First Gigaton

Carbon Removal Purchase Application

General Application

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

Company or organization name

First Gigaton Carbon Removal Inc.

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

Canada and the Philippines

Name of person filling out this application

Mike Dickhout

Email address of person filling out this application

[redacted]

Brief company or organization description

Fast, Scaleable Seaweed-CDR to avert climate catastrophe.

1. Overall CDR solution (All criteria)

a. Provide a technical explanation of the proposed project, including as much specificity regarding location(s), scale, timeline, and participants as possible. Feel free to include figures and system schematics.

First Gigaton ("FG") (https://firstgigaton.com) is Seaweed-CDR designed for rapid deployment and scaling.

Our Model is unique in that FG combines nearshore seaweed farming with FG's proximate offshore sequestration.

FG partners with Seaweed Farming Cooperatives in the Philippines and soon, throughout the Global South. The Coops grow seaweed in arrays that FG builds exclusively for CDR. At each harvest, FG takes possession of the seaweed. We weigh it, sample it for carbon content, and sequester it at ocean depths greater than 1000 metres. An independent third party verifies everything.

Our Model combines nearshore seaweed farming with proximate offshore sequestration. To date, all our partner farms are within 15 km (11 miles) of ocean depths greater than 1000 meters. This facilitates quick, easy, and low-emission sequestration.

FG landed in the Philippines in January 2022. As of March 2022, we have partnered with three coops on Mindanao and have our first few hundred meters of line in the water.

With Stripe's support, we'll scale capacity to over 1000 tonnes (net) CDR per year starting January 2023, and over 13,000 tonnes per year starting January 2024. This will require 48 hectares of sea area in 2023 scaling to 528 hectares in 2024. (To date, we have access to 250 hectares of sea area).

There are four key elements to the First Gigaton Model.

Local Partners mean FG starts on third base. Our partner coops have the local seaweed farming expertise, all the required permits, and established relationships with local officials to quickly secure permission for expansion and sequestration. FG provides our local partners with funding to deploy dedicated CDR-only growing arrays, a monthly salary, operating expenses, and the resources to optimize seaweed cultivation and carbon capture.

Nearshore Farming, because it's easier. Nearshore farming eliminates the need to develop new technology for nutrient supply, CDR measurement, autonomous operations, and offshore monitoring, verification, and maintenance. Moreover, our partners have been farming seaweed nearshore for years/decades/generations, capturing thousands of tonnes of carbon. They just haven't been sequestering it. Nearshore seaweed aquaculture is the low-hanging fruit of CDR.

Proximate Offshore Sequestration minimizes the CO2e emissions from transporting seaweed to sequestration areas. Currently, our two main areas of operation (Digos and Santa Cruz on the east coast of Mindanao) are within 11km (6.9 miles) of depths that exceed 1000 meters. West of the mouth of Sarangani Bay in southern Mindanao, depths over 4,000 meters are within 15 km of the shore (and within our partner's municipal jurisdiction). As electric tugs and barges become available and their ranges increase, more farms and coastlines around the globe will be able to produce Seaweed-CDR efficiently.

Climate Justice is not only an important "social benefit," it is the most effective business strategy. First, our partners are subsistence fisherfolk. A living annual salary empowers them to feed their families without worry, grow their businesses, and secure generational prosperity. We de-risk the farmers while paying them substantially more than they earn from farming. At the same time, we increase their productivity and secure seaweed at capacity for less than the farm-gate price (which is about 140 USD per wet tonne of seaweed or 700 USD per tonne for seaweed-carbon).

Second, Climate Justice is the fastest way to open the doors needed to scale rapidly. Economic benefits that are seen immediately secure eager support from farmers, their communities, and local and national authorities. Everyone wants to join the mission to make the Philippines a world leader in Seaweed-CDR.

FG's PLAN

The Philippines is uniquely positioned for combining nearshore farming with offshore sequestration. Much of the country's 36,000 km of coastline is both ideal for seaweed cultivation *and* only 8 to 40 km (5 to 25 miles) from depths of more than 1000 metres.

FG and our partner farms cultivate three types of seaweed endemic to the Philippines:

- *Kappaphycus striatum*
- *Kappaphycus alvarezii*
- *Eucheuma spinosum*

Each coop will have a number of dedicated FG Seaweed-CDR Arrays. These are of the "Long-Line" design consisting of 54 lines, each line being 150 metres long and spaced 1.5 meters apart.

- 50 lines for CDR (The Seaweed will be harvested and sequestered).
- 3 lines for seedlings for the following crop.
- 1 line as a buffer to cover shortfalls in either CDR or seedlings.

This amounts to 8,100 metres of line per array. The total area covered by each array is approximately 1.2 hectares.

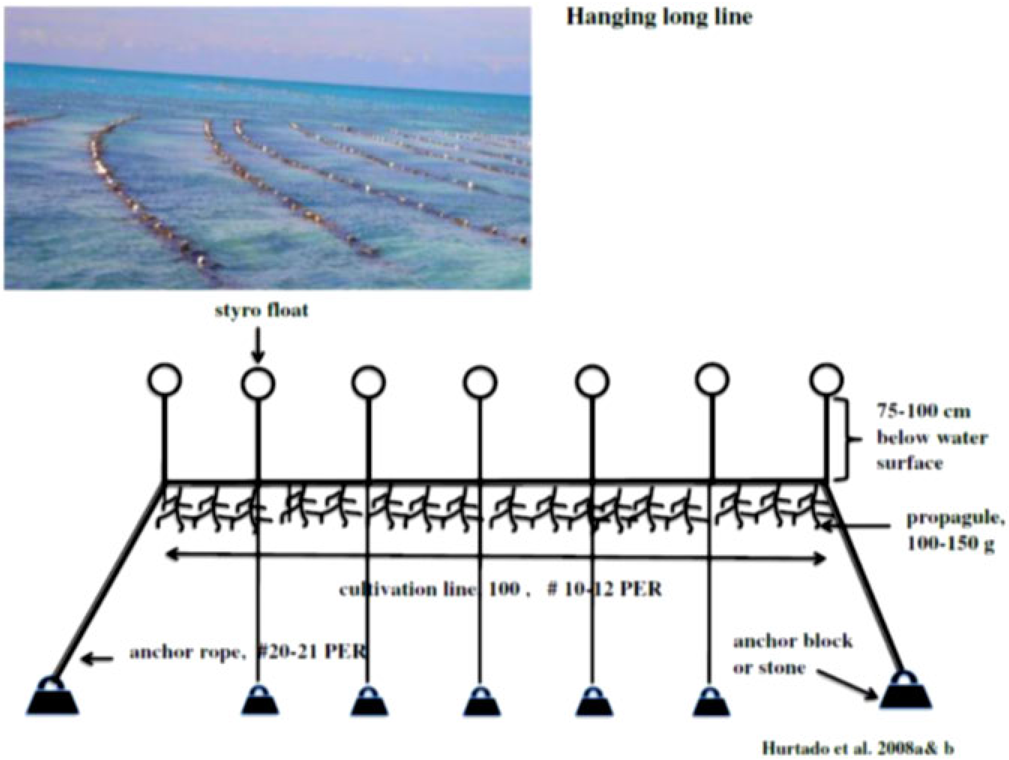


Figure 8: Single hanging longline method (HLL), from Hurtado et al. (2013)

However, the area of the Array does not have to be contiguous. Depending on local conditions or environmental requirements, the Array can be sub-divided into smaller areas, such as two smaller arrays of 27 lines each (x 150m/line) for the combined 8,100 meters of line.

Each line is estimated (conservatively) to grow 315kg of seaweed every 4 weeks from January to August. Due to the seaweed disease of "ice-ice" which is more common in the last quarter of the year, each line is projected to grow only 158 kg every 4 weeks from September to December.

This amounts to 3150 kg of seaweed per line per year. One FG Seaweed-CDR Array of 50 CDR lines will produce 157.5 tonnes of seaweed (Fresh Weight). Assuming a carbon content of 20 percent (confirmed by our own tests at a DOST lab):

Each FG Seaweed-CDR Array sequesters 31.5 tCO_2 /Array/Year (Gross) and 27.686 tCO_2/Array/Year (Net).

As of March 2022, FG has partnered with three Coops from the municipalities of Alabel in Sarangani Province (in Sarangani Bay on the southcoast of Mindanao), and Digos and Santa Cruz in the Province of Davao del Sur (on the eastcoast of Mindanao).

The three Coops have made more than 250 hectares available to FG and are confident they can get permits for more area for seaweed farming as required. Municipal governments grant permits to the coops typically of 100 hectares to start. However, most coops lack the resources to cultivate more than just a few hectares.

THE FIRST GIGATON MODEL

FG's operational model for the Philippines is outlined below. We will replicate it throughout the country ~ and throughout the Global South ~ with modifications tailored to local conditions.

1. FG contracts our Partner Cooperatives to grow seaweed for CDR exclusively on our behalf. (They can grow seaweed for other purposes in separate farm arrays). FG receives the full harvest of Seaweed for CDR in return for providing each Cooperative with

    - Funding to establish a series of FG Seaweed-CDR Growing Arrays with a gross CDR capacity of 31.5 tCO_2 /Array/Year.
    - A monthly payment (year-round) to the Coop or farmer based on the number of CDR Arrays under cultivation.
    - Funding for seedlings when needed.
    - Funding for fuel, maintenance, repair, and upgrades (e.g. as we mechanize operations).
    - Training in environmental and aquaculture best practices.
    - Production bonuses.
    - Regular project support for the Coop's local community.

2. The Cooperative grows the seaweed following First Gigaton's Protocol, including following environmental and aquaculture best practices, and the recording of all material (e.g ropes, buoys, etc.) and energy (e.g. fuel for farm boats) for use in a Lifecycle Analysis for each Array.

