TerraFixing Inc.

Carbon Dioxide Removal Purchase Application

Fall 2022

General Application - Prepurchase

(The General Application applies to everyone; all applicants should complete this)

Company or organization name

TerraFixing Inc.

Company or organization location (we welcome applicants from anywhere in the world)

Ottawa, Ontario, Canada

Name(s) of primary point(s) of contact for this application

Dr. Vida Gabriel – [redacted]
Dr. Sean Wilson – [redacted]

Brief company or organization description

TerraFixing is a direct air capture company geared towards cold climates using adsorption-based technology

1. Project Overview[1]

a. Describe how the proposed technology removes CO_2 from the atmosphere, including as many details as possible. Discuss location(s) and scale. Please include figures and system schematics. Tell us why your system is best-in-class, and how you're differentiated from any other organization working on a similar technology. (<1500 words)

At TerraFixing, we are distinctive in our strategy to capture, concentrate, and sequester CO_2 with the aim of helping the world reach net zero and going beyond. We use a unique

[1] We use "project" throughout this template, but note that term is not intended to denote a single facility. The "project" being proposed to Frontier could include multiple facilities/locations or potentially all the CDR activities of your company.

adsorption-based process using readily available industrial materials, and by placing our process in desirable cold dry climates, we can achieve the lowest operating and capital costs in the DAC industry. The working material of our process are zeolites, which are cheap, robust, and effective at capturing CO_2 from the air. These supermaterials with surface areas of over 800 m^2/g work via adsorption whereby the CO_2 is selectively captured on the surface. We employ these materials in a temperature vacuum swing adsorption (TVSA) cycle where CO_2 is captured at environmental conditions and then released with temperature and a vacuum at high purities for sequestration. This process is simple, with only 5-unit operations, and operating energies as low as 1 MWh/tonCO_2 in cold dry climates, we can achieve low capital costs and operating costs for DAC.

Technology and Process: TerraFixing's IP protected technology has the potential to be the lowest cost DAC process to date due to its high volumetric efficiency (low CAPEX) and lowest reported operating energy cost (1 MWh/tCO_2 from TRL5 prototype i.e., low OPEX). We can achieve costs well below $100/ton$CO_2$ at scale due to the synergies of this technology with cold climates. Our patented technology (PCT/CA2021/051696) uses adsorbents in a 5-step temperature vacuum swing adsorption (TVSA) cycle to capture and concentrate the CO_2 from the air (Figure 1).

Figure 1 – TerraFixing's 5-step TVSA DAC process

1. In the first step, input air is flown over a desiccant contained in a water capture bed to remove any moisture. The dried air is then flown over an adsorbent (industrial readily available zeolite) to capture CO_2 directly from the air, at ambient conditions (Adsorption Step),
2. Once the CO_2 adsorbent bed is saturated, a weak vacuum is applied, purging any N_2, O_2, and Ar from the zeolite bed (Blowdown Step),

3. From there, the bed is heated to release the CO_2 from the adsorbent and vacuumed out to yield a concentrated CO_2 stream as high as 99.999% using a single TVSA cycle (Evacuation Step),
4. The CO_2 adsorbent bed is then pressurized (Pressurization Step), and
5. The flow of air is reversed to bring the heat from the CO_2 adsorbent bed to regenerate the water capture bed (Waterbed Regeneration Step). This TVSA cycle is repeated to capture and concentrate more CO_2 from the air.

Advantages of our Process: Our next generation solution was strategically designed to operate in the cold to take advantage of the thermodynamic advantages that cold climate operations bring to gas separations. No other DAC technology is viable below 0°C. The synergies with cold climates are:

1) Thermodynamically, separations fundamentally require less energy in cold conditions. For example, the energy required to capture and concentrate CO_2 at -50°C is 45% smaller than at 50°C (Figure 2).

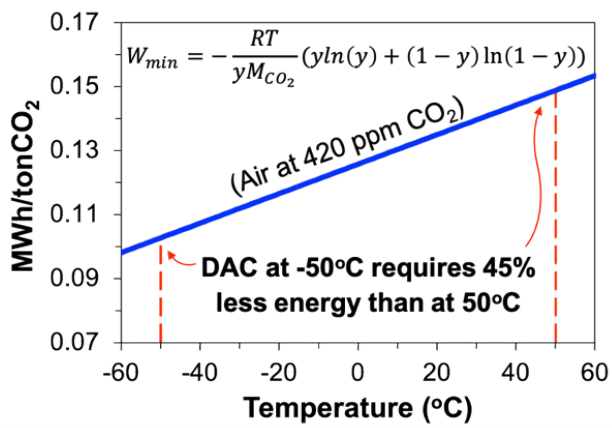


Figure 2 – Minimum work required to separate CO_2 from air at 420 ppm vs. temperature derived from the second law of thermodynamics

2) Adsorbents perform significantly better in cold conditions. This can be seen in Figure 3 which shows the exiting concentrations from the CO_2 adsorbent bed from our prototype during the adsorption step as a function of time. As the temperature cools, the adsorption capacity increases, thereby increasing the duration before the CO_2 begins to break through the column. By cooling the temperature from 0°C to -58°C, the adsorption capacity increases from 0.64 to 2.5 mmol/g. The increased adsorption capacity reduces the amount of thermal energy needed to heat up the adsorbent (E_S), decreases the mechanical energy required to remove N_2, O_2 & Ar (E_V), and it diminishes CAPEX because less adsorbent is needed per ton of CO_2 captured, per cycle.

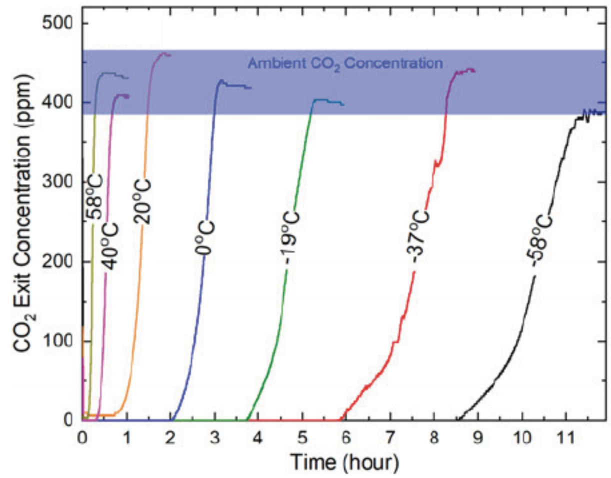


Figure 3 – Breakthrough curves of CO_2 during the adsorption step with varied temperatures from 58°C to -58°C for zeolite. Adsorption capacity significantly greater in cold conditions shown by later breakthrough

3) Air holds significantly less water at colder temperatures (Figure 4). By operating in these colder temperatures, TerraFixing deals with little to no water unlike competitors, like Climeworks, whose DAC process suffers a significant water penalty.

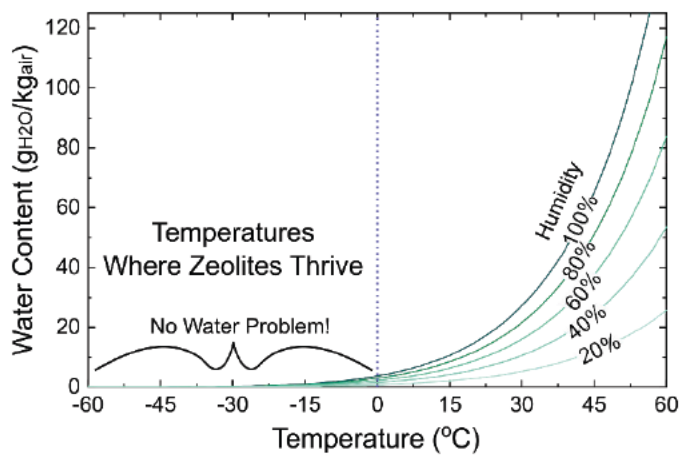


Figure 4 – Water content in air for different temperatures and humidity.

Our DAC Unit: A preliminarily engineered TRL 8 prototype (the "4x unit" Figure 5) comprises four adsorption units, occupying less than a half of a 20ft high cube shipping container. The 4x unit works with 3 adsorption units on the adsorption and waterbed regeneration steps while the fourth unit is on the blowdown, evacuation, and pressurization steps. A peer reviewed paper of our technology is available from iScience and discusses our technology in length including the energies required for the heater ($E_S + E_D$), fan (E_F), vacuum (E_V), and compressor (E_C).[1]

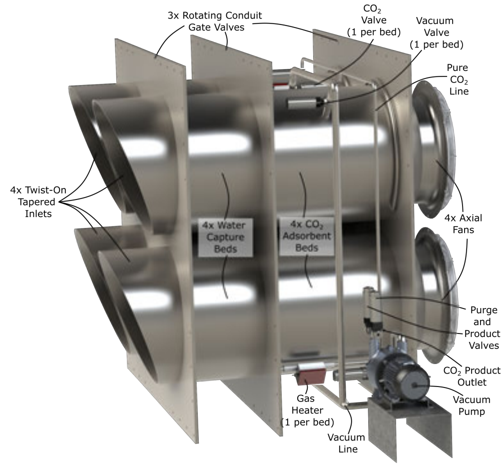


Figure 5 – The "4x unit" (TRL 8) with 1,000 tonCO_2/year capacity.

