Nitricity 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

Nitricity Inc.

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

Fremont, California and Muscle Shoals, Alabama

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

Nico Pinkowski & Motahare Athariboroujeny

Brief company or organization description

Nitricity distributes and electrifies the production of fertilizer. We are commercializing a breakthrough technology that produces fertilizer using only air, water, and renewable energy.

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.

We propose building (or retrofitting) NPK fertilizer factories to draw down CO2 from the atmosphere and permanently store the carbon in the form of calcium carbonate (limestone). This process leverages a unique property of nitrophosphate (nitrogen and phosphate) solutions and the well-characterized process called the 'carbonization of nitrophosphoric acid'. This fertilizer approach has been validated thoroughly since the 1960's and implemented in fertilizer plants in Norway, Czechoslovakia, and

[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.

Alabama. At its core, this process may accelerate the adoption of green fertilizer technologies - a 2.8 gigaton/yr global opportunity accounting for all fertilizer emissions.

A summary of the *green carbonization of nitrophosporic acid:*

STEP 1: turn air, water, and sunshine into ammonia (NH_3) and nitric acid (HNO_3) - two fertilizer feedstocks. While not the subject of this grant, the central focus of our startup Nitricity is to manufacture fertilizer using renewable energy rather than natural gas.

Figure 1. A representative Nitricity solar-fertilizer project that manufactures carbon-free fixed nitrogen.

STEP 2: Combine nitric acid with rock phosphate ($Ca_3(PO_4)_2$). Rock phosphate is a naturally occurring non-carbonate form of calcium. Rock phosphate is mined in large quantities globally for its phosphate content and it is an essential macronutrient needed for plant growth. Acidulating rock phosphate with nitric acid forms a liquid nitrophosphoric acid solution containing calcium nitrate ($Ca(NO_3)_2$) and phosphoric acid (H_3PO_4) .