3. At each harvest (in the Philippines: every four to six weeks, up to 12 per year), FG's SQ Team:

    - Takes possession of the seaweed at the farm site.
    - Sends a 1 kg sample (per seaweed type) from each farm to a Philippines Department of Science and Technology (DOST) Laboratory to determine carbon content through chemical analysis.
    - Uses an FG-supplied scale to weigh the crop to the nearest kilogram.
    - Compactly bales the seaweed with natural fibre twine to ensure each bale has the negative buoyancy to sink through the mesopelagic zone to the ocean floor. (Baling the seaweed also discourages the seaweed's consumption by fauna as it descends to the ocean floor).
    - Loads the harvest onto a near-shore Sequestration Vessel.

4. FG transfers (sinks) the seaweed to the ocean floor at areas designated by the appropriate municipal authority (e.g. MENRO for Sarangani or MAO for Davao del Sur) and the Coast Guard to be optimal for sequestration (i.e. deeper than 1000m

with no upwelling or onshore currents). Each sequestration is conducted over a broad area (e.g. one square kilometre) at a range of locations to prevent a build-up of sequestered seaweed at a single location. Sequestration locations and procedures are recorded and confirmed by GPS data and video.

5. FG projects conservatively 95 percent of FG's seaweed reaches the ocean floor to be sequestered for more than 1000 years. According to scientific consensus, at depths greater than 1000 metres, the seaweed that reaches the ocean floor becomes buried in ocean sediments and mineralizes, along with the baling twine, and is sequestered on a geological scale of thousands of years.

   Three things happen to that "other five percent" of seaweed assumed to not make it to the ocean floor (and not counted as sequestered).

   - Seaweed fails to reach 1000m, due to escaping its bale, in which case the seaweed dissolves or is consumed by vertebrates and/or invertebrates and the carbon returns to the surface and is not sequestered.

   - Seaweed descends below 1000m only to be eaten by deep-sea fauna. The carbon is returned to the water as $CO2$ after digestion or retained in the animal's body until it dies and decomposes on the ocean floor. Below 1000 metres any released $CO2$ is compressed to a density greater than water. Propelled by the ocean's deep-sea conveyor current, the compressed $CO2$ will take 800-4000 years (depending on the ocean) to return to the surface and the atmosphere.

   - Seaweed descends below 1000m but is not consumed nor does it reach the ocean floor. This seaweed degrades and dissolves in the seawater, but again, the $CO2$ will not make it to the surface for at least 800 years.

6. Net CDR is calculated for each crop using each crop's:

   - Fresh weight as measured by FG.
   - Lab results for carbon content.
   - Recorded LCA inputs from the farm.
   - Fuel used by the Sequestration Vessel (from home port to farm(s), to sequestration area, and return to port).
   - A conservative assumption of 95 percent successful sequestration.

7. An Independent Third Party verifies all data and calculations.

b. What is your role in this project, and who are the other actors that make this a full carbon removal solution? *(E.g. I am a broker. I sell carbon removal that is generated from a partnership between DAC Company and Injection Company. DAC Company owns the plant and produces compressed CO_2. DAC Company pays Injection Company for storage and long-term monitoring.)*

First Gigaton is the principal actor. We initiate, fund, and manage the entire CDR Process, bringing in the local partners who are central to our success, including:

1. **Our Coop Partners** hold the licence and permits for growing seaweed on our behalf.
2. **Municipal Environment and Natural Resources Offices (MENRO for Sarangani) or Municipal Agriculture Office (MAO for Davao del Sur)** issue the permits for seaweed aquaculture and, for the first time, the permits for Seaweed-CDR sequestration at sea. (FG expects to receive the first sequestration permit from MENRO-Alabel in April 2022).
3. **Bureau of Fisheries and Aquatic Resources** provides technical assistance and cooperation on environmental monitoring.
4. **Philippine Department of Science and Technology Lab** provides carbon content analysis of samples from each harvest.
5. **Local Charter Companies** provide vessels for transporting seaweed to sequestration areas.
6. **Independent Third Party** verifies all measurements and calculations during the CDR Process.

c. What are the three most important risks your project faces?

1. **Risks typical to aquaculture:** severe weather damaging/destroying crops and/or growing arrays; disease damaging crops; warming and acidifying seawater impacting crop yields. We mitigate these risks through geographic and crop diversification. Growing arrays can also be moved onshore for protection from destructive weather when forecasted in time.

2. **Geo-Economic Risk:** The Russian invasion of Ukraine impacts global fuel prices which FG will mostly feel in the costs of chartering sequestration vessels. Should the conflict impact the global supply of fertilizer and wheat, there may be pressure in the Philippines to grow more seaweed both for fertilizer and food. In this event, our CJ Model offers some protection as it de-risks the farmer.

   Should the social need for fertilizer or food be seen by the local community as in its best interest, we will help our partners serve the markets using separate, additional growing arrays in return for them continuing to grow seaweed for FG's CDR. However, pressure to use aquaculture sea areas for fertilizer and food crops may limit the availability of sea area for CDR crops, slowing our plans for rapid scaling.

3. **Regulatory challenges regarding deepsea sequestration.** Currently, we are only sequestering within the Philippines' territorial waters. They have no regulations banning this and we have received approval due to the fact that it is only all-natural material being deposited (seaweed and natural fibre twine). When scaling requires the use of international waters, we will ensure we meet all requirements of international agreements, such as the London Protocol. At that time, our track record in the Philippines and other countries' territorial waters will set a strong precedent.

d. If any, please link to your patents, pending or granted, that are available publicly.

- At this time, all IP required for the project as planned is widely used and in the public domain. However, it is possible for new technologies, farming techniques and machines, and seed types (e.g. fast-growing, disease-resistant, high carbon-content) to be developed over the duration of the project that would benefit the project's CDR capacity. In such cases, we will approach the IP owners for licensing, acquisition, or purchase. However, no new IP is required for the successful completion of the project. Furthermore, should FG develop any IP our first instinct is to make it open source so others in the Global South can use it without delay in their Seaweed-CDR efforts.

e. Who's the team working on this? What's your team's unfair advantage in building this solution? What skills do you not yet have on the team today that you are most urgently looking to recruit?

The FG Team (So far):

- **Mike Dickhout** (CEO, Canada), MA in international affairs, expertise in international relations and international business development.
- **Junie Coscos** (Project Manager, Philippines), B. Agriculture, expertise in foreign business development in the Philippines and NGO Project Management.
- **Romeo Calo** (Local Business Development Officer, Philippines), expertise in local government and marine industry, seaweed farming, and seaweed farming cooperatives on Mindanao.
- **Our Next Recruit:** An in-house seaweed aquaculture expert to research, iterate, and monitor our partner farms for environmental practices, impacts, and optimal carbon capture.

FG's unfair advantage.

1. FG broke the code for *rapidly scalable* Macroalgae-CDR:

   Effective Seaweed CDR = Lines + Buoys + CDR Protocol.

   (Local Partners x Nearshore Seaweed Farming x Proximate Offshore Sequestration) = CDR(Additional + Measurable + Verifiable + Rapidly Scalable).

2. Our simple, proven, age-old tech (lines and buoys) allows for speed of deployment and scalability. (Simply deploying more lines in the water = more CDR). Other *offshore* macroalgae solutions face engineering challenges from rough offshore weather, deficient offshore nutrient supply, remote CDR measurement and verification, and in some cases, autonomous operations and offshore maintenance. FG's absence of engineering challenges means

   - No delays from slow seasonal R&D, technical setbacks, complex construction needs, or supply chain issues for key components.
   - No engineering, factory, or construction cost overruns.
   - FG's CDR capacity directly increases as money comes in, i.e. we install new CDR Arrays (lines in the water) at existing and new locations.
   - Without interrupting or delaying our CDR ops, FG will conduct ongoing, on-site research to optimize the carbon yield of each array and the productivity of each farm partner.

3. FG energizes farmers, their communities, and official support for our project by

delivering the right localized mix of incentives (coop-directed investment, liveable salaries, growth opportunities, community-led support projects, and inspiring local and national missions).

4. We have a growing network of all the key players ~ on Mindanao and soon nationwide: BFAR, MENRO, MAO, Philippine Coast Guard (PCG), DOST, Aquaculture Colleges, and most importantly, our army of seaweed farmers and cooperatives eager to join the project.

5. We move fast. **FG landed in PH in January 2022.** We already have:

    - Over 250 hectares "available" for the project in Alabel, Digos, and Santa Cruz. (Local coops have the permits and are encouraged to develop these areas but do not have the resources to do so. They are excited to see FG step up).

    - Deployed our first "fish cage design" seaweed array in Alabel. (First harvest will occur at end of April).

    - **Conducted our first demonstration of sequestration-at-sea for MENRO-Alabel, PAMO, and PCG on April 1, 2022 (the same day and just hours before this Application was submitted to Stripe). We used our Ladol Coop Partner's seaweed. MENRO was impressed and assures us they will issue a Sequestration Permit shortly.**

    - Started prepping our first standardized "Long Line" FG Seaweed-CDR Arrays in Digos and Santa Cruz.

    - Completed two community projects: commissioned the construction of a new outrigger for Ladol Village in Alabel and provided support for the labourers rebuilding the local church.

    - Officially registered in the XPRIZE Carbon Removal.

    - Sent our first samples for testing to DOST Lab. (20.1 percent carbon content for *Kappaphycus*).

6. With Stripe, we can confidently remove 1,200+ tonnes of carbon by December 2023 and 12,000+ additional tonnes by December 2024.