Looking at this 4x unit, it should be noted the relative simplicity of the process. Only a water capture bed, CO_2 adsorption bed, heater, vacuum pump, and a fan are required unit operations to capture and concentrate CO_2 from the air. This significantly reduces CAPEX compared to other DAC technologies. Another benefit of adsorption processes is the ability to flow air through the column at very high space velocities while capturing the majority of the CO_2. For example, during the adsorption step of our prototype, we get a capture fraction of ≈70% with an air velocity of 10 m/s in cold conditions. This allows more air to flow through the unit faster allowing the unit to be smaller.

The Na-X zeolite employed in our process has a higher affinity for CO_2 than the other components of dry air. This can be seen in data from the blowdown step and the evacuation step showing the composition and flowrates of exiting gas during the cycle Figure 6. In the blowdown step, weakly adsorbed N_2, O_2, and Ar are purged by applying a vacuum without losing CO_2. After the blowdown step, the evacuation step begins by heating up the CO_2 adsorption bed to 200°C thereby releasing the CO_2 from the zeolite. Our process can achieve a CO_2 purity of 99.999% due to the high affinity of CO_2 to the zeolite compared to that of N_2, O_2, and Ar.

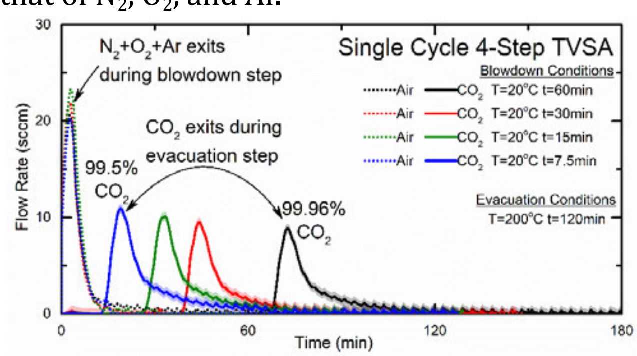


Figure 6 – Flow rates of N_2, O_2, Ar, and CO_2 at different conditions for the blowdown step with N_2, O_2, and Ar exiting and evacuation step of CO_2 exiting.

Locations: The specific locations for the technology deployment are discussed in supporting information (confidential). At TerraFixing, we locate our DAC plant in cold dry climates like Canada, Norway, Alaska, Russia, Finland, Greenland, and Antarctica which have optimum conditions for our process. We also ensure that these DAC plants are located next to clean cheap abundant energy sources as well as a sequestration site to allow us to capture the CO_2 for the lowest \$/tonCO_2. This formula will allow our technology to outcompete other DAC technologies and will allow a pathway to net-zero and beyond.

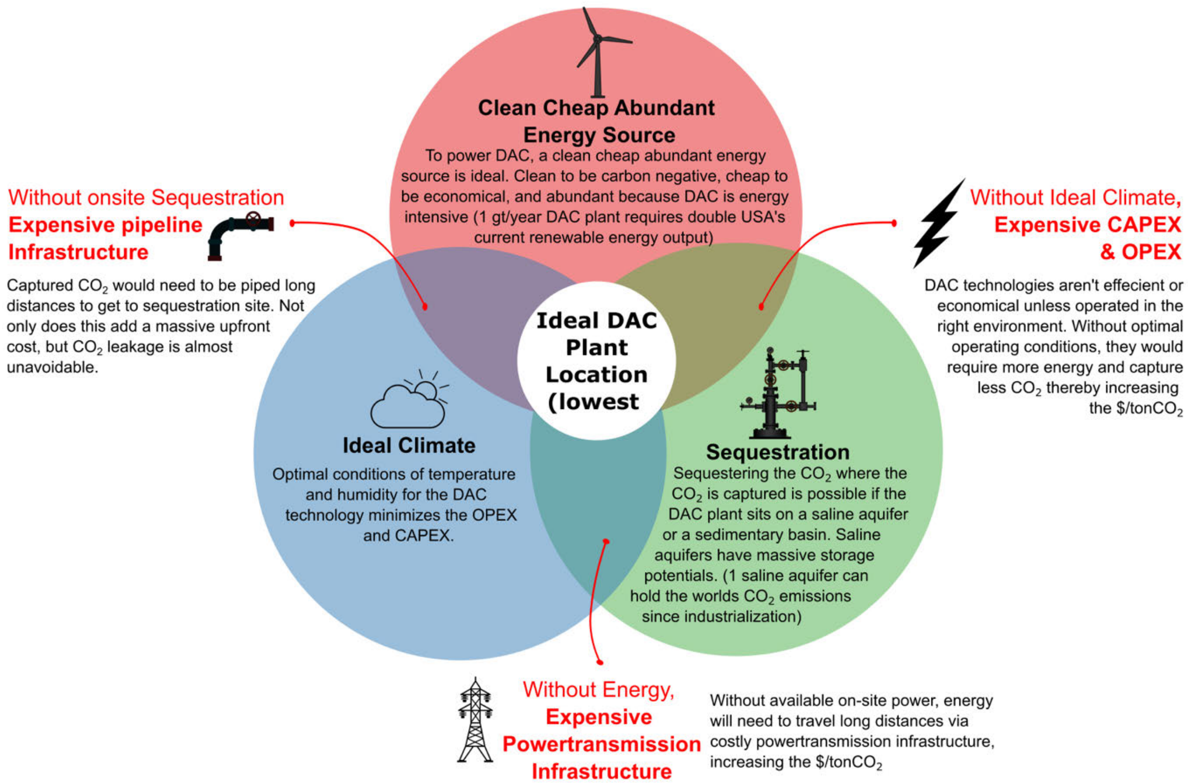


Figure 7 – TerraFixing locates their DAC technology in an ideal cold climate, next to clean cheap abundant energy, and a sequestration site to have the lowest cost DAC option.

Unlimited Scalability: At TerraFixing, our technology has a scalability advantage with our modular unit and integration with renewable energy. The locations that we place our technology allow for unlimited scalability without NIMBYism and minimal impact to flora and fauna.

b. What is the current technology readiness level (TRL)? Please include performance and stability data that you've already generated (including at what scale) to substantiate the status of your tech. (<500 words)

TerraFixing's prototype is at TRL 5 and each of the components (i.e., water-capture bed, zeolite bed, pump, vacuum pump, and fan) are integrated to capture roughly 100gCO_2/day from the cold Ottawa air. The equipment is running in a real-life environment at small scale. We have published data obtained in peer-reviewed articles.[1,2] 1

Some key performance metrics from our prototype includes: CO_2 adsorption capacity of the zeolite: 2.54 mmol $g^{-1.}$ (at -58°C), CO_2 uptake rate of the zeolite: 2.4×10^{-2} s^{-1} and CO_2

heat of sorption of 0.28MWh/tCO_2. Looking at key metrics for a variety of sorbents where low CO_2 heat of sorption and high CO_2 sorption capacity at 420ppm are desired, operating our zeolites in cold climates are the most promising materials for DAC. Lower CO_2 heat of sorption reduces the energy required to regenerate the sorbent. For instance, energy intensive materials like CaO that Heirloom uses, has a heat of sorption that requires 1.13 MWh/tCO_2 just to break the CO_2-CaO bond. TerraFixing's zeolite requires just 0.28 MWh/tCO_2. This energy is also 2/5ths of that of Climeworks & Global Thermostat which uses amines (MEA & TRI-PE). TerraFixing's zeolite in cold conditions also adsorbs a significant amount more CO_2 in cold to freezing conditions for the same mass of material. This translates into CAPEX saving but also energy savings that allows our technology to have the lowest DAC energy around 1 MWh/tCO_2 in favorable climates.

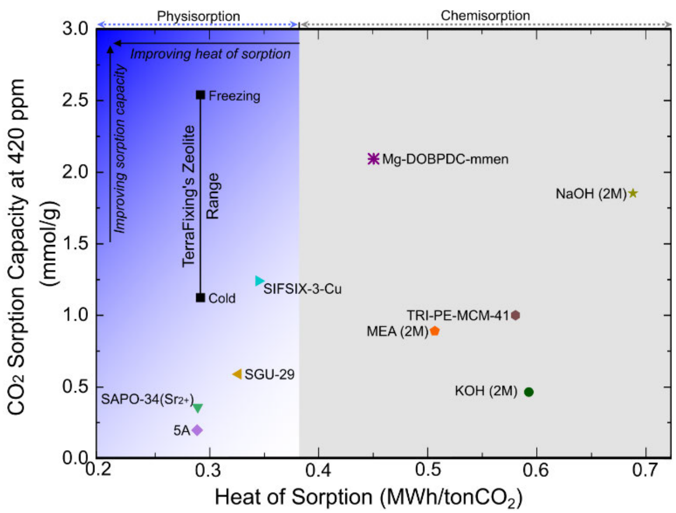


Figure 8 – Zeolites are more ideal DAC materials: Higher CO_2 capacity and lower CO_2 heat of sorption compared to other technologies.

