRV uncertainties (if any) and we have high confidence in the ability to quantify volumes purchased. • Company has a plan for independent verification of CDR outcomes.
Techno-economic analysis (TEA)	• A TEA based on a process flow diagram and mass and energy balance, using realistic engineering values (or similar) for equipment pricing, first principles estimates of performance, and basic assumptions for utility costs (format provided).	• A high-fidelity TEA based on a pre-FEED design or similar, including a full process model. Key performance assumptions identified and validated with data. • For larger offtakes: TEA validated from past systems with quotes for major equipment, utilities, and O&M costs for specific locations.
Ecosystem safety (e.g., impact to soils and oceans)	• Compelling case for why this CDR project does not cause additional ecosystem damage, based on experimental data and models. • Company identifies potential risks and presents a plan to generate new data to confirm ecosystem safety at scale across early deployments.	• Compelling case for why their CDR project does not cause additional ecosystem damage, based on experimental data. • Company has published ecosystem impact data and responded to feedback from the scientific community regarding potential risks. • There is minimal remaining uncertainty around ecosystem impact, and company will actively manage deployments based on ongoing ecosystem monitoring.
Community engagement	• Clear plans to collect input from stakeholders impacted by the project at early stages and to improve deployment based on that input.	• Has proactively engaged stakeholders and revised deployment plans accordingly. • Has a community benefits plan and an ongoing process to collect and act on community input.
Team and operational capability	• There is demonstrated expertise on the team for initial development work. • Company has a hiring and/or partnering plan for other aspects of the project.	• Company has experienced technical and commercial staff in place and project partners are identified and committed.
Business strategy & financing	• Key business case assumptions and risks identified. • Preliminary plan established for next steps if the project is successful.	• Company can define how the project fits within their strategy and the CDR market and policy landscape. • Team has a credible path to securing financing and reaching a final investment decision. • For larger offtakes: Company has supply chain, manufacturing, and risk management strategies.

Continue reading if you would like to apply for an offtake. If the prepurchase track is a better fit, please go to our prepurchase RFP to get a sense of what our next cycle in 2024 might look like. If you're still not sure which track makes the most sense for you at this time, get in touch at suppliers@frontierclimate.com.

Frontier offtake track

2023 request for proposals

To apply for a Frontier offtake, please fill out this expression of interest *after* you've read this RFP.

This is a short initial application to help us better understand your project, and for consideration in 2023 or 2024, we ask that you complete it as early as possible. We will review submissions and invite a subset to submit full applications with the goal of minimizing time spent applying by projects that likely don't meet the criteria of this RFP.

We anticipate contracting several hundreds of millions of dollars in offtakes over the next year or so. The basic information provided in this form is incredibly helpful for us as we're planning the shape of the next 6–12 months. Our team is still quite small and planning ahead helps us cover more ground with the resources we have. For this reason, we encourage you to submit interest in our program as early as possible, *even if the details aren't finalized* (just tell us so).

We're especially interested in prioritizing diligence for candidates that meet our RFP criteria and have these two characteristics:

- They *could* deliver tons in 24/25, but need an offtake ASAP to pull forward the delivery of those tons
- They need an offtake ASAP in order to unblock or speed up construction/breaking ground on a project

If you applied for a Frontier offtake agreement previously, you are already on our radar. However, we know it's common for projects to shift directions and/or make rapid progress. In this case, we request that you please reexpress offtake interest, focusing your response on *what's changed*.

Contents

1 | Diligence process overview

Frontier facilitates offtake agreements from high-potential CDR projects on behalf of a number of buyers. We run a thorough technical, commercial, and governance diligence process. We've recently added several gates throughout the process, to help us make decisions while also doing our best to be cognizant of your team's time.

Here's the rough shape of this process from beginning to end, with the caveat that we are still learning and will continue to improve and edit as we go.

	Step	Details
1	Offtake expression of interest	• Companies submit an offtake expression of interest with basic information on the proposed project and capacity. We may ask for a short conversation to clarify any questions. • We consider offtake candidates on a rolling basis, but encourage you to submit interest in our program **as early as possible**.
2	Candidate screen	• Frontier reviews submissions to assess: (1) whether the project is an eligible, compelling candidate for a Frontier offtake; and (2), if so, when to sequence diligence. • Frontier invites a subset to submit full applications. Note: For some candidates, we may opt to delay an invitation for application until a later date given our team's bandwidth (e.g., you might be proposing an offtake for CDR pathway X, but we are focusing on CDR pathways Y and Z first).
3	Offtake application	• Company prepares an offtake application, including a techno-economic analysis (TEA) spreadsheet.

4	Application review	• Frontier staff, as well as a team of scientific, commercial, and governance experts, review each application.
		• Company is invited to respond to Frontier's questions and feedback.
		• After application review, we will notify applicants whether Frontier would like to:
		  ○ Progress with diligence now (i.e., we are excited by what we've learned so far and would like to advance to a site visit)
		  ○ Pause diligence (i.e., we have significant open questions, and it makes sense to pause for multiple months while the team collects the necessary data)
		  ○ Halt diligence entirely (i.e., we are not able to continue considering the company's candidacy at this time)

5	Frontier site visit	• Company hosts a ~half-day Frontier team site visit to meet the team in person, discuss the project in more detail, and see the current system. • Topic areas include reviewing your performance data, TEA, life cycle analysis, project partners, etc.
6	Diligence memo	• The Frontier team determines whether to propose the project to Frontier buyers for purchase. If Frontier elects to move forward, we draft a thorough diligence memo which summarizes our assessment of the project against Frontier's purchasing lenses (see below) so our buyers have a detailed understanding of the project—both the potential for impact and the risks. • This step will involve close discussion between Frontier and the project as we dig into the details. We may follow up with additional requests for information as relevant.