7. As a Canadian company, we can leverage funding up to 20x Stripe's purchase amount from the Canadian government's international development program. https://www.international.gc.ca/world-monde/funding-financement/funding_development_projects-financement_projets_developpement.aspx?lang=eng

8. We are in the Philippines and ready to launch. The world won't avoid climate catastrophe without Seaweed-CDR. The Philippines holds the geographic advantage to launch and scale Seaweed-CDR to over 1 Megatonne per year in the country by 2030 *and* be the catalyst to scale over 1 Gigatonne per year globally by 2040. Stripe holds the launch button.

2. Timeline and Durability (Criteria #4 and Criteria #5)

a. Please fill out the table below.

	Timeline for Offer to Stripe
Project duration *Over what duration will you be actively running your DAC plant, spreading olivine, growing and sinking kelp, etc. to deliver on your offer to Stripe? E.g. Jun 2022 - Jun 2023. The end of this duration determines when Stripe will consider renewing our contract with you based on performance.*	**January 2023 - December 2024** **Phase One: 1,260 tonnes (gross)**; January - December 2023 **Phase Two: 13,860 tonnes**; January - December 2024. **Phase Two capacity/offer is flexible to suit Stripe's needs (e.g. 6000 - 13,860t).** NOTE: We favour a higher volume, not just for the obvious reasons, but also sequestering 13,000+ tonnes in 2024 would put FG in the running as a finalist of the XPRIZE Carbon Removal. Numbers in the application going forward assume ~ **15,120 tonnes gross CDR** for the duration of the project.
When does carbon removal occur? *We recognize that some solutions deliver carbon removal during the project duration (e.g. DAC + injection), while others deliver carbon removal gradually after the project duration (e.g. spreading olivine for long-term mineralization). Over what timeframe will carbon removal occur?* *E.g. Jun 2022 - Jun 2023 OR 100 years.*	Seaweed is harvested and sequestered roughly every 3-5 weeks or up to 12 times per year and 24 times during the project period.
Distribution of that carbon removal over time *For the time frame described above, please detail how you anticipate your carbon removal capacity will be distributed. E.g. "50% in year one, 25% each year thereafter" or "Evenly distributed over the whole time frame". We're asking here specifically about the physical carbon removal process here, NOT the "Project duration". Indicate any uncertainties, eg "We anticipate a steady decline in annualized carbon removal from year one into the*	Evenly distributed in each phase (1,000 tonnes over 2023 and 11,000 tonnes over 2024).

out-years, but this depends on unknowns re our mineralization kinetics".	
Durability *Over what duration you can assure durable carbon storage for this offer (e.g, these rocks, this kelp, this injection site)? E.g. 1000 years.*	1000+ years. *<10 words*

b. What are the upper and lower bounds on your durability claimed above in table 2(a)?

1000+ years (We do not include a 5 percent "loss" of seaweed that we assume does not make it to the ocean floor, some of which may still sequester for 800 - 4000 years (depending on the speed of the particular area's deep-sea conveyor current).

c. Have you measured this durability directly, if so, how? Otherwise, if you're relying on the literature, please cite data that justifies your claim. *(E.g. We rely on findings from Paper_1 and Paper_2 to estimate permanence of mineralization, and here are the reasons why these findings apply to our system.* OR *We have evidence from this pilot project we ran that biomass sinks to D ocean depth. If biomass reaches these depths, here's what we assume happens based on Paper_1 and Paper_2.)*

FG has not measured this durability directly.

The varieties FG cultivates for CDR are naturally denser than seawater and readily sink. FG's seaweed will additionally be baled compactly with natural fibre material to further increase its negative buoyancy and ensure its descent below 1000 meters.

On April 1, 2022, we conducted our first sequestration trials in cooperation with MENRO-Alabel, PAMO-Sarangani Bay, BFAR-Sarangani, and PCG-Sarangani to determine with high confidence the seaweed reaches the ocean floor at depths more than 1000 meters. 1500 meter lines attached to the seaweed were used to indicate a successful sinking beyond 1000 meters.

Our model assumes 95 percent of Seaweed deployed for sequestration will successfully reach the ocean floor and be sequestered. The other five percent fails to reach the required depth, or reaches the depth but does not embed on the ocean floor. This five percent is not considered sequestered.

The consensus in the oceanographic community is that:

At depths greater than 1000m, the seaweed that reaches the ocean floor becomes buried in ocean sediments and mineralizes, along with the bailing twine, and is sequestered for thousands of years.

Seaweed that escapes its bale and fails to reach 1000m may be consumed by fauna, in which case the Carbon returns to the surface when it leaves the body of the animal. (The Carbon is not sequestered).

For Seaweed that escapes its bale and descends below 1000m only to be eaten by deep-sea fauna, the Carbon returns to the water as CO2 after digestion or retained in the animal's body until it dies and decomposes on the ocean floor. (FG does not count this as sequestered).

Seaweed that descends below 1000m but is not consumed nor does it reach the ocean floor will degrade and dissolve in the seawater as CO2.

Below 1000 metres, any CO2 from the Seaweed (digested or dissolved) is compressed to a density greater than water. Propelled by deep sea conveyor current, the compressed CO2 will take 800-4000 years (depending on the ocean) to return to the surface and the atmosphere. (FG does not count this as sequestered).

Sources:

Krause-Jensen, D., Lavery, P., Serrano, O., Marba, N., Masque, P. & Duarte, C.M. (2018). Sequestration of macroalgal carbon: the elephant in the Blue Carbon room. Biology letters 14, (6):20180236.

https://royalsocietypublishing.org/doi/10.1098/rsbl.2018.0236

Broecker, W.S. (1971) A kinetic model for the chemical composition of sea water. Quaternary Research 1, 188-207.

https://www.cambridge.org/core/journals/quaternary-research/article/abs/kinetic-model-for-the-chemical-composition-of-sea-water-1/11870E7472A5B325A0D8D0C7CBC6443F

Broecker, W.S. & Peng, T.-H. (1982) Tracers in the Sea. Lamont-Doherty Geological Observatory, Palisades, N.Y., Eldigio Press.

https://www.ldeo.columbia.edu/~broecker/Home_files/TracersInTheSea_searchable.pdf

d. 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?

There are no socioeconomic risks, such as mismanagement of storage because the seaweed is sequestered shortly after harvest (usually the same or next day).

Once the seaweed reaches the ocean floor below 1000 meters there are no known natural or anthropogenic (e.g. ocean trawling) risks that the carbon will escape. The scientific consensus is that carbon from seaweed that reaches the ocean floor will be sequestered for thousands of years. Carbon from seaweed that reaches 1000 meters but not the ocean floor will remain in the water for 800 - 4000 years. FG assumes conservatively a 95 percent success rate of seaweed reaching the ocean floor.

e. How will you quantify the actual permanence/durability of the carbon sequestered by your project? 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.)

At this time FG cannot directly quantify the permanence or durability of the carbon that we sequester. Instead, we must rely on models and the consensus of the oceanographic community. FG will continue to monitor and participate in the science produced by the community. All sequestration locations will be permanently recorded. Conceivably, once we hit scale, we can partner with deep-sea research vessels to have their submersibles directly observe the condition of our sequestered seaweed bales on the ocean floor.

3. Gross Capacity (Criteria #2)

a. Please fill out the table below. **All tonnage should be described in metric tonnes here and throughout the application.**

	Offer to Stripe (metric tonnes CO_2) over the timeline detailed in the table in 2(a)
Gross carbon removal Do not subtract for embodied/lifecycle emissions or permanence, we will ask you to subtract this later	**15,120 tCO_2.**
If applicable, additional avoided emissions e.g. for carbon mineralization in concrete production, removal would be the CO_2 utilized in concrete production and avoided emissions would be the emissions reductions associated with traditional concrete production	N/A

b. Show your work for 3(a). How did you calculate these numbers? If you have significant uncertainties in your capacity, what drives those? *(E.g. This specific species sequesters X tCO_2/t biomass. Each deployment of our solution grows on average Y t biomass. We assume Z% of the biomass is sequestered permanently. We are offering two deployments to Stripe. X*Y*Z*2 = 350 tCO_2 = Gross removal. OR Each tower of our mineralization reactor captures between X and Y tons CO_2/yr, all of* *which we have the capacity to inject. However, the range between X and Y is large, because we have significant uncertainty in how our reactors will perform under various environmental conditions)*

Assumptions:

- 3,150 kg of seaweed per 150m line per year. (To be a conservative estimate, we project 10% less than 3500/kg per year experienced by Farmers in Digos and Santa Cruz).
- 50 lines per Array for CDR, plus one in reserve (and three more lines for re-seeding the Array for the following crop).
- 157,500 kg of seaweed (50 lines x 3,150kg/line) /Array/Year.
- 20 percent carbon content, based on general statements in literature and confirmed by FG's sample sent to DOST Lab (20.1%).
- **31.5 tCO_2 /Array/Year Gross** (157.5 tonnes seaweed x 20% carbon content)

- 2023: 1,260 tCO_2 from 40 Arrays (20 in Digos; 20 in Santa Cruz)
- 2024: 1,260 tCO_2 from original 40 Arrays
  12,600 tCO_2 from 400 Arrays (200 in Digos & Area; 200 in Santa Cruz & Area)
  15,120 tCO_2 from 440 Arrays

- Our offer to Stripe is **15,120 tCO_2** Gross Removal.

c. What is your total overall capacity to sequester carbon at this time, e.g. gross tonnes / year / (deployment / plant / acre / etc.)? Here we are talking about your project / technology as a whole, so this number may be larger than the specific capacity offered to Stripe and described above in 3(b). We ask this to understand where your technology currently stands, and to give context for the values you provided in 3(b).