Another key metric for a DAC process is the kinetics of how fast the CO_2 reacts or uptakes into the sorbent which is known as CO_2 rate constant. Slow kinetics require larger equipment and/or slower cycle times, and therefore increasing the CAPEX. Traditional DAC materials like (OH^-) of Carbon Engineering, amines (MEA & DEA) of Climeworks either have a moderate sorption enthalpy or fast sorption rate. And companies using CaO like Heirloom have neither. TerraFixing's zeolite however, has both a fast sorption rate as well as moderate sorption enthalpy which fits into the ideal material zone. This ideal material zone was highlighted in 2011 by the DAC community in the APS report with committee members including Jennifer Wilcox, Peter Eisenberger (Global Thermostat), David Keith (Carbon Engineering), Klaus Lackner, and 30 other academics.[3]

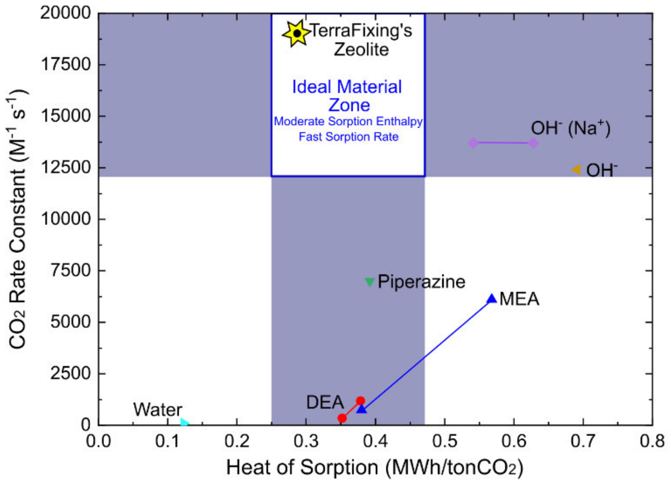


Figure 9 – Zeolites are more ideal DAC materials: Faster rate constant and lower CO_2 heat of sorption compared to other technologies.

When comparing overall performance of our technology to available data from competitors (Figure 10), the benefits from before translates into our technology requiring significantly less energy than the competition. This energy can be as low as 1 MWh tCO_2^{-1}. With energy being the largest cost for most DAC technologies, this gives TerraFixing's technology a significant economical edge over other technologies.

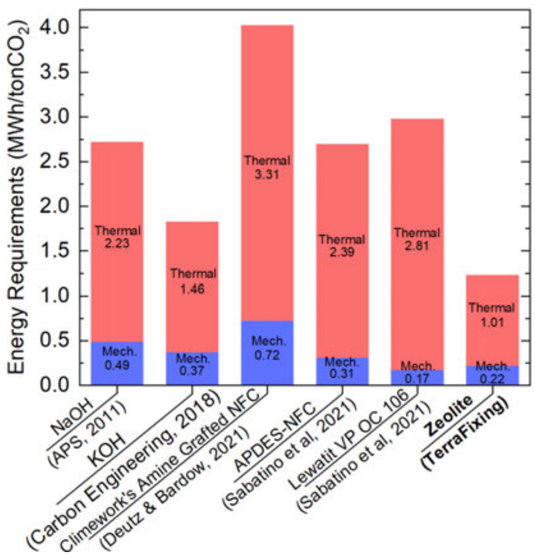


Figure 10 – The thermal and mechanical energy requirements for DAC using NaOH absorption,[4] KOH absorption,[5] Climework's amine grafted NFC,[6] APDES-NFC,[7] Lewatit VP OC 106,[7] and zeolite from TerraFixing.[1]

c. What are the key performance parameters that differentiate your technology (e.g. energy intensity, reaction kinetics, cycle time, volume per X, quality of Y output)? What is your current measured value and what value are you assuming in your nth-of-a-kind (NOAK) TEA?

Key performance parameter	Current observed value (units)	Value assumed in NOAK TEA (units)	Why is it feasible to reach the NOAK value?
Thermal energy requirements	1.37 MWh/tCO_2 (@-20°C)	0.8 MWh/tCO_2 (@-20°C)	Improved adsorbent material, heat integration, process integration
Mechanical energy requirements for CO_2 capture and pressurizing	0.22 MWh/tCO_2 (@-20°C)	0.2 MWh/tCO_2 (@-20°C)	Process integration, heat integration, lower pressure drop design, taking advantage of monodirectional winds.
Overall energy requirements for CO_2 capture	1.59 MWh/tCO_2 (@-20°C)	1 MWh/tCO_2 (@-20°C)	We have already measured this at the lab scale – this is the sum of the two last energies
CO_2 purity	95-99.999%	99%	Already achieved
CO_2 capture rate	A few kilograms/year	1 Gt/year	After the pilot and demonstration projects, we hope to secure the funds to grow to the gigaton scale.

d. Who are the key people at your company who will be working on this? What experience do they have with relevant technology and project development? What skills do you not yet have on the team today that you are most urgently looking to recruit? (<300 words)

Dr. Sean Wilson, co-founder and CEO, obtained his PhD in Chemical Engineering in the field of adsorption separations for carbon capture applications. Dr. Wilson has skills in prototyping and manufacturing allowing him to design, build, and troubleshoot TerraFixing's technology. His innovative and outside-the-box thinking has made him a critical player in developing TerraFixing's intellectual property; Dr. Wilson is in fact the author of TerraFixing's pending patents and peer reviewed articles.
Mr. Tim Wilson: a co-founder and CFO of TerraFixing and has 40 years P. Eng. Experience as a Chemical Engineer in a variety of carbon intensive industrial processes. Management positions included process and plant engineering, research, technical service and sales, quality control, environment, production, and business consultant. Mr. Wilson has been business consulting for over 10 years, taking equity positions and returning businesses to profitability.

Dr. Vida Gabriel, Ph.D in Chemical Engineering, is the CSO. Her specific skillset related to project management, experimental design, data analysis, and interpretation are critical to the realization of TerraFixing's projects. Ms. Fatma Al-Enzi obtained her M.A.Sc at the University of Ottawa in the field of adsorption. Her areas of expertise include aerogels, carbon aerogels and activated carbons. She is well versed in materials characterization (e.g., surface area, pore size, surface groups, ash content) and can assess their impact on adsorption and adsorption capacity. We are currently in the process of recruiting technical staff with expertise in computational fluid dynamics, electrical engineering, ceramics manufacturing and production/mechanical engineering, as well as additional finance, control, back office, and commercial staff. Tugliq will be providing many services and aiding with the development and deployment of TerraFixing's Technology (Tugliq has previous experience in developing and deploying first-of-a-kind technology).

e. Are there other organizations you're partnering with on this project (or need to partner with in order to be successful)? If so, list who they are, what their role in the project is, and their level of commitment (e.g., confirmed project partner, discussing potential collaboration, yet to be approached, etc.).

Partner	Role in the Project	Level of Commitment
TUGLIQ Énergie Co.	Fundraising, business consulting, EPC experience, and are developing the wind power infrastructure in the North that will enable this technology to scale to annual gigaton capture	Confirmed project partner
NGIF	Financial	Confirmed project partner
Confidential Partners	Sequestration, Municipal, Indigenous partners	Confirmed and in negotiations

f. What is the total timeline of your proposal from start of development to end of CDR delivery? If you're building a facility that will be decommissioned, when will that happen? (<30 words)

Assuming a Q1-2023 start, the scale-up will be complete and CDR delivery by Q4-2025. The unit has a 20-year lifetime. After the unit's life, decommissioning will happen at manufacturing facilities.

g. When will CDR occur (start and end dates)? If CDR does not occur uniformly over that time period, describe the distribution of CDR over time. Please include the academic publications, field trial data, or other materials you use to substantiate this distribution.

CDR will likely start around Q4 2024 and will continue through to the end of the life of the unit. CO_2 can be captured year-round at the chosen location (in the supporting information) but higher volumes of CO_2 will be captured during the winter months.

h. Please estimate your gross CDR capacity over the coming years (your total capacity, not just for this proposal).

Year	Estimated gross CDR capacity (tonnes)
2023	-
2024	100 (will likely only start running Q4 of 2024)
2025	500-700
2026	2400
2027	50,000
2028	50,000
2029	1,000,000
2030	2,500,000

i. List and describe at least three key milestones for this project (including prior to when CDR starts), that are needed to achieve the amount of CDR over the proposed timeline.

	Milestone description	Target completion date (eg Q4 2024)
1	Design and Construction of 4x Unit	Q3 2023
2	Preliminary 4x Unit Operation and Optimization	Q3 2024
3	Scaling up Adsorbent Bed	Q4 2023
4	Evaluating Finalized 4x Unit Operation	Q4 2024
5	Long-term Continuous Use Trials (Controlled)	Q2 2025

6	Long-term Continuous Use Trials (Cold Climate)	Q4 2025

j. What is your IP strategy? Please link to relevant patents, pending or granted, that are available publicly (if applicable). (<200 words)

> One provisional patent application and PCT/CA2021/051696 have been filed and non-provisional patent will be submitted to countries with cold/dry climates. Via this project, many patents for the manufacturing, process, and design of our units will be produced. Three peer reviewed articles are already published from prior work and data from the TRL8 prototype (this work) will likewise be published. This IP strategy supports our path to scale because we will be the only company able to do DAC in the most promising locations (cold climates).

k. How are you going to finance this project? (<300 words)

> We have already obtained $100,800 from NGIF and are in talks with several potential investors through the Plug & Play Accelerator program (not at liberty to disclose details). One of our partners, TUGLIQ Energie, will be supporting the development of our technology. We are likewise seeking government grants in Canada (e.g., $2.5M from NRCan) and will leverage our capital to get a loan from the Business Development Bank of Canada for the rest of the financing. We will also take advantage of Canada's investment tax credit to get 60% back for investment in equipment/personnel to capture CO_2 in direct air capture projects.

l. Do you have other CDR buyers for this project? If so, please describe the anticipated purchase volume and level of commitment (e.g., contract signed, in active discussions, to be approached, etc.).