		• Frontier facilitates a meeting with Frontier buyers so the company can engage with the buying group directly to answer any remaining questions they might have.
7	Offtake agreement negotiation	• Price, removal volumes, and timing will be discussed throughout the drafting of the diligence memo. • The final step will be to review the terms and conditions in Frontier's offtake agreement and discuss project-specific content such as milestones before each buyer signs.

We will operate a rolling process and expect the end-to-end timing of our review to vary based on the carbon removal pathway, the nature of the reviewers' questions, timeliness of responses, and other factors. That said, we will aim to conduct our diligence process in ~6 months with each candidate, with the goal of reducing this over time.

2 | How we evaluate projects

We look for permanent CDR solutions that have the potential to be low-cost and high-volume in the future, even if they're not today. Importantly, Frontier aims to help create net new CDR supply rather than compete over what exists today. The goal is to send a strong demand signal to researchers, entrepreneurs, and investors that there is a growing market for these technologies. For projects scaling up, this means a hard contract commitment that we hope can enable follow-on purchasing and investment.

We use three lenses to make purchasing decisions:

- **Approach**: Does the CDR approach meet our target criteria?
- **Execution**: Can this team deliver on the proposal, given where the technology is today?
- **Portfolio**: Will this purchase help us build a diverse, risk-adjusted portfolio of CDR approaches?

Lens 1: Approach

Rigorous external scientific and governance assessment against Frontier's CDR criteria is the first and most critical qualifying step in Frontier's purchasing process.

Criteria	Description
Durability	Stores carbon permanently (>1,000 years)
Physical footprint	Takes advantage of carbon sinks and sources less constrained by arable land
Cost	Has a path to being affordable at scale (<$100 per ton)
Capacity	Has a path to being a meaningful part of the carbon removal solution portfolio (>0.5 gigatons per year)
Net negativity	Maximizes net removal of atmospheric carbon dioxide
Additionality	Results in net new carbon removed, rather than taking credit for removal that was already going to occur
Verifiability	Has a path to using scientifically rigorous and transparent methods for monitoring and verification
Safety and legality	Is working towards the highest standards of safety, compliance, and local environmental outcomes; actively mitigates risks and negative environmental and other externalities on an ongoing basis

Because of Frontier's 1,000-year durability threshold, we do not consider the following CDR approaches as being in scope for Frontier procurement:

- Afforestation and reforestation
- Coastal restoration (blue carbon)
- Organic soil carbon

Lens 2: Execution

We look for evidence that the team will be able to execute their proposed plan rigorously, quickly, and responsibly. The specifics of what we look for will vary based on the stage of the project, but generally we look for:

- **Technology readiness level:** Is the technology far enough along to make the proposal realistic/plausible? We typically look for an existing proof of concept at or beyond pilot scale, to what extent prior testing mimics operating conditions, and a plausible roadmap to close the gap between current data and assumed performance at scale. We also look at whether the technology has been tested as an integrated system.
- **Likelihood of successful execution:** Is this team set up to deliver on the proposed project? This includes whether the team has the necessary expertise and experience to execute, as well as the qualifications and commitments of potential project partners. We also factor in the stage of project development and the feasibility of securing any financing necessary.
- **Delivery volume:** When will this project start delivering tons? We are looking for projects that can deliver meaningful volume (tens of thousands of tons or more) in the next 2–5 years, with a preference for earlier delivery (i.e., 2024/2025).
- **Past and expected learning rates**: Since this project's start, how much progress has been made and over what time period? Is this approach fundamentally compatible with fast iteration? How costly is each iteration?
- **Ambitious but plausible and responsible scaling plans:** We are looking for companies to move urgently, but responsibly and realistically. For most approaches, this likely means increasing scale by no more than 10x per deployment, whereas for others, 100x might be acceptable if the applicant includes a justification for that scaling magnitude.

Lens 3: Portfolio

We believe it will take a portfolio of carbon removal solutions and companies to achieve the gigatons of annual scale needed. Frontier's goal is to build a risk-adjusted portfolio that maximizes the likelihood of that happening. This means that there is a possibility that even if a company meets our criteria, we may not make a purchase if, for example, we're over-indexed on, or there are more compelling candidates for, that type of solution.

3 | Other information

Confidentiality and transparency

Frontier recognizes that we ask for a lot of sensitive information in order to make informed purchases. As such, we will not post offtake application materials publicly on our GitHub repository. Application information will remain confidential among Frontier staff and our expert review team (who have non-disclosure agreements in place with Frontier).

However, because commercial-scale permanent CDR is a nascent field, we want to be transparent about what we're purchasing. Thus in order for Frontier to sign an offtake agreement, we will work together with companies to draft a public summary of the project so that external stakeholders can understand what the project is, including details such as volumes and average price over the term of the agreement.

Contracting

Our offtakes are pay-on-delivery, multiyear purchase agreements. Total contract values at this time are in the tens of millions of dollars. Delivery windows are typically from first delivery through 2030 (~5 years). Frontier works with each supplier to identify the volume and price per year of the agreement, and then each Frontier buyer signs an identical contract populated with the volume specific to their organization.

Communication

All communication related to Frontier's offtake purchasing should be sent to suppliers@frontierclimate.com.

Supplemental information

- Introducing Frontier
- Purchasing Q&A
- Frontier GitHub source materials (applications, contracts, templates)