As of March 2022, FG has installed 230 meters of lines in Alabel (Ladol) for an estimated capacity (gross) of 0.097 tCO_2/yr.

d. We are curious about the foundational assumptions or models you use to make projections about your solution's capacity. Please explain how you make these estimates, and whether you have ground-truthed your methods with direct measurement of a real system (e.g. a proof of concept experiment, pilot project, prior deployment, etc.). We welcome citations, numbers, and links to real data! *(E.g. We assume our sorbent has X absorption rate and Y desorption rate. This aligns with [Sorbent_Paper_Citation]. Our pilot plant performance over [Time_Range] confirmed this assumption achieving Z tCO_2 capture with T tons of sorbent.)*

There are three key assumptions in our projections:

1. 3,150 kg of seaweed per 150m line per year.
   - This is the consensus of farmers based on their experience of 3,500kg per 150m line per year.
   - Wisely or unkindly we have assumed a 10% discount.
   - We are confident the yield will increase as we enlist aquaculture experts from local colleges and universities to deploy and standardize best

practices across our farm operations.

2. 20% carbon content for local seaweed varieties.
    - References found in the literature did not provide any precise measurements beyond "about 20 percent."
    - We sent samples to a Department of Science and Technology Lab which confirmed an average for *Kappaphycus* of 20.1 percent.
    - We will continue to sample each harvest from each area to ensure the most accurate calculation of carbon content.

3. 95% permanent sequestration rate.
    - The Climate Foundation estimates a 99% sequestration rate for a directly comparable process (sinking baled seaweed).
    - We can afford to be more conservative.

e. Documentation: If you have them, please provide links to any other information that may help us understand your project in detail. This could include a project website, third-party documentation, project-specific research, data sets, etc.

- Company website: *https://firstgigaton.com*
- Company site for the Philippines: *https://sea.cat*
- "Impact Investment For A Business Venture For Community-Based Seaweed Farming In Northern Palawan, Philippines" *http://seaknowledgebank.net/e-library/impact-investment-business-venture-community-based-seaweed-farming-northern-palawan*
- "Explorative environmental life cycle assessment for system design of seaweed cultivation and drying" https://reader.elsevier.com/reader/sd/pii/S2211926416302946?token=33145298585E0329E61B3FBF89C14411AFC61996CF8A0B05902214090672E05F05A2FDEECAA4344DED1F949653FE155D&originRegion=us-east-1&originCreation=20220330194126

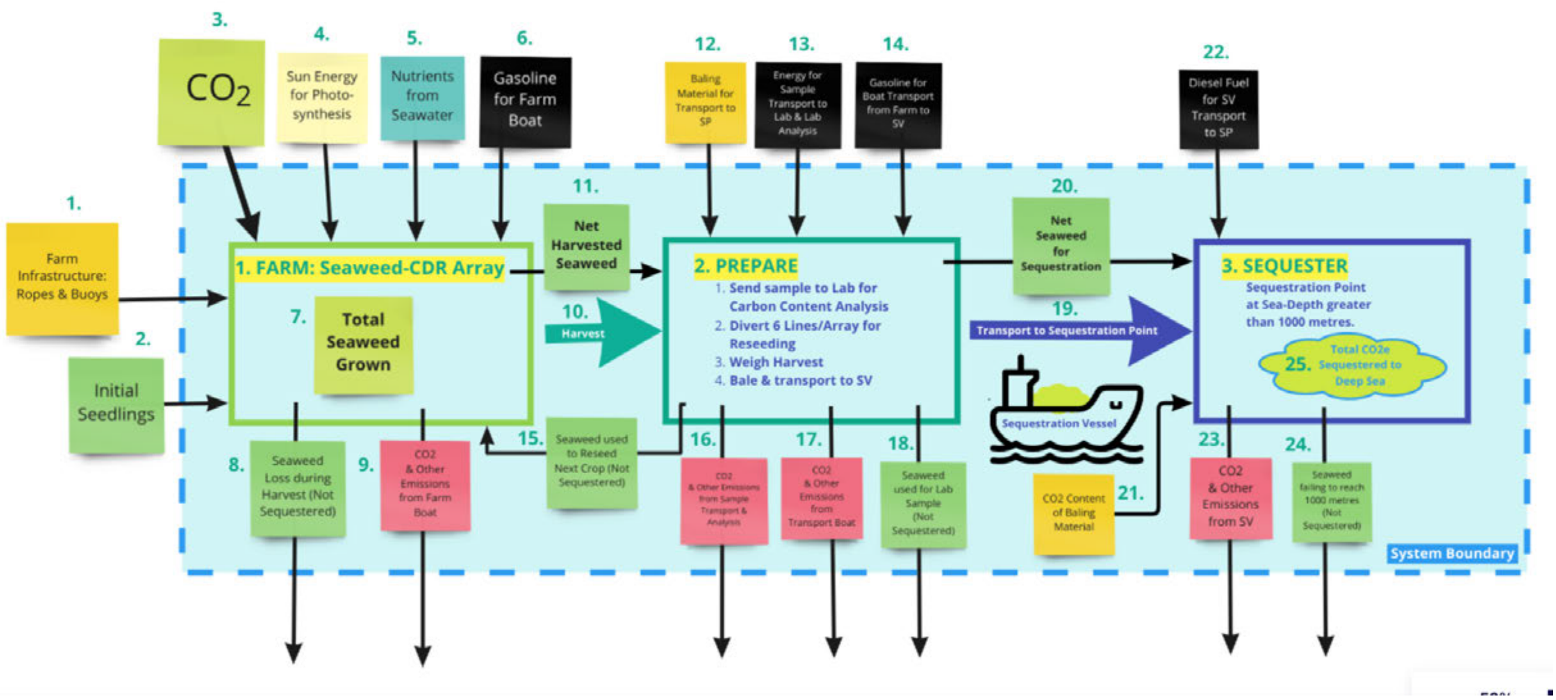
4. Net Capacity / Life Cycle Analysis (Criteria #6 and Criteria #8)

a. Please fill out the table below to help us understand your system's efficiency, and how much your lifecycle deducts from your gross carbon removal capacity.

	Offer to Stripe (metric tonnes CO_2)
Gross carbon removal	**15,120 tCO_2**
Gross project emissions	**1,678 tCO_2**
Emissions / removal ratio	**0.111**
Net carbon removal	**13,442 tCO_2**

b. Provide a carbon balance or "process flow" diagram for your carbon removal solution, visualizing the numbers above in table 4(a). Please include all carbon flows and sources of energy, feedstocks, and emissions, with numbers wherever possible *(E.g. see the generic diagram below from the CDR Primer, Charm's application from 2020 for a simple example, or CarbonCure's for a more complex example).* If you've had a third-party LCA performed, please link to it.

Process Flow Diagram - FG Seaweed-CDR Array



Process Flow Diagram for FG Seaweed-CDR Array

1. **Farm Infrastructure: Ropes & Buoys: - 0.531 tCO_2e /Array/Year**
    - Longlines = 0.006 tCO_2e/100m/Year x 8,100m/Array
    - Buoys = 0.00055 tCO_2e/100m/Year x 8,100m/Array
    - Source: "Explorative environmental life cycle assessment for system design of seaweed cultivation and drying" https://reader.elsevier.com/reader/sd/pii/S2211926416302946?token=33145298585E0329E61B3FBF89C14411AFC61996CF8A0B05902214090672E05F05A2FDEECAA4344DED1F949653FE155D&originRegion=us-east-1&originCreation=20220330194126

2. Initial Seedlings (Vegetative Cuttings from Nearby Farms).
3. Ambient CO_2 in the seawater.
4. Ambient sun energy for photosynthesis.
5. Ambient nutrients from Seawater.
6. Energy (gasoline) for farm pump boat (outriggers with small improvised outboard motors).
    - The vast majority of farmers (FG Estimate 90%) only have access to paddle outriggers which they use for farm operations.
    - As gasoline is expensive, farmers paddle when they can even when they have a motor.
    - For a conservative outcome, we assume a full 50% of Arrays use gas-powered pump boats.
    - Assume 5 litres /Array/Week (Farmer Estimate).
    - 260 litres/Array/Year x 50% of Arrays.
    - **130 litres gasoline /Array/Year for farm operations.**
    - 1 litre gasoline = 35.4MJ
    - 130 litres = 4,602 MJ /Array/Year
7. Total Seaweed Grown for CDR (50 out of 54 lines).
8. Seaweed loss (breakage, consumed by vertebrate and invertebrate fauna) during growing. (Not counted as sequestered).

9. **CO_2e Emissions from Pumpboat for operations: - 0.299 tCO_2 /Array/Year.**
    - 130 litres gasoline /Array/Year for farm operations.
    - Burning 1 litre of gasoline produces approximately 2.3 kg of CO_2. (https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/pdf/transportation/fuel-efficient-technologies/autosmart_factsheet_6_e.pdf

10. *Transition to Harvest Phase.*
11. **Harvested Seaweed: 157,500 kg = 31.5 tCO_2 /Array/Year (Gross)**
12. Bailing Twine.
13. Energy for transporting Samples to DOST Lab. (de minimus)
14. Gasoline for Pumpboat transporting Seaweed to offshore Sequestration Vessel.
    - Assuming 5 litres per Sequestration Day x 12 Days/Array/Year x 50% of Arrays. (FG Estimate)
    - 30 litres/Array/Year.
    - 1 litre gasoline = 35.4MJ
    - 30 litres = 1,062 MJ/Array/Year.
15. Seaweed from 3 lines diverted for use reseeding the following crop.
16. **CO_2e Emissions from transporting Samples to Lab.**
    - FG estimates emissions are *de minimis*.