> Suncor (in active discussions)
> Mitsubishi Corp (in active discussions)
> South Pole (in active discussions)
> Catena Carbon (in active discussions)
> Carbicrete (in active discussions)

m. What other revenue streams are you expecting from this project (if applicable)? Include the source of revenue and anticipated amount. Examples could include tax credits and co-products. (<200 words)

> Hight value carbon credits generated from CO_2 sequestration in geologic storage
> High purity CO_2 for agriculture/food/healthcare industry (particularly in high pain markets that are not served by current CO_2 infrastructure)

n. Identify risks for this project and how you will mitigate them. Include technical, project execution, ecosystem, financial, and any other risks.

Key Risks	Prob	Imp	Risk	Risk Mitigation and Response Strategy
			Technical	
Scaling up flow (uneven flow or high pressure drop)	Low	High	Med	- Mitigate risk by OpenFOAM modeling to determine potential pitfalls before testing and during testing - Change unit design to circumvent problem (contingency) - Reduce volumetric flow rate (longer adsorption step)
Uneven heating during scale up	Low	Med	Low	- Mitigate using OpenFOAM modeling to determine heating effectiveness (induction heating vs gas heater), verify model using data from unit - Increase duration of the evacuation step to allow more even heating - Allow for the use of additional heating (contingency)
			Commercialization & Market Adoption	
Lack of cold weather infrastructure (renewable power, rail, roads, ports)	High	Med	High	- Share the risk of renewable power by outsourcing the energy requirements to a green energy company. I.e., Meridian Energy - Discuss opportunities with the Canadian government for infrastructure development in North - Use locations with minimal infrastructure requirements as possible
Delegislation of the carbon tax	Low	High	Med	- Retargeting technology to other cold dry climate countries - To mitigate risk, lobby conservatives to inform them that affordable CO_2 capture is possible in Canada
			Regulatory & Permitting Risks	
Utility unable power energy requirement for operations (energy req too high or inaccessible or takes too long)	Low	Med	Low	- Discuss with utility in advance to ensure that there will be no bottlenecks - Allow for the use of a generator to make up for extra energy requirements (contingency)
			Project Plan & Timelines	
Construction of 1000 $tonCO_2$/year unit timeframe elongated (Manufacturing problems/design problems)	Low	High	Med	- Discuss unit construction with contractor to ensure that mistakes will be avoid - Modify unit to fix design issue - Allow for contingency time in the construction of the unit
Budget & Cost Uncertainties				
Insufficient funding acquired from funding leads	Med	High	High	- Reduce threat impact by through by pre-emptively applying for BDC funding through their cleantech practice program, innovation solutions Canada, etc.

2. Durability

a. Describe how your approach results in permanent CDR (> 1,000 years). Include citations to scientific/technical literature supporting your argument. What are the upper and lower bounds on your durability estimate? < 300 words, including number/range of durability estimate

Our approach results in permanent CDR because we are coupling DAC with geological sequestration. For more than 40 years, the O&G industry in the USA has been safely injecting fluids, including CO_2, into the ground in association with petroleum productions. The DOE has also done many case studies and have demonstrated CO_2 sequestering and that 99% or more of the CO_2 injected is likely to be retained for 1000+ years. The DOE/USGS likewise confirms that billions of tons of CO_2 can be stored in geologic formations safely and securely across the globe and that risks occurring during injections and well closures are minimal. Thus, at the large scale, we plan to sequester the CO_2 in saline aquifers and carbon depleted wells.

b. What durability risks does your project face? Are there physical risks (e.g., leakage, decomposition and decay, damage, etc.)? Are there socioeconomic risks (e.g., mismanagement of storage, decision to consume or combust derived products, etc.)? What fundamental uncertainties exist about the underlying technological or biological process? (<200 words)

We will rely on our geological sequestration partners (either at the mines or other) to monitor the injection sites (as per class IV requirements or similar standards implemented in Canada)

3. Gross Removal & Life Cycle Analysis (LCA)

a. How much GROSS CDR will occur over this project's timeline? All tonnage should be described in **metric tonnes** of CO_2 here and throughout the application. Tell us how you calculated this value (i.e., show your work). If you have uncertainties in the amount of gross CDR, tell us where they come from.

Gross tonnes of CDR over project lifetime	500-700 per year (gross capacity 1000tCO_2/year with a 0.5-0.7 capacity factor)
Describe how you calculated that value	Assuming "this project lifetime" means for the duration of this project proposal (Q1 2023- Q4 2025) we estimate that the 4x unit will capture 100 tons by the end of 2024, and 500-700 tonnes in 2025, for a total of 600-800 tonnes by the end of 2025. Each year thereafter the unit will be capturing similar volumes annually. With a total lifetime of 20 years, we expect 10,000 – 14,000 tCO_2 over the lifetime of the unit.

b. How many tonnes of CO_2 have you captured and stored to date? If relevant to your technology (e.g., DAC), please list captured and stored tons separately.

To date we are capturing small amounts of CO_2 and are therefore not sequestering it.

c. If applicable, list any avoided emissions that result from your project. For carbon mineralization in concrete production, for example, removal would be the CO_2 utilized in concrete production and avoided emissions would be the emissions reductions associated with traditional concrete production. Do not include this number in your gross or net CDR calculations; it's just to help us understand potential co-benefits of your approach.

We do not plan to have any avoided emissions from this project.

d. How many GROSS EMISSIONS will occur over the project lifetime? Divide that value by the gross CDR to get the emissions / removal ratio. Subtract it from the gross CDR to get the net CDR for this project.

Gross project emissions over the project timeline *(should correspond to the boundary conditions described below this table)*	295 tonnes
Emissions / removal ratio *(gross project emissions / gross CDR–must be less than one for net-negative CDR systems)*	0.021-0.029
Net CDR over the project timeline *(gross CDR - gross project emissions)*	9,705 – 13,705 tonnes

e. Provide a process flow diagram (PFD) for your CDR solution, visualizing the project emissions numbers above. This diagram provides the basis for your life cycle analysis (LCA). Some notes:

- The LCA scope should be cradle-to-grave
- For each step in the PFD, include all Scope 1-3 greenhouse gas emissions on a CO_2 equivalent basis
- Do not include CDR claimed by another entity (no double counting)
- For assistance, please:
  - Review the diagram below from the CDR Primer, Charm's application from 2020 for a simple example, or CarbonCure's for a more complex example
  - See University of Michigan's Global CO_2 Initiative resource guide
- If you've had a third-party LCA performed, please link to it.

Please find PFD and 3rd party LCA (confidential) in the supporting information

f. Please articulate and justify the boundary conditions you assumed above: why do your calculations and diagram include or exclude different components of your system? (<100 words)

The boundaries of the system include the renewable wind energy, the production & transportation of DAC units, the sorbents, DAC plant operation, compression, and sequestration. These are the major sources of CO_2 from our process. Sources of CO_2 in the LCA that are insignificant include R&D, FEED, dismantling & recycling (transportation however is included), CO_2 leakage by pipeline (sequestration on-site), etc.

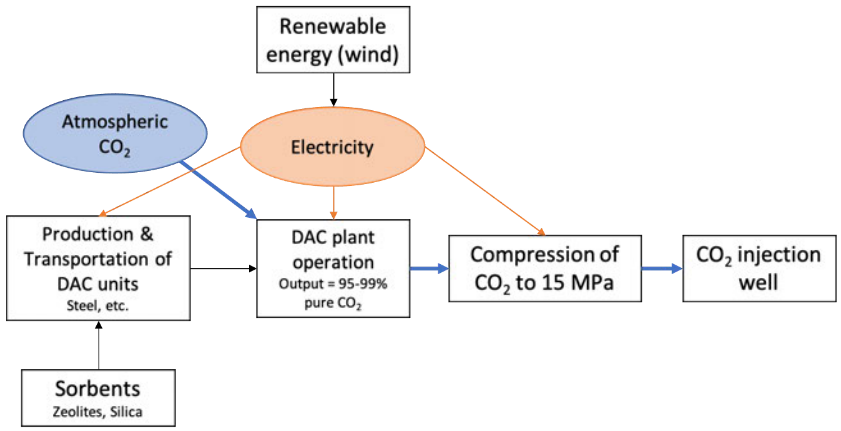


Figure 11 – System boundaries of a DAC system for the life cycle assessment.

g. Please justify all numbers used to assign emissions to each process step depicted in your diagram above. Are they solely modeled or have you measured them directly? Have they been independently measured? Your answers can include references to peer-reviewed publications, e.g. Climeworks' LCA paper.

Process Step	**CO_2(eq) emissions over the project lifetime (metric tonnes)**	**Describe how you calculated that number. Include references where appropriate.**
Renewable energy	224.2	Calculated from system energy requirements for the project of 1.59MWh/tCO_2 to capture, concentrate, and compress CO_2 to 15MPa as well as the energy required to manufacture the units (3rd party CI for North America)
Sorbents	27.3	The zeolite and silica gel DAC unit requirement for the project (CI "ref Table A1. Nienborg, B., Helling, T., Fröhlich, D., Horn, R., Munz, G., & Schossig, P. (2018). Closed adsorption heat storage—A life cycle assessment")

Production DAC units	42.1	The raw materials, heaters, vacuum pump, compressor, insulation, valves, housing, shipping container, fans, etc. for the production of the DAC units (3rd party CI for North America)
Transportation of DAC units	2.2	In order to transport the DAC units after manufacturing to the DAC site, as well as back to returning the DAC units to manufacturing for dismantling (3rd party CI for North America)
DAC plant operation	Captures and concentrates 10,000-14,000 tonCO_2	This step captures the CO_2 from the air and concentrates it up before compression, and sequestration (requires energy which is accounted for in the renewable energy (wind)).
Compression of CO_2 to 15MPa	Pressurizes 10,000 – 14,000 tonCO_2	This step compresses the CO_2 so that it may be in the supercritical pressure range for sequestration. (requires energy which is accounted for in the renewable energy (wind)).
CO_2 injection well	Sequesters the 10,000-14,000 tonCO_2	This step places the sequesters the CO_2 in the geological storage site for 1000+ years

4. Measurement, Reporting, and Verification (MRV)

Section 3 above captures a project's lifecycle emissions, which is one of a number of MRV considerations. In this section, we are looking for additional details on your MRV approach, with a particular focus on the ongoing quantification of carbon removal outcomes and associated uncertainties.

a. Describe your ongoing approach to quantifying the CDR of your project, including methodology, what data is measured vs modeled, monitoring frequency, and key assumptions. If you plan to use an existing protocol, please link to it. Please see Charm's bio-oil sequestration protocol for reference, though note we do not expect proposals to have a protocol at this depth at the prepurchase stage. <300 words

> Simply put, our DAC technology produces a stream of CO_2 which you measure its flowrate and its composition at the point of injection to determine how much CO_2 is being sequestered. These measurements are double checked based on the performance of the DAC unit. (VCL = 5)
> One plan on validating our emissions is using Puro Earth's methodologies or American Carbon Registry's "Methodology for the Quantification, Monitoring, Reporting and Verification of Greenhouse Gas Emissions Reductions and Removals from Carbon Capture and Storage projects" (PDF attached in our application Folder)

b. How will you quantify the durability of the carbon sequestered by your project discussed in 2(b)? If direct measurement is difficult or impossible, how will you rely on models or assumptions, and how will you validate those assumptions? *(E.g. monitoring of injection sites, tracking biomass state and location, estimating decay rates, etc.) <200 words*

As discussed in section 2, the uncertainties of the geological sequestration of CO_2 are extremely low for sequestering in geological storage. [8] It is estimated that the CO_2 will remain sequestered between 1000 years to hundreds of millennia. Monitoring, reporting, verification will be used to ensure that CO_2 does not leak from the geological sequestration site.

c. This tool diagrams components that we anticipate should be measured or modeled to quantify CDR and durability outcomes, along with high-level characterizations of the uncertainty type and magnitude for each element. We are asking the net CDR volume to be discounted in order to account for uncertainty and reflect the actual net CDR as accurately as possible. Please complete the table below. Some notes:

- In the first column, list the quantification components from the Quantification Tool relevant to your project (e.g., risk of secondary mineral formation for enhanced weathering, uncertainty in the mass of kelp grown, variability in air-sea gas exchange efficiency for ocean alkalinity enhancement, etc.).
- In the second column, please discuss the magnitude of this uncertainty related to your project and what percentage of the net CDR should be discounted to appropriately reflect these uncertainties. Your estimates should be based on field measurements, modeling, or scientific literature. The magnitude for some of these factors relies on your operational choices (i.e., methodology, deployment site), while others stem from broader field questions, and in some cases, may not be well constrained. We are not looking for precise figures at this stage, but rather to understand how your project is thinking about these questions.
- See this post for details on Frontier's MRV approach and a sample uncertainty discount calculation and this Supplier Measurement & Verification Q&A document for additional guidance.

Quantification component Include each component from the Quantification Tool relevant to your project	**Discuss the uncertainty impact related to your project** Estimate the impact of this component as a percentage of net CDR. Include assumptions and scientific references if possible.
Storage	(Uncertainty = Negligible) The mass of CO_2 injected for geologic storage can be measured directly as a metered output from the DAC system and a metered input to the storage system. It can also be checked for consistency against operational data from the CO_2 capture system.
Leakage	(Uncertainty = Low "1%") When sequestering CO_2 in a geologic storage on land, leakage can be directly monitored during and after the injection period. Targeted geological storage results in a functionally

	stable form on a short timescale allowing for fugitive emissions associated with the full lifetime of storage may be estimated based on direct observations of the storage reservoir.
Materials & Energy	(Uncertainty = Low “2%”) There is no material input but there is energy input in the form of renewable wind energy in the cradle-to-grave lifecycle assessment (LCA). The embodied emissions of non-consumed project equipment and infrastructure are considered and are amortized over the expected lifetime of operation of 20 years. The LCA has transparency around boundary assumptions, data sources, and uncertainties.
Secondary impacts of energy demand	(Uncertainty = Negligible) The emissions associated with the energy requirements for our DAC technology are minimal due to our technology being directly connected to its own renewable energy supply.

d. Based on your responses to 4(c), what percentage of the net CDR do you think should be discounted for each of these factors above and in aggregate to appropriately reflect these uncertainties? <50 words

> Roughly 3% of the emissions should be discounted based on the factors above.

e. Will this project help advance quantification approaches or reduce uncertainty for this CDR pathway? If yes, describe what new tools, models or approaches you are developing, what new data will be generated, etc.? <200 words

> TerraFixing’s core mission is to reduce GHG emissions to mitigate climate change and ultimately fix global warming – we know that it takes a community of innovators to accomplish such a feat, thus, we have a strong plan for disseminating the knowledge we gain to support further replications of DAC projects. We plan to advance the world’s knowledge, similarly to Climeworks, by publishing articles with regards to DAC.

f. Describe your intended plan and partners for verifying delivery and registering credits, if known. If a protocol doesn’t yet exist for your technology, who will develop it? Will there be a third party auditor to verify delivery against that protocol or the protocol discussed in 4(a)? <200 words

We will be using 3rd party verification standards and registering credits for DAC such as Puro Earth, ACR, etc.

5. Cost

We are open to purchasing high-cost CDR today with the expectation the cost per tonne will rapidly decline over time. The questions below are meant to capture some of the key numbers and assumptions that you are entering into the separate techno-economic analysis (TEA) spreadsheet (see step 4 in Applicant Instructions). There are no right or wrong answers, but we would prefer high and conservative estimates to low and optimistic. If we select you for purchase, we'll work with you to understand your milestones and their verification in more depth.

a. What is the levelized price per net metric tonne of CO_2 removed for the project you're proposing Frontier purchase from? This does not need to exactly match the cost calculated for "This Project" in the TEA spreadsheet (e.g., it's expected to include a margin), but we will be using the data in that spreadsheet to consider your offer. Please specify whether the price per tonne below includes the uncertainty discount in the net removal volume proposed in response to question 4(d).

Cost = 546.51$/tonne CO_2
A table with the breakdown of these costs and calculations can be found in the supporting document.
In our Levelized capital expenditure calculations, we have included all of the following categories:
EPC services, contingencies, total plant costs etc. The list includes:

- R&D costs (~$2.1M, which includes salaries for supervisors, engineers, research personnel, analytical equipment, energy, overhead, materials, facility leases, etc.)
- Parts and Labor
- Manufacturing overhead
- Transportation
- Balance of plant (40%)
- Owner's cost (40%)
- Contingency (40%)

In the Fixed operating costs, we include:

- Capital Recovery Factor (20%)
- Inspection, servicing, equipment replacement
- Plant supervisors and operators

The variable operating costs are the wind energy costs (estimates provided by our Wind Energy partner)
End of project costs:

- Transportation from site, disassemble & salvage
- Inspection of site, intensive monitoring for 20 years post project.

For the project, the costs do not include the cost of drilling because our operational site already has them. For the FOAK and NOAK projects, we do include these costs as well as well sealing and land remediation.
For the FOAK and NOAK, our costing includes a learning curve with different learning

curve factors applied differently for the chemical industry, machining tools, electronics, electrical wiring, machining, assembly, raw materials, purchased parts, and welding.

b. Please break out the components of this levelized price per metric tonne.

Component	**Levelized price of net CDR for this project ($/tonne)**
CAPEX & upfront costs	$ 249.66
Fixed operating costs	$ 196.74
Variable operating costs	$ 99.38
End of life costs (includes fees etc. for MVR over 20 years)	$ 0.74
Total	**$ 546.51**

c. Describe the parameters that have the greatest sensitivity to cost (e.g., manufacturing efficiencies, material cost, material lifetime, etc.). For each parameter you identify, tell us what the current value is, and what value you are assuming for your NOAK commercial-scale TEA. If this includes parameters you already identified in 1(c), please repeat them here (if applicable). Broadly, what would need to be true for your approach to achieve a cost of $100/tonne?