17. **CO_2e Emissions from Pump Boat transporting Seaweed to Sequestration Vessel: - 0.069 tCO_2 /Array/Year.**
    - 30 litres/Array/Year (FG Estimate)
    - Burning 1 L of gasoline produces approximately 2.3 kg of CO_2. (https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/pdf/transportation/fuel-efficient-technologies/autosmart_factsheet_6_e.pdf

18. Seaweed used for Lab Sample (1 kg/Farm/Harvest = 12kg per year).
19. *Transition to Sequestration Phase.*
20. **Net Seaweed for Sequestration: 157,500 kg = 31.5 tCO_2 /Array/Year (Gross)**
21. CO_2e of Bailing Twine. (Sequestered but *de minimus*.)
22. Diesel Fuel for Sequestration Vessel transporting Seaweed to Sequestration Area.
    - Assuming 60km average round trip of Sequestration Vessel from home port to farm(s) (20km), to sequestration area (15km), and return to home port (25km). (FG Estimate)
    - Assume one trip per two Arrays based on Sequestration Vessel capacity of 30 tonnes (i.e. 13.2 tonnes of seaweed from each Array)
    - 60km/trip/2 Arrays = 30km/Array x 12 trips/Year = 360km/Array/Year. (FG Estimate)
    - Small barge of 30m consumes 15 litres/hour diesel-oil travelling 12kph. A 360 km trip will take 30 hours travel time and consume 450 litres/Array/Year. (FG Estimate based on http://barge-for-sale.com/Article_fuel-consumption-of-a-barge.php , https://tools.genless.govt.nz/businesses/wood-energy-calculators/co2-emission-calculator/ https://www.engineeringtoolbox.com/co2-emission-fuels-d_1085.html)
    - 1 litre of diesel-oil = 35.9MJ.
    - 450 litres/Array/Year = 16,155 MJ/Array/Year.

23. **CO_2e Emissions from Sequestration Vessel During Sequestration Process: -1.34 tCO_2/Array/Year.**
    - **450 litres Diesel (Fuel-Oil) /Array/Year.**
    - https://tools.genless.govt.nz/businesses/wood-energy-calculators/co2-emission-calculator/

24. Seaweed Failing to Reach 1000+ meters.
    - Assume a 5% Failure Rate.
    - 1.575 tonnes Seaweed /Array/Year.

25. **GROSS Seaweed Sequestered 29.925 tCO_2/Array/Year.**
    - **95% Success Rate.**

27.686 tCO_2/Array/Year NET SEQUESTERED

31.50 tCO_2e **(GROSS Sequestration/Array/Year)**
- 1.575 tCO_2e **(5% does not make it to ocean floor: 95% Successful Sequestration)**
- 0.531 tCO_2e **(Farm Infrastructure: Ropes & Buoys /Array/Year)**
- 0.299 tCO_2e **(Pumpboat emissions for Farm Ops/Array/Year)**
- 0.069 tCO_2e **(Pumpboat emissions transporting Seaweed to Sequestration Vessel/Array/Year)**

- 1.340 tCO_2e **(Sequestration Vessel emissions during Sequestration Process)**
27.686 tCO_2

c. Please articulate and justify the boundary conditions you assumed above: why do your calculations and diagram include or exclude different components of your system?

We have not included any emissions related to the initial seeding of the arrays (Item 2). The common practice is vegetative seeding where cuttings from the preceding crop are used to seed the following crop. (The juvenile seedling plants are tied to the longline). The initial seeding of each array will use juvenile plants sourced locally, most likely within the same or adjacent coop. Emissions therefore will be de minimus.

However, vegetative seeding becomes less effective over time resulting in the need for a fresh stock of seedlings from a nursery. We have no available data on emissions related to nurseries in the Philippines but plan to model this in upcoming iterations of our LCA/PFD for each Array.

We have also not included data regarding the emissions or carbon sequestered associated with the natural-fibre baling material. At our current scale, it is de minimus but will become increasingly significant as we grow. As soon as possible we will begin including it in our LCAs for each Array's harvest.

d. Please justify all numbers used in your diagram above. Are they solely modelled 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.

Each Array will have its own LCA recording all material and energy inputs in as much detail as possible for an accurate calculation of the net CDR at each harvest.

For the PFD/LCA included here, we've attempted to get the best available data for infrastructure and energy inputs. The reference cited used for infrastructure inputs (lines and buoys) offers a sound benchmark. Once we have standardized our Array design and materials suppliers we will be able to provide a more precise LCA. All new materials (e.g. for repairs) will also be recorded for each Array's own LCA.

Energy inputs, i.e., fuel for farm operations, transport to the Sequestration Vessel, and fuel for Sequestration are estimates made by the farmers and FG. Once regular operations begin, all fuel used will be measured weekly by the farmer and reported to FG where it will be recorded. Fuel used by the sequestration vessel will be measured and recorded by FG.

e. If you can't provide sufficient detail above in 4(d), please point us to a third-party independent verification, or tell us what an independent verifier would measure about your process to validate the numbers you've provided.

FG will contract a local Third Party (e.g. a Professional Engineer or Engineering Firm) to independently verify data from each Array and harvest. Data to be verified/audited includes:

- Energy Inputs from each Array recorded by the Farmer and reported to FG.
- Material inputs for the construction and repair of Arrays will be obtained and recorded directly by FG Staff.
- FG will weigh each harvest, recording and documenting it via images, video, and ultimately, IOT/mobile data connected scales.
- Carbon content analysis for each harvest will be conducted by DOST and made public.
- Calculations of net CDR will be public and audited by the Independent Third Party.

Everything will be shared with Buyers and Stakeholders, accessible from the FG website.

5. Learning Curve and Costs (Backward-looking) (Criteria #2 and #3)

We are interested in understanding the learning curve of different carbon removal technologies (i.e. the relationship between accumulated experience producing or deploying a technology, and technology costs). To this end, we are curious to know how much additional deployment Stripe's procurement of your solution would result in. (There are no right or wrong answers here. If your project is selected we may ask for more information related to this topic so we can better evaluate progress.)

a. Please define and explain your unit of deployment. (*E.g.* # of plants, # of modules)

Our unit of deployment is the "FG Seaweed-CDR Array" or "Array."

Each Array sequesters 31.5 tCO_2 /Array/Year (Gross) and 27.686 tCO_2/Array/Year (Net).

Arrays are based on the "Long-Line" design consisting of 54 lines, each line being 150 metres long and spaced 1.5 meters apart.

- 50 lines for CDR (The Seaweed will be harvested and sequestered).
- 3 lines for seedlings for the following crop.
- 1 line as a buffer to cover shortfalls in either CDR or seedlings.

This amounts to 8,100 metres of cultivated line per array. The total area covered by each array is approximately 1.2 hectares.

b. How many units have you deployed from the origin of your project up until today? Please fill out the table below, adding rows as needed. Ranges are acceptable.

Year	Units deployed (#)	Unit cost ($/unit)	Unit gross capacity (tCO_2/unit)	Notes
2024	400	**$3,600 - 4,050**	31.5 tCO_2/unit	By December 2023, 440 cumulatively, including 400 new units and 40 units from 2022. (More units may be added throughout 2024).
2023	40	**$4500**	31.5 tCO_2/unit	By December 2022.
2022	0.02	**$6000**	31.5 tCO_2/unit	As of MARCH 28, 2022. We are in the process of launching the latest Long Line design of our CDR Arrays.

c. Qualitatively, how and why have your deployment costs changed thus far? (*E.g. Our costs have been stable because we're still in the first cycle of deployment, our costs have increased due to an unexpected engineering challenge, our costs are falling because we're innovating next stage designs, or our costs are falling because with larger scale deployment the procurement cost of third party equipment is declining.*)

Our deployment costs have already been reduced substantially. Our first deployment in Ladol employed a "Fish-Cage" design due to their "turtle problem." This involved wood frames and barrels, bamboo walkways, as well as netting around the entire structure. We have learned to not deploy in areas with turtle problems. FG is now officially deploying the Longline (lines and buoys) design in relatively turtle-free Digos and Santa Cruz. Costs will further decline as we go bulk, wholesale, and then direct for our materials.

d. How many additional units would be deployed if Stripe bought your offer? The two numbers below should multiply to equal the first row in table 3(a).

# of units	Unit gross capacity (tCO_2/unit)
440 units will be deployed by December 2023. As 40 of these units will be deployed by December 2022 and operate for two full years, the operational output is **480 units** for	**31.5 tCO_2/unit**

the duration of this project.	

6. Cost and Milestones (Forward-looking) (Criteria #2 and #3)

We are open to purchasing high cost carbon removal today with the expectation the cost per ton will rapidly decline over time. We ask these questions to get a better understanding of your potential growth and the inflection points that shape your cost trajectory. 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 expect to work with you to understand your milestones and their verification in more depth. If you have any reservations sharing the information below in the public application format, please contact the Stripe team.

a. What is your cost per ton of CO_2 today?

\$485/tonne CO_2 (High/Conservative)

b. Help us understand, in broad strokes, what's included vs excluded in the cost in 6(a) above. We don't need a breakdown of each, but rather an understanding of what's "in" versus "out." Consider describing your CAPEX/OPEX blend, non-levelized CAPEX costs, assumptions around energy costs, etc.

- Array Deployment Costs (Lines, Buoys, Sandbags, Seedlings, Installation)
- Array Maintenance Costs (20% of Deployment Costs annually after deployment)
- Farm Operations (includes farmer salaries and energy costs)
- DOST Laboratory Costs (for Carbon content analysis, includes courier costs to DOST Lab)
- Sequestration Costs (Permits, Baling Twine, Vessel Charter, Fuel)
- Operational Support (FG Staff in Philippines)
- Some support for Canadian office.

c. How do you expect your costs to decline over time? Specifically, what do you estimate your cost range will be as you reach megaton and then gigaton scale? We recognize that at this point, these are speculative and directional estimates, but we would like to understand the shape of your costs over time.