Parameter with high impact on cost	**Current value (units)**	**Value assumed in NOAK TEA (units)**	**Why is it feasible to reach the NOAK value?**
CAPEX & upfront costs	249.66 $/tonne	0.94 $/tonne	A substantial part of the current value cost was associated to Research and Design. After the initial design of the unit, the base 4x unit would just be repeated with economies of scale to produce larger plants. According to our calculations, the CAPEX & upfront costs for a FOAK (megaton scale) is $6.10 because we will benefit from economies of scale and learning curves. The CAPEX and upfront costs decrease further, to 0.94 $/tonne

			as we reach NOAK (gigaton scale) One substantial reason for this decrease is the learning curve, as well as our units having higher capacity factor which reduces CAPEX costs of the gigaton DAC plant.
Fixed OPEX	196.74 $/tonne	3.88 $/tonne	A large portion of the fixed OPEX is related to the Capital recovery factor (CRF) on the CAPEX and upfront costs (CRF not applied to R&D). Because these values in the current project were high relative to the carbon captured over the lifetime of the project, the effect of the CRF was substantial. For the FOAK (megaton scale), the Fixed OPEX is 25$/tonne and it decreases to 3.88 $/tonne in the NOAK (gigaton scale deployment).
Variable OPEX	99.38 $/tonne	20.00 $/tonne	In the current project, we estimate that the wind energy price was 62.50 $/MWh, and that the energy requirements of the system were 1.59 MWh/tonCO_2. During our scale-up, our wind energy partners will likewise be scaling up their operations. We estimate an energy price of 40.0 $/MWh for the FOAK (megaton scale) and total energy requirements of 1.2 MWh/tonCO_2 because of optimizations. Thus, the variable OPEX decreases to 48$/tonCO2. For the NOAK (gigatonne scale) we anticipate 20.0 $/MWh and energy requirements of 1.0 MWh/tonCO_2, yielding a variable OPEX of 20 $/tonne$CO_2$. The main driving force for the lower Variable OPEX is process integration, heat integration, and

			better materials combined with utilizing the world's best winds (highest WPD and capacity factors) to power our DAC technology
End of life costs	$ 0.74/tonne	$ 0.08 $/tonne	This cost will be lowered mainly due to the scales of economy.
Total	546.51 $/tonne	24.89 $/tonne	The cost for a FOAK project (megaton scale) is $79.71 $/tonne$CO_2$.

d. What aspects of your cost analysis are you least confident in?

Because we will be deploying our technology to Northern locations, we are uncertain about how this cold and frigid climates will impact the on-site installation as well as transportation costs. To mitigate this uncertainty, we have been relying heavily on our wind energy partner and make use of their experience and technical know-how about operating in frigid windswept areas.

e. How do the CDR costs calculated in the TEA spreadsheet compare with your own models? If there are large differences, please describe why that might be (e.g., you're assuming different learning rates, different multipliers to get from Bare Erected Cost to Total Overnight Cost, favorable contract terms, etc.). <200 words

The costs calculated in the TEA spreadsheet are quite similar to our costs
For this project, the TEA spreadsheet is estimating total LLC of $943/t$CO_2$, whereas our numbers are closer to $546.51. One reason for the difference in our models is that we did not include the R&D costs in the capital recovery factor whereas the Frontier spreadsheet did because they were in the "capital cost" section.
For the FOAK project, the TEA spreadsheet estimates $57/t$CO_2$ for the levelized cost of net CO_2 removed, whereas our projections are closer to $79.71 $/t$CO_2$. Difference reason: different capital recovery factor (20% vs 12%) For the levelized cost at the NOAK scale, the spreadsheet estimates 49$/t$CO_2$ whereas our estimates are 24.89 $/t$CO_2$. Difference reason: lower energy requirements, $/MWh, more accurate learning curves.

f. What is one thing that doesn't exist today that would make it easier for you to commercialize your technology? (e.g., improved sensing technologies, increased access to X, etc.) <50 words

Access to unlimited resources and manpower, or more realistically, a philanthropist with vast resources who would dedicate his resources and access to manpower to solving global warming and pushing forward good ideas to do it.

6. Public Engagement

In alignment with Frontier's Safety & Legality criteria, Frontier requires projects to consider and address potential social, political, and ecosystem risks associated with their deployments. Projects with effective public engagement tend to:

- Identify key stakeholders in the area they'll be deploying
- Have mechanisms in place to engage and gather opinions from those stakeholders, take those opinions seriously, and develop active partnerships, iterating the project as necessary

The following questions help us gain an understanding of your public engagement strategy and how your project is working to follow best practices for responsible CDR project development. We recognize that, for early projects, this work may be quite nascent, but we are looking to understand your early approach.

a. Who have you identified as relevant external stakeholders, where are they located, and what process did you use to identify them? Please include discussion of the communities potentially engaging in or impacted by your project's deployment. <300 words

We are still developing our public engagement strategy.
We will be deploying our technology in an area with renewable energy, and near a mining site and the community in the area surrounding our deployment site are the Innu's.
Each mine in the Impact and Benefits Agreement (IBA) has a governance council that include the leaders of the community and the leaders of mines. They meet periodically to discuss future plans, problems, and opportunities. TUGLIQ is on their meeting agenda and the founder and president of the board of directors, Dr. Pierre Rivard, is including us in these meetings to discuss using the land for atmospheric CO_2 removal.
Throughout the project, we will establish local, safe, and high-quality job opportunities to promote local capacity building in underserved communities. Our goal is to increase equitable workforce development opportunities in the deployment region to strengthen it. Finally, we will solicit feedback and input from the Innu elders to reinforce community-government engagement.

b. If applicable, how have you engaged with these stakeholders and communities? Has this work been performed in-house, with external consultants, or with independent advisors? If you do have any reports on public engagement that your team has prepared, please provide. *See Project Vesta's community engagement and governance approach as an example and Arnestein's Ladder of Citizen Participation for a framework on community input.* <300 words

N/A

c. If applicable, what have you learned from these engagements? What modifications have you already made to your project based on this feedback, if any? <100 words

N/A

d. Going forward, do you have changes to your processes for (a) and (b) planned that you have not yet implemented? How do you envision your public engagement strategy at the megaton or gigaton scale? <100 words

N/A yet

7. Environmental Justice[2]

As a part of Frontier's Safety & Legality criteria, Frontier seeks projects that proactively integrate environmental and social justice considerations into their deployment strategy and decision-making on an ongoing basis.

a. What are the potential environmental justice considerations, if any, that you have identified associated with your project? Who are the key stakeholders? Consider supply chain impacts, worker compensation and safety, plant siting, distribution of impacts, restorative justice/activities, job creation in marginalized communities, etc. <200 words

The main environmental concern is land usage; in the application supplement, a 100,000,000 tonne/year deployment will only require 1.05km^2 of land. Large scale DAC installations will be placed in frigid windswept regions where there are no people living, and minutes amounts of flora and fauna.
Reception from First Nations and Inuit communities that do live in Northern Locations have been very receptive of our DAC technology. They face disproportionate levels of air, food, and water pollution, and mining activities worsens these pollutions. These First Nations and Inuit communities experience greater climate change effects because Northern regions warm at three time the global rate. For example, both the land and animals that the Innu community relies on are noticeably being affected by climate change.
The manifestation of TerraFixing's DAC technology will create economic and equitable workforce development opportunities for the locals near our small-scale deployment sites. We also hope that our technology will allow for renewable electricity penetration in Northern communities while producing foods and fuels. We have partnered with two Inuit owned businesses to this end as well as having a First Nations partner. The aim is to have a meaningful positive impact for these northern communities.

[2] For helpful content regarding environmental justice and CDR, please see these resources: C180 and XPRIZE's Environmental Justice Reading Materials, AirMiners Environmental and Social Justice Resource Repository, and the Foundation for Climate Restoration's Resource Database

b. How do you intend to address any identified environmental justice concerns and / or take advantage of opportunities for positive impact? <300 words

TerraFixing's moral imperative is to address climate change via carbon removal while improving the well-being of communities in which its technology resides – in this case, we will be capturing CO_2 and supporting the development of renewable energy infrastructure in the area. The Innu community will reap the benefits of our project. Throughout the project, we will establish local, safe, and high-quality job opportunities to promote local capacity building in the underserved communities near our operating site. Our goal is to increase equitable workforce development opportunities in these regions to strengthen it. Finally, we will solicit feedback and input from the Innu elders to reinforce community-government engagement.

8. Legal and Regulatory Compliance

a. What legal opinions, if any, have you received regarding deployment of your solution? <100 words

Canada has been quite favorable view of DAC and is devoting significant funds to it. Currently, DAC framework is under review from the government.

b. What permits or other forms of formal permission do you require, if any, to engage in the research or deployment of your project? What else might be required in the future as you scale? Please clearly differentiate between what you have already obtained, what you are currently in the process of obtaining, and what you know you'll need to obtain in the future but have not yet begun the process to do so. <100 words

Permits and legal documents for our project deployment are being obtained by Tugliq Energie, our renewable energy partner. They have several projects in the pipeline for large scale wind power installments to decarbonize mining sites in the North – these locations are also favorable for DAC and sequestration. We are in the midst of combining the DAC unit deployments with the wind power infrastructure underneath the same project banners.

c. Is your solution potentially subject to regulation under any international legal regimes? If yes, please specify. Have you engaged with these regimes to date? <100 words

N/A

d. In what areas are you uncertain about the legal or regulatory frameworks you'll need to comply with? This could include anything from local governance to international treaties. For some types of projects, we recognize that clear regulatory guidance may not yet exist. <100 words

Currently, Canada is working out much of the details with regards to DAC regulations with respects to carbon taxes, as well as sequestration.

e. Do you intend to receive any tax credits during the proposed delivery window for Frontier's purchase? If so, please explain how you will avoid double counting. <50 words

We are not planning on receiving any carbon tax credits during the proposed delivery window.

9. Offer to Frontier

This table constitutes your **offer to Frontier**, and will form the basis of contract discussions if you are selected for purchase.

Proposed CDR over the project lifetime (tonnes) *(should be net volume after taking into account the uncertainty discount proposed in 4(c))*	Assuming a 20-year life of the unit, the unit will be able to capture 9,705 – 13,705 tonnes.
Delivery window *(at what point should Frontier consider your contract complete? Should match 1(f))*	Q4 2024 - 2027
Levelized Price ($/metric tonne CO_2) *(This is the price per tonne of your offer to us for the tonnage described above)*	We would like to propose selling 625 tonnes of CO_2 to frontier at a price of 800 $/tonne (for a total of $500,000 in prepurchases).

Application Supplement: DAC

(Only fill out this supplement if it applies to you)

Note: these questions are with regards only to air capture: e.g. your air contactors, sorbents or solvents, etc. Separately, there exist Geologic Injection and CO_2 Utilization supplements. We anticipate that most companies filling out this DAC supplement should ALSO fill out one of those supplements to describe their use of the CO_2 stream that's an output of the capture system detailed here.

Physical Footprint

1. What is the physical land footprint of this project, and how do you anticipate this will change over the next few years? This should include your entire physical footprint, i.e., how much land is not available for other use because your project exists. Also, what is the estimated footprint if this approach was removing 100 million tons of CO_2 per year?

Land footprint of this project (km^2)	7.05 m^2 (or 7.05 x10^{-6} km^2)
Land footprint of this tech if scaled to 100 million tons of CO_2 removed per year (km^2)	1.05 km^2

Justification:

The unit proposed has a gross capture capacity of 1000 tonsCO2/year and occupies half of a 20 ft high cube shipping container, hence a land footprint of 7.05 m^2

The commercial unit's gross capture capacity is 4000 tonsCO2/year and occupies a 40 ft high cube shipping container, which occupies 29.7 m^2 of land. Shipping containers can be stacked up to 9 units high. We have capped this stacking at 5 units, thus, an area of 29.7 m^2 can facilitate 20,000 $tonCO^2$/year carbon capture. With a 5 unit stack and a 5m buffer around the stack included in the land footprint, we would only require 1.05 km^2 for a 100 million ton CO_2 removal plant.

Capture Materials and Processes

1. What material(s) is/are you using to remove CO_2? <50 words

We are using commercially available zeolites, specifically, Na-X type zeolites

2. How do you source your material(s)? Discuss how this sourcing strategy might change as your solution scales. Note any externalities associated with the sourcing or manufacture of it (e.g., hazardous wastes, mining, etc.). You should have already included the associated carbon intensities in your LCA in Section 3. <300 words

Our zeolites are industrially available and can be ordered directly from a manufacturer

3. How much energy is required for your process to remove 1 net tonne of CO_2 right now (in GJ/tonne)? Break that down into thermal and electrical energy, if applicable. What energy intensity are you assuming for your NOAK TEA? <100 words

Energy requirements today: Thermal: 4.93 GJ/tonneCO_2 Mechanical: 0.79 GJ/tonneCO_2 Total: 5.74 GJ/tonneCO_2 Energy requirements for the NOAK: Thermal: 2.88 GJ/tonneCO_2 Mechanical: 0.72 GJ/tonneCO_2 Total: 3.6 GJ/tonneCO_2

4. What is your proposed source of energy for this project? What is its assumed carbon intensity? How will this change over the duration of your project? (You should have already included the associated carbon intensities in your LCA in Section 3). <100 words

(CI = 0.011 per MWh or 224 over the life of the project) We will be integrating our device with renewable energy from our wind energy provider, TUGLIQ, who are installing wind turbines to decarbonize mines in the deployment region, and to power our DAC units. As we scale, TUGLIQ will likewise be scaling their wind turbine deployments which will reduce the cost of power as we scale.

5. Besides energy, what other resources do you require (if any, such as water)? Where and how are you sourcing these resources, and what happens to them after they pass through your system? (You should have already included the associated carbon intensities in your LCA in Section 3). <100 words

No other resources are required

6. Do you have experimental data describing how your system's CDR performance changes over time? If so, please include that data here and specify whether it's based on the number of cycles or calendar life. <100 words

Zeolites are known for their stability and durability with lifetime longer than 20+ years proven in industries with similar separations. Data can be found in our papers which shows repeated cycles with insignificant degradation.[1,2,9]

7. What happens to your capture medium at end-of-life? Please note if it is hazardous or requires some special disposal, and how you ensure end-of-life safety. <100 words

Zeolites are composed of the same material as sand but are just very ordered and crystaline. Also they can be found in nature and are commonly mined. At the end of the project life, they can be disposed of safely, or in some cases, recycled to produce new working materials. Zeolites pose little to no safety hazards when in use or upon disposal.

8. Several direct air technologies are currently being deployed around the world. Why does your DAC technology have a better chance to scale and reach low cost than the state of the art? <200 words

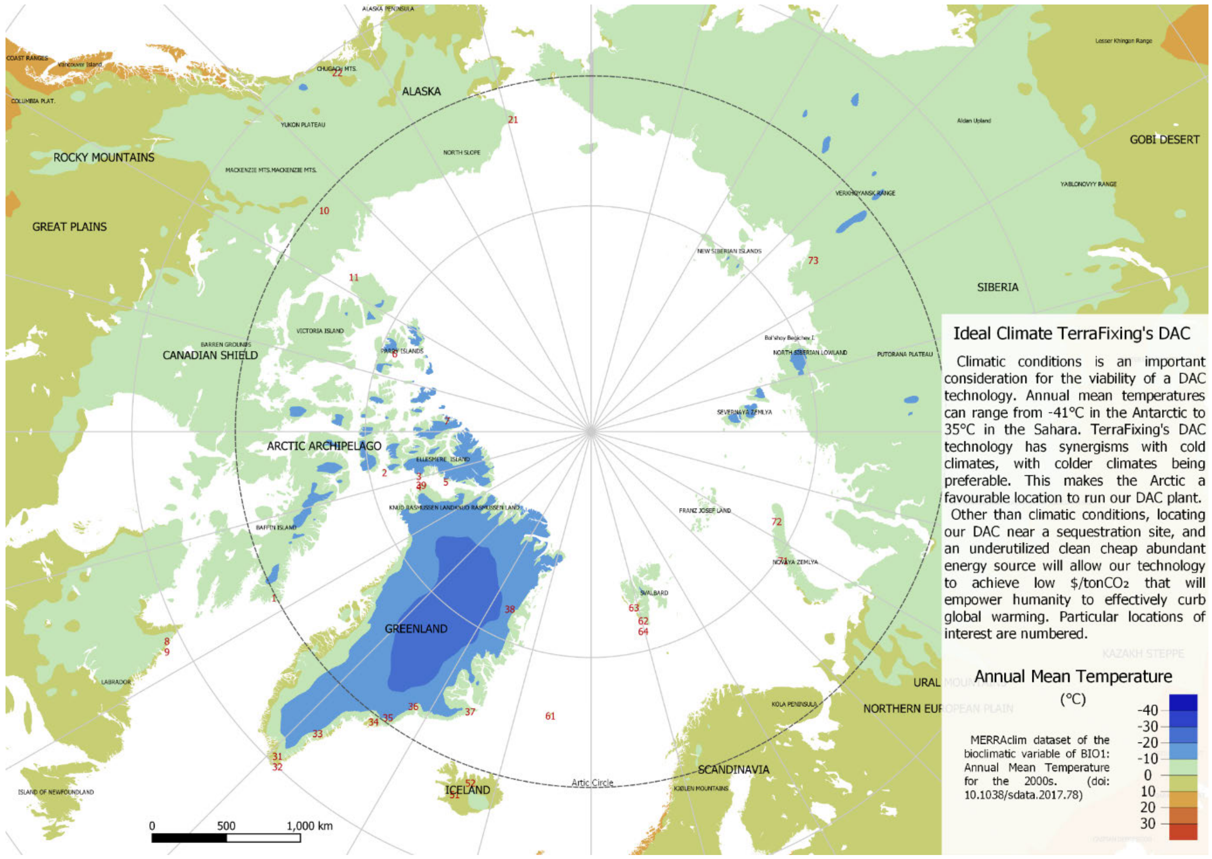
The DAC technology with the best economics will win, and TerraFixing's technology has the potential to reach <$40/tonne at gigatonne scale. To achieve this, we take advantage of cold climates!