\$75/tonne CO_2 at MT; <\$50/tonne CO_2 at GT.

d. Where are the primary areas you expect to be able to achieve cost declines? E.g., what are the primary assumptions and sensitivities driving your cost projection? What would need to be true for a long-term cost of <\$100/ton to be achievable with your technology? (i.e., you are able to negotiate an x% reduction in CAPEX at scale and purchase renewable electricity at \$y/kWh)

- **Array Deployment Costs:** 20 - 50% decline in costs as we go direct to suppliers with long-term purchasing contracts. At scale, an in-house seedling nursery may further reduce costs and ensure a secure supply.

- **Array Maintenance Costs:** Decline in lockstep with Deployment Costs.

- **Farm Operations:** Declines with mechanization and iterations on operational processes. Currently, we are at 2 farmers per CDR-Array (27 lines each). With very simple mechanization (planting, harvesting) we can get to at least 4 Arrays per farmer (216 lines each = **8x increase in productivity**).

- **Carbon per line:** Current projections are based on 3,150 kg per line of seaweed or 0.63 tonnes CDR per line per year or 31.5t/Array/Year (in the Philippines). With iterations on best practices, we should boost that to at least a consistent 0.7 tonnes per line or 35 tonnes per array per year.

- **Laboratory Costs:** Reduced through volume contracts, increase in farm area covered by each test, and a decline in the frequency of testing due to a growing dataset.

- **Sequestration Costs:** Decline with long-term charter contracts and then by bringing it in-house with electric (and eventually autonomous) barges or towboats. Associated energy costs will be minimized with in-house solar/wind recharging.

- **Operational Support Costs:** Directly benefit from economies of scale, increasing at a much lower rate than the growth in operations.

e. In a worst-case scenario, what would your range of cost per ton be? We've been doing a lot of purchasing over the past few years and have started to see a few pieces that have tripped people up in achieving their projected cost reductions: owned vs leased land, renewable electricity cost, higher vendor equipment costs, deployment site adjustments, technical performance optimization, supporting plant infrastructure, construction overruns, etc. As a result, we'll likely push on the achievability of the cost declines you've identified to understand your assumptions and how you've considered ancillary costs. We would love to see your team kick the tires here, too.

$500 - 685 per tonne.

The main drivers of our costs are Farm Infrastructure, Fuel, and Labour (salaries). Fuel costs for farm operations and sequestration are the most likely to increase. They would have to double current high prices to add about $60 per tonne.

Labour/salaries will only become an issue if farmers believe they can earn more from seaweed farming on their own or in another industry. Doubling their salary would add about $200 to the price. We would work hard to offset much of this by matching it with increases in productivity.

Farm infrastructure costs could increase with fuel related increases for import and transportation costs. While we will be affected, we can probably limit their impact through competitive sourcing for reductions on our current prices (retail).

f. List and describe **up to three** key upcoming milestones, with the latest no further than Q2 2023, that you'll need to achieve in order to scale up the capacity of your approach.

Milestone #	Milestone description	Why is this milestone important to your ability to scale? (200 words)	Target for achievement (eg Q4 2021)	How could we verify that you've achieved this milestone?
1	Recieve permits for sequestration for Alabel, Digos, and Santa Cruz.	FG requires the permits to sequester seaweed at sea legally. With each permit from a new community, the pressure of precedent builds on other communities to issue permits as well.	Q2 2022	FG will show the permits to Stripe and provide detailed contact information for the government body and officer (e.g. MENRO or MAO) issuing the permits.
2	Deploy 40 Arrays, 20 each in Digos and Santa Cruz.	Deployment of a minimum of 40 Arrays is needed to meet the requirements of the purchase agreement with Stripe.	Q4 2022	FG can provide photo and video proof of the Arrays, and associated permits and purchases. We will provide the contact information of local officials. Stripe can engage a local representative (at FG's expense) or fly in (at Stripe's expense) to directly observe the Arrays.
3	Deploy an additional 400 Arrays, 200 each in Digos and Santa Cruz and their adjacent communities.	Deployment of a minimum of 400 additional Arrays is needed to meet the requirements of the purchase agreement with Stripe.	Q4 2023	FG can provide photo and video proof of the Arrays, and associated permits and purchases. We will provide the

				contact information of local officials. Stripe can engage a local representative (at FG's expense) or fly in (at Stripe's expense) to directly observe the Arrays.

i. How do these milestones impact the total gross capacity of your system, if at all?

Milestone #	Anticipated total gross capacity prior to achieving milestone (ranges are acceptable)	Anticipated total gross capacity after achieving milestone (ranges are acceptable)	If those numbers are different, why? (100 words)
1	Zero Capacity. Not possible to sequester without permits.	All becomes possible with the permits.	Makes the start and scaling of operations possible.
2	0.097 tCO_2/yr	1,260 tCO_2	Scaling from 0.02 Array of one design type to 40 Arrays of another.
3	1,260 tCO_2	13,860 tCO_2	Scaling from 40 Arrays to 440 Arrays.

g. How do these milestones impact your costs, if at all?

Milestone #	Anticipated cost/ton prior to achieving milestone (ranges are acceptable)	Anticipated cost/ton after achieving milestone (ranges are acceptable)	If those numbers are different, why? (100 words)
1	Does not impact cost.	Does not impact cost.	Does not impact cost.
2	$550 - 600/tonne	$485	Changed Array design from Fish Cage to Longline.

3	$485	$388 - 460	Scaling from 40 Arrays to 440 resulting in economies of scale. Increases in productivity will decrease the cost further.

h. If you could ask one person in the world to do one thing to most enable your project to achieve its ultimate potential, who would you ask and what would you ask them to do?

John Doerr, the legendary venture capitalist and climate action champion. Doerr's book, ***Speed & Scale***, is an inspiration and solid roadmap for what must be done. We would ask John to invest in First Gigaton's Seaweed-CDR Solution. The mission would benefit from the money but immeasurably more from his wisdom and network.

i. Other than purchasing, what could Stripe do to help your project?

1. While people may try to reduce their emissions to a minimum, too many companies and individuals believe they cannot afford to "offset" their remaining carbon emissions even with a price below $100 per tonne. The solution is to get people to change their focus from their "own offsets" to what really matters: collectively removing the 10-15 GTCO2 annually required by 2050. We believe companies and individuals should be empowered to do what they can "collectively" through an affordable subscription. (If you can afford Netflix, you can afford restoring a stable climate for your grandkids). The focus is not just on minimizing their remaining emissions, but on joining with other companies and citizens to collectively remove that "first gigaton" and then collectively remove a growing share of the 15 GT per year. This is far more than the "subscribe to plant trees" apps out there as FG can show precisely how much carbon they have actually sequestered permanently each and every month. Progress toward goals can be shown for individual, as a whole collectively, and sub-divided by each member's own custom groups, such as families, schools, clubs, companies, divisions, etc. **Stripe** can help FG with the "distribution" of the subscription model by pitching it to your existing corporate customers. (Let's talk).

2. Provide a warm introduction to John Doerr.

7. Public Engagement (Criteria #7)

In alignment with Criteria 7, Stripe requires projects to consider and address potential social, political, and ecosystem risks associated with their deployments. Projects with effective public engagement tend to do the following:

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

The following questions are for us to help us gain an understanding of your public engagement strategy and how your project is working to follow the White House Council on Environmental Quality's draft guidance on responsible CCU/S 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 your 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.

> Our external stakeholders are first our Coop farmers and their families, followed by their local communities. They are located in the immediate vicinity of our farm operations (Alabel, Digos, Santa Cruz). Coops are registered and can be found through government publications. **Romeo Calo** our local Business Development Officer is a member of NAMALASA (the Ladol, Alabel Coop) and has family, political, and industry relations throughout Mindanao. His role is to connect us and liaise with Mindanao Coops and local officials from national departments as needed e.g. Bureau of Fisheries and Aquatic Resources (BFAR) and the Philippines Coast Guard (PCG).
>
> Socially and economically we have an immediate and substantial impact on our stakeholders and their community.
>
> Failure to find a buyer that pays a fair price for their seaweed puts the well-being of our coop partners' families at risk. Even when they do receive a fair price, the money earned is never above subsistence. FG provides our partners with a monthly salary paid year-round. This salary de-risks their farm operations, empowers them to feed their families without worry, grow their businesses, and secure generational prosperity.

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.*

> Alabel is in Sarangani Bay, a seascape protected under the Department of Environment and Natural Resources and its Protected Area Management Office (PAMO). On March 21, 2022, our Project Manager, **Junie Coscos** made a presentation at the **First Sarangani Bay Protected Seascape Biodiversity Conservation & Monitoring Technical Working Committee Meeting** in General Santos City. The presentation was well-received and met the approval of the scientific members. On March 27 **Romeo Calo**, our BDO and local seaweed farmers coop member met with BFAR and the PCG of the municipality of Alabel to lobby their support for a sequestration permit from MENRO. Their good relations prompted a quick offer from MENRO to host FG on their regular patrol with PCG of Sarangani Bay in order to demonstrate FG's Sequestration-At-Sea protocol. The patrol took place on April 1, 2022 just hours before we submitted this application. We are expecting our first permits shortly.

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?

> To date, we have confirmed that it is important to have a local coop member take the lead in discussions with local authorities. Separately, feedback from the coop members

indicates that our initial plan to "bag" the seaweed in burlap sacks for sequestration was deemed overkill. They suggested baling the seaweed as the types they grow are substantially denser than water and sink rapidly. Compactly baling and/or wrapping the seaweed with organic natural fibres would further enhance the seaweed's density for a rapid descent. Also, it would be easier and cheaper than purchasing burlap sacks.

d. Going forward, do you have changes planned that you have not yet implemented? How do you anticipate that your processes for (a) and (b) will change as you execute on the work described in this application?

Junie and **Romeo** will attend all open PAMO and BFAR local meetings to give regular updates on our operations. As well, there is an open invitation to PAMO, BFAR, DENR, PENRO, MENRO, PCG, and members of the scientific community to observe and participate in our farming and sequestration operations. We are also establishing partnerships with local Aquaculture Colleges offering faculty and students opportunities to participate in FG operations and research, as well as to conduct their own research. Finally, we will establish a modest budget (supplemented with grants from the Canadian government) for local projects that improve life in each of our local coop partners' wider communities. To date, we have provided a new outrigger for Ladol and support for the labourers rebuilding the local church in the form of a 25kg bag of rice for each of the ten workers. This will help feed a family of five for at least a month. (Please note: None of the carbon associated with the quarter tonne of rice was sequestered). *<100 words*

8. Environmental Justice (Criteria #7)

a. What are the potential environmental justice considerations, if any, that you have identified associated with your project? Who are the key stakeholders?

Environmental (and Climate) Justice is at the centre of FG's CDR Solution. It is a core company value that the people most impacted by climate change (the Global South) should be the first ones to benefit socially and economically from climate change solutions.

In FG's CDR Solution, it is the very families working the seaweed farms who receive the bulk of the economic returns for removing the Global North's carbon.

Our first partners are seaweed farm families on the island of Mindanao, one of the poorest regions of the Philippines. They farm seaweed to supplement and/or replace declining livelihoods from fishing. In many areas, fish stocks are depleting due to overfishing, pollution, and increasing water temperatures and acidity from climate change.

Failure to find a buyer that pays a fair price for their seaweed puts the well-being of our farm families at risk. Even when they do receive a fair price, the money earned is never above subsistence. FG provides our partners with a monthly salary paid year-round. This salary de-risks their farm operations, empowers them to feed their families without worry, grow their businesses with our investment, and secure generational prosperity.

However, as stated earlier, Climate Justice is also a good business strategy. It is the surest way to get the eager support of the farmers, their communities, and local and national authorities. We believe the speed of our progress to date is due to our strategy of letting our local partners lead the discussions of what they need from local authorities (and from us) to reap the rewards of Seaweed CDR.

b. How do you intend to address any identified environmental justice concerns?

Under a certain scale, by following environmental best practices in locating and operating farms, our environmental impact will be undeniably positive. We can expect:

- **Reduced pressure on local fish stocks** as a secure income for farmers means they can afford other sources of food and devote more time to seaweed farming.
- **Increased biodiversity** due to more food nutrients and shelter in the local marine environment from the seaweed.
- **Fish farm effluent being absorbed.** Effluent from fish farms contains high levels of waste that can endanger other aquatic life. In Ladol, our CDR array is adjacent to a fish farm. Our seaweed absorbs much of this material as nutrients, reducing turbidity and neutralizing the negative impact of the fish farm.
- **Cleaner, safer water** as seaweed absorbs zinc and cadmium from polluted waters improving the health of aquatic life and the people depending on it for food).
- **Remediation** of local eutrophic, hypoxic, and/or acidic conditions.

However, at scale, intense seaweed farming can potentially lead to alterations in the local ecosystem due to the seaweed's blocking and absorption of light and absorption of nutrients, carbon, and the kinetic energy of waves. To prevent adverse effects of operating and scaling our farms we will employ an in-house aquaculture expert to keep abreast of best environmental practices and monitor our partner farms for compliance and emerging issues. As well, we will remain in regular contact and consultation with local offices of BFAR, PAMO, and the Department of Environment and Natural Resources Municipal Office (MENRO) to ensure all best practices are followed and precautions are taken, and for early detection of emerging issues. Generally, the remedy in most cases will be to limit the size of farming arrays (e.g. half-hectare), spread them further apart, and locate them in deeper waters.

Sequestration Risks are unknown and considered unlikely until deep-sea sequestration reaches the megatonne level globally. However, depositing millions/billions of tonnes of seaweed and carbon into the Bathypelagic Zone (1000-4000m) may have unanticipated consequences. FG will follow the science and remain in regular contact and consultation with local offices of BFAR and the Department of Environment and Natural Resources, as well as with international bodies to monitor sequestration areas for possible impacts. Should negative impacts be detected, solutions may include further diversification of sequestration locations and/or "going deeper" to sequester in the Abyssopelagic Zone (4000-6000m).

9. Legal and Regulatory Compliance (Criteria #7)

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

In January, FG hired a local legal researcher to determine whether we face any legal prohibitions on sequestering seaweed in Philippine waters. Her conclusion was that there were no laws at federal or provincial levels doing so in part because seaweed does not fit the definition of pollution or hazardous materials. Her report indicated that Local Government Units, including coastal municipalities, make regulations regarding the use of the sea and its resources up to 15 km from the shoreline. (Outside of Sarangani Bay, depths from 3000m to more than 4000m occur within 15 km (9.3 miles) of the shore). Local and national regulations are enforced by the Philippine Coast Guard. Depending on the province, sequestration at sea requires a permit from the local Municipal Environment and Natural Resources Office (MENRO) or the Municipal Agriculture Office (MAO).

b. What domestic permits or other forms of formal permission do you require, if any, to engage in the research or deployment of your project? 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.

We require a permit from the local Municipal Environment and Natural Resources Office (MENRO - Sarangani Province) or the Municipal Agriculture Office (MAO - Davao Province). **We demonstrated our sequestration process to MENRO-Alabel and anticipate receiving our Permit in early April 2022.** This will allow us to sequester seaweed in an area that is physically outside Sarangani Bay but still within the jurisdiction of Alabel Municipality and Sarangani Province. Receiving the permit will also set a precedent for other communities to follow Alabel's example and also issue permits.

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?

Initially, the FG Model involves sequestration only within the territorial waters of our partner farms, which currently are the territorial waters of the Philippines under the jurisdiction of municipalities and provinces (e.g. Alabel Municipality and Sarangani Province). As we scale beyond the Philippines and other countries that qualify as "Proximate Offshore Sequestration," we will need to sequester in international waters. In those cases, we will comply with international legal regimes such as the London Protocol. At this time, it appears the London Protocol is not an obstacle, but we will monitor the situation as it evolves and join with our "offshore" colleagues in lobbying for acceptance of sequestering in international waters.

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.

Given our received legal opinion and the legal precedent of receiving a sequestration permit from MENRO- Alabel, Sarangani office, we anticipate other jurisdictions (e.g. Digos and Santa Cruz) will quickly follow suit. However, it does remain up to the jurisdiction of local municipalities, so it cannot be guaranteed. This underscores the need to enlist our local partner coops in lobbying/applying for sequestration permits from their own communities. As more municipalities come on board, those that initially refuse will be under increasing pressure to reconsider.

e. Has your CDR project received tax credits from any government compliance programs to-date? Do you intend to receive any tax credits during the proposed delivery window for Stripe's purchase? If so, which one(s)? (50 words)

No Tax Credits are anticipated. However, we will apply for funding from the Canadian Government's CIDA for international development projects for assistance with deploying and scaling operations. In addition, we will help local organizations apply for CIDA grants for community projects (e.g. water towers, sanitation systems) that are separate from FG operations but will have a meaningful and lasting impact on our Coop Partners' wider communities. https://www.international.gc.ca/world-monde/funding-financement/funding_development_projects-financement_projets_developpement.aspx?lang=eng

10. Offer to Stripe

This table constitutes your offerill form the basis of our expectations for contract discussions if you are selected for purc to Stripe, and whase.

	Offer to Stripe
Net carbon removal *metric tonnes CO_2*	**13,442 tCO_2** *Should match the last row in table 4(a), "Net carbon removal"*
Delivery window *at what point should Stripe consider your contract complete?*	**January 2023 - December 2024**
Price ($/metric tonne CO_2) ***Note on currencies:*** *while we welcome applicants from anywhere in the world, our purchases will be executed exclusively in USD ($). If your prices are typically denominated in another currency, please convert that to USD and let us know here.*	**$485 per tonne for Phase 1 (2023).** **$485 or less per tonne for Phase 2 (2024).** *This is the price per ton of your offer to us for the tonnage described above. Please quote us a price and describe any difference between this and the costs described in (6).*

Application Supplement: Biomass

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

Feedstock and Physical Footprint (Criteria #1)

1. What type of biomass does your project rely on?

FG and our partner farms cultivate three types of seaweed endemic to the Philippines: ● *Kappaphycus striatum* ● *Kappaphycus alvarezii* ● *Eucheuma spinosum*

2. Are you growing that biomass yourself, or procuring it, and from whom?

First Gigaton is growing the seaweed in partnership with seaweed farm cooperatives in the Philippines. FG contracts our Partner Cooperatives to grow seaweed for CDR exclusively on our behalf. (They may grow seaweed for other purposes in separate farm arrays). FG receives the full harvest of Seaweed for CDR in return for providing each Cooperative with ○ Funding to establish a series of "one-hectare" (108 lines x 100 m/line) Seaweed-CDR Growing Arrays. ○ A monthly payment (year-round) to the Coop or farmer based on the number of CDR Arrays/Hectares under cultivation. ○ Funding for seedlings when needed. ○ Funding for fuel, maintenance, repair, and upgrades (e.g. as we mechanize operations). ○ Training in best practices. ○ Production bonuses. ○ Regular project support for the Coop's local community. At each harvest, FG takes possession of the seaweed. We weigh it, sample it for carbon content, and sequester it at ocean depths greater than 1000 metres.

3. Please fill out the table below regarding your feedstock's physical footprint. If you don't know (e.g. you procure your biomass from a seller who doesn't communicate their land use), indicate that in the table.

	Area of land or sea (km^2) in 2022	Competing/existing project area use (if applicable)
Feedstock cultivation	0.0025 km^2 (0.25 hectare) in March 2022.	

	0.48 km² (48 hectares) by December 2022. 5.28 km² (528 hectares) by December 2023.	
Processing	Approximately 0.005km² (1000 m²) on the shoreline of the farm area.	
Long-term Storage	Unknown as it is on the ocean floor dispersed at a different location for each sequestration and spread over at least one square kilometre.	

4. Imagine, hypothetically, that you've scaled up and are sequestering 100Mt of CO_2/yr. Please project your footprint at that scale (we recognize this has significant uncertainty, feel free to provide ranges and a brief description).

	Projected # of km^2 enabling 100Mt/yr	**Projected competing project area use (if applicable)**
Feedstock cultivation	**40,000km^2** Or just 0.08 percent of the 48 million km2 of ocean area identified as capable of supporting seaweed aquaculture (Froehlich, 2019).	
Processing	At such an industrial scale, each farm will be sizeable and thus processing the seaweed on rafts on the water would be more efficient.	
Long-term Storage	Unknown as it is on the ocean floor dispersed at a different location for each sequestration and spread over at least one square kilometre.	

Permanence, Additionality, Ecosystem Impacts (Criteria #4, #6, and #7)

5. How is your biomass processed to ensure its permanence? What inputs does this process require (e.g. energy, water) and how do you source these inputs? (You should have already included their associated carbon intensities in your LCA in Section 6.)

FG's Seaweed is baled fresh at harvest (without drying) and sequestered shortly afterward. The seaweed is transported to shore for baling and then out to the sequestration vessel. Material inputs are limited to natural fibre baling material. Energy inputs are limited to fuel consumed by the pump boats (if used) and the sequestration vessel traveling from home port to farm(s), to sequestration area, and back to home port. As we scale, farm pump boats, and eventually sequestration vessels, will be converted to battery electric and recharged using solar and wind.

6. (Criteria 6) If you didn't exist, what's the alternative use(s) of your feedstock? What factors would determine this outcome? *(E.g. Alternative uses for biomass include X & Y. We are currently the only party willing to pay for this biomass resource. It's not clear how X & Y would compete for the biomass resources we use.* OR *Biomass resource would not have been produced but for our project.)*

The seaweed we grow for CDR is 100% "additional" as our growing arrays are newly constructed and deployed exclusively for FG's Seaweed-CDR. Local farmers and their coops are contracted to grow the seaweed on our behalf. They may grow seaweed for other purposes such as food, fertilizer, and industrial additives, but they must use their own separate arrays.

7. We recognize that both biomass production and biomass storage can have complex interactions with ecological, social, and economic systems. What are the specific negative impacts (or important unknowns) you have identified, and what are your specific plans for mitigating those impacts (or resolving the unknowns)? *(200 words)*

Environmental risks include:

- Biodiversity impacts due to seaweed monocultures.
  - This can be managed by ensuring our Partner Farms are diligent in using a variety of only endemic seaweed species.
- Local impacts on biodiversity due to the sheer volume of cultivated seaweed such as alterations in the local ecosystem due to the seaweed's blocking and absorption of light and absorption of nutrients, carbon, and the kinetic energy of waves.
  - This can be managed by diversifying locations, requiring larger distances between smaller CDR Arrays, and limiting the size of operations over a given area (i.e. limiting the number of hectares of operations per kilometre of coastline).
- Disruption of local seawater temperature and chemistry due to very high volumes of cultivated seaweed.
  - FG will work with BFAR and PAMO to monitor local seawater and follow their recommended remedies, which likely would include rotating the

locations of CDR Arrays as needed.

- Unknowns include the impact of depositing millions/billions of tonnes of seaweed and carbon into the Bathypelagic Zone (1000 - 4000 metres).
  - FG will follow the science and partner with local (BFAR, PAMO, Department of Environment and Natural Resources, MENRO, PENRO), and national and international bodies to monitor sequestration areas for possible impacts.
  - Should hazardous impacts be suspected or detected, solutions may include further diversification of sequestration locations and/or "going deeper" to sequester in the Abyssopelagic Zone (4000 - 6000 metres). The Abyssopelagic Zone is within 15 km of parts of Mindanao's shoreline (and occurs across 83% of the total area of the ocean).

8. Biomass-based solutions are currently being deployed around the world. Please discuss the merits and advantages of your solution in comparison to other approaches in this space.

FG's Seaweed-CDR is "one month and done" month after month. This is in stark contrast to the years or decades it takes trees to grow, and even contrasts with the six to eight months it takes kelp to reach peak carbon capture.

Each hectare of FG's Seaweed-CDR Arrays continually capture carbon year-round, indefinitely. The carbon capture of trees and forests slows and even reverses with age. Trees and forests are also under the constant threat of complete reversal from wildfires, lethal diseases and pests, and human encroachment.

One could assume offshore macroalgae solutions hold an advantage of the "unlimited area" for expansion in the oceans. However, the low-hanging fruit of FG's Nearshore Seaweed-CDR has the potential to reach 1 GT of CDR annually *and still use less than one percent* of the 48 million km2 of ocean area identified as capable of supporting seaweed aquaculture (Froehlich, 2019).

The trade-off offshore macroalgae solutions make for "limitless expansion" instead results in substantial engineering challenges from:

- Rough offshore weather.
- Deficient offshore nutrient supply impacting growth rates.
- Autonomous operations and offshore maintenance.

In contrast, FG's absence of engineering challenges means

- No delays from slow seasonal R&D, technical setbacks, complex construction needs, or supply chain issues for technical components.
- No engineering, factory, or construction cost overruns.
- FG's CDR capacity directly increases as money comes in, i.e. instead of having to research and develop new technology, we install new CDR Arrays (lines in the water) at existing and new locations.
- Without interrupting or delaying our CDR ops, FG can conduct ongoing,

on-site research to optimize the carbon yield of each array and the productivity of each farm partner.

Most importantly FG's Seaweed-CDR provides for direct, verifiable measurement of captured carbon.

- Tree-planting and offshore macroalgae must rely on models, theories, and assumptions with no actual measurement or verification.

Moreover, offshore solutions do not deliver any of the additional environmental benefits of nearshore Seaweed-CDR. When done right, nearshore solutions deliver reduced pressure on local fish stocks, increased biodiversity, cleaner safer seawater as fish farm effluent and heavy metal pollution are absorbed by the seaweed, and the remediation of local eutrophic, hypoxic, and/or acidic conditions.

Finally, FG's Seaweed-CDR is the only solution we know that simultaneously delivers effective climate justice with the potential to directly improve the generational well-being of millions of families.

Application Supplement: Ocean

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

Physical Footprint (Criteria #1)

1. Describe the geography of your deployment, its relationship to coastlines, shipping channels, other human or animal activity, etc.

> Typically, seaweed farms are in the intertidal zone and rarely in water deeper than ten metres. Our seaweed farming occurs nearshore in areas designated by local environmental officials to be safe from interfering with and interference from local fauna and human activity. It is also in our best interest to avoid farming in areas with turtle problems to avoid the extra costs of keeping the turtles away from our seaweed.
>
> Similarly, sequestration zones will be designated by local authorities. In all cases, they will be at depths greater than 1000 metres, away from migratory routes, onshore currents and upwelling, and usually within 15 km of the shore to be within the regulatory jurisdiction of the responsible authority.

2. Please describe your physical footprint in detail. Consider surface area, depth, expected interaction with ocean currents and upwelling/downwelling processes, etc.
   a. If you've also filled out the Biomass supplement and fully articulated these details there, simply write N/A.

> N/A

3. Imagine, hypothetically, that you've scaled up and are sequestering 100Mt of CO_2/yr. Please project your footprint at that scale, considering the same attributes you did above (we recognize this has significant uncertainty, feel free to provide ranges and a brief description).
   a. If you've also filled out the Biomass supplement and fully articulated these details there, simply write N/A.

> N/A

Potential to Scale (Criteria #2 and #3)

4. Building large systems on or in the ocean is hard. What are your core engineering challenges and constraints? Is there any historical precedent for the work you propose?

Based “nearshore,” FG’s Seaweed-CDR Solution is probably the easiest in the world from an engineering perspective. It’s lines and buoys, with a CDR Protocol. More lines mean more CDR. There are no engineering constraints or challenges comparable to “offshore” solutions. Our farming partners have literally been doing it for years/decades/generations.

However, FG is proposing to rapidly “industrialize” Philippine seaweed aquaculture to achieve one megatonne of CDR per year by 2030. This require scaling Philippine seaweed aquaculture tomore than four times its current size. It is a monumental challenge, but there is historical precedent in that Indonesia rapidly industrialized its seaweed aquaculture. In a very short time, Indonesia surpassed the Philippines to become the second-largest seaweed producer after China. We are studying how Indonesia achieved this. FG will modify the Indonesian model to apply it to the Philippines in ways that deliver rapid industrial-level scaling with environmentally beneficial outcomes and climate justice.

Externalities and Ecosystem Impacts (Criteria #7)

5. How will you quantify and monitor the impact of your solution on ocean ecosystems, specifically with respect to eutrophication and alkalinity/pH, and, if applicable, ocean turbidity?

FG is already working closely with local environmental authorities and stakeholders, including Protected Area Management Offices, Bureau of Fisheries and Aquatic Resources, Municipal and Provincial Environmental Resources Offices, and the Philippine Coast Guard. Together, we will monitor the environment around our farms and sequestration areas to prevent negative impacts, and ensure that if they occur, they are detected and dealt with immediately.