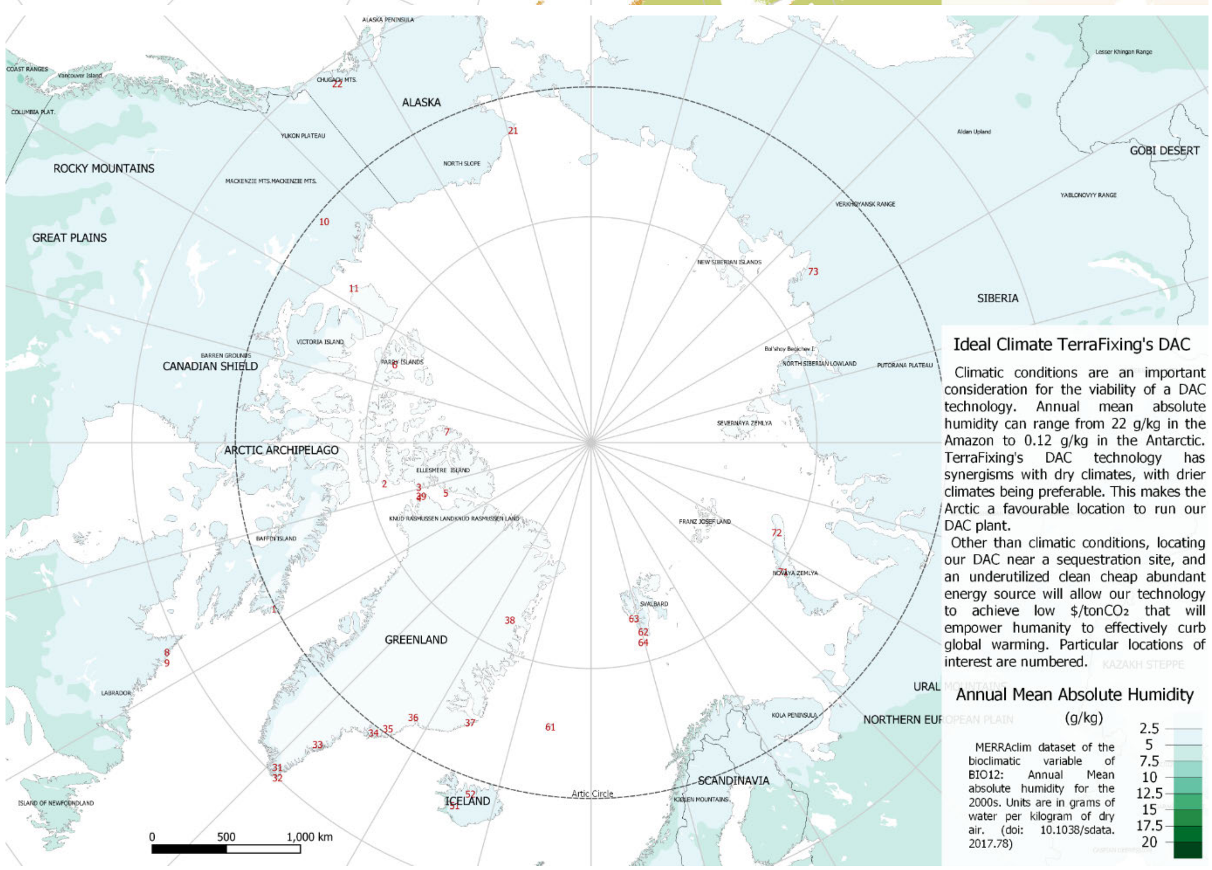
Lowest CAPEX: we have a simple process (i.e., 5 unit operations), the highest reported CO_2 adsorption capacity, and our DAC units are small&modular. They can be manufactured at scale offsite and shipped to the desired location for plug&play installation.

Lowest OPEX: by taking advantage of synergies between our process and cold climates (favorable separations thermodynamics, no moisture in the air) TerraFixing's technology has the lowest energy requirements/tonneCO_2.

Locating our technology in cold and windy locations enables us to increase our process efficiency and take advantage of the world's best winds. In cold and windswept regions, we will minimally impact flora and fauna (windswept areas are generally barren) meaning that there is unlimited scalability for DAC *and* wind turbines.

DAC units will be deployed where the geology is favorable for onsite sequestration, eliminating the technical challenges/costs associated with CO_2 transportation. TUGLIQ's mission is to decarbonize Canadian northern communities and mines. Wind turbine and DAC deployments will be near mining sites where we can take advantage of pre-existing wells for injections.


ALASKA
ROCKY MOUNTAINS
GREAT PLAINS
CANADIAN SHIELD
ARCTIC ARCHIPELAGO
GREENLAND
ICELAND
SCANDINAVIA
NORTHERN EUROPEAN PLAIN
URAL MOUNTAINS
SIBERIA
GOBI DESERT
Artic Circle
0 500 1,000 km
Ideal Climate TerraFixing's DAC
Climatic conditions is an important consideration for the viability of a DAC technology. Annual mean temperatures can range from -41°C in the Antarctic to 35°C in the Sahara. TerraFixing's DAC technology has synergisms with cold climates, with colder climates being preferable. This makes the Arctic a favourable location to run our DAC plant.
Other than climatic conditions, locating our DAC near a sequestration site, and an underutilized clean cheap abundant energy source will allow our technology to achieve low $/tonCO₂ that will empower humanity to effectively curb global warming. Particular locations of interest are numbered.
Annual Mean Temperature
(°C)
MERRAclim dataset of the bioclimatic variable of BIO1: Annual Mean Temperature for the 2000s. (doi: 10.1038/sdata.2017.78)
-40
-30
-20
-10
0
10
20
30


ALASKA
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GREAT PLAINS
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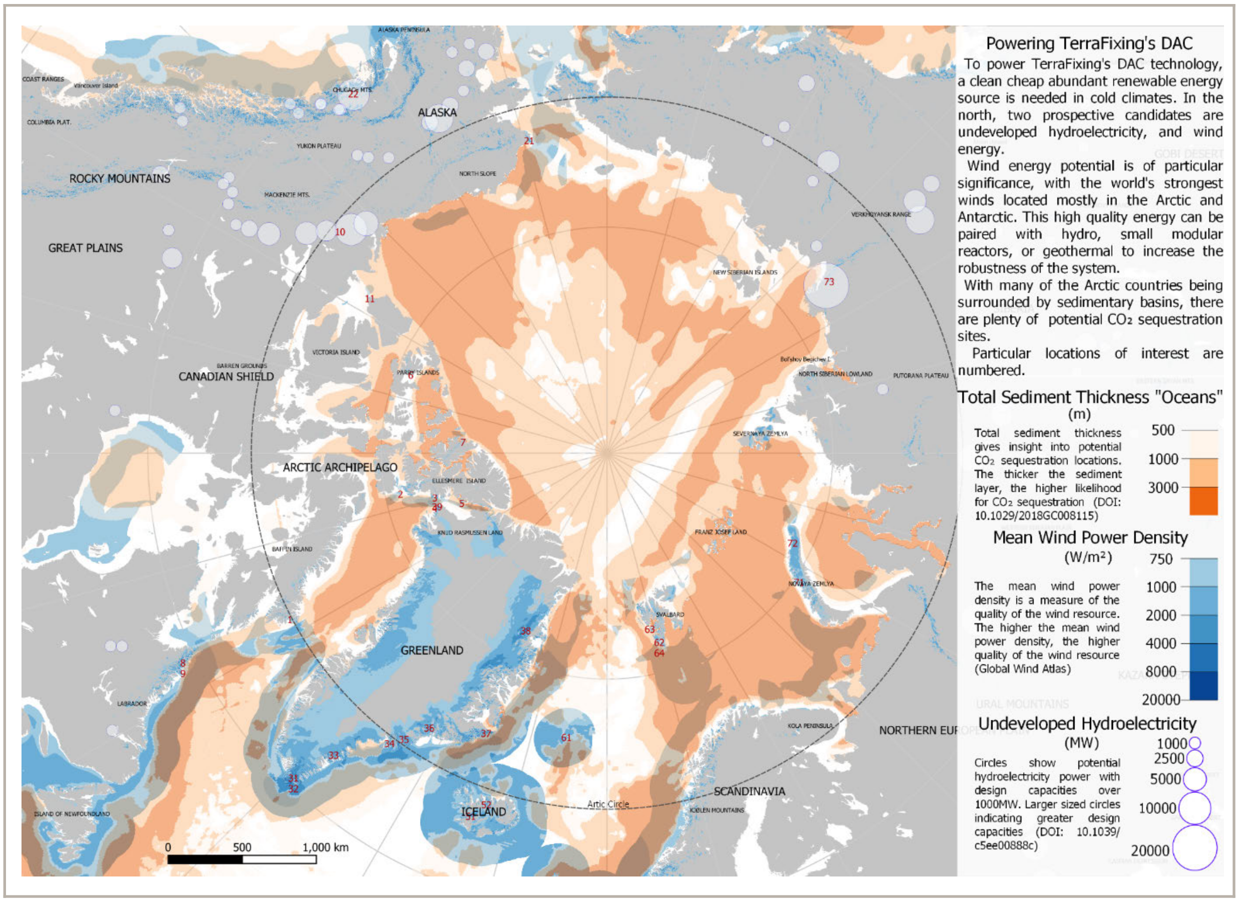
GREENLAND
ICELAND
SCANDINAVIA
NORTHERN EUROPEAN PLAIN
URAL MOUNTAINS
SIBERIA
GOBI DESERT
Artic Circle
0 500 1,000 km
Ideal Climate TerraFixing's DAC
Climatic conditions are an important consideration for the viability of a DAC technology. Annual mean absolute humidity can range from 22 g/kg in the Amazon to 0.12 g/kg in the Antarctic. TerraFixing's DAC technology has synergisms with dry climates, with drier climates being preferable. This makes the Arctic a favourable location to run our DAC plant.
Other than climatic conditions, locating our DAC near a sequestration site, and an underutilized clean cheap abundant energy source will allow our technology to achieve low $/tonCO₂ that will empower humanity to effectively curb global warming. Particular locations of interest are numbered.
Annual Mean Absolute Humidity
(g/kg)
MERRAclim dataset of the bioclimatic variable of BIO12: Annual Mean absolute humidity for the 2000s. Units are in grams of water per kilogram of dry air. (doi: 10.1038/sdata.2017.78)
2.5
5
7.5
10
12.5
15
17.5
20



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(2) Wilson, S. M. W. High Purity CO2 from Direct Air Capture Using a Single TVSA Cycle with Na-X Zeolites. *Sep Purif Technol* **2022**, *294* (April), 121186. https://doi.org/10.1016/j.seppur.2022.121186.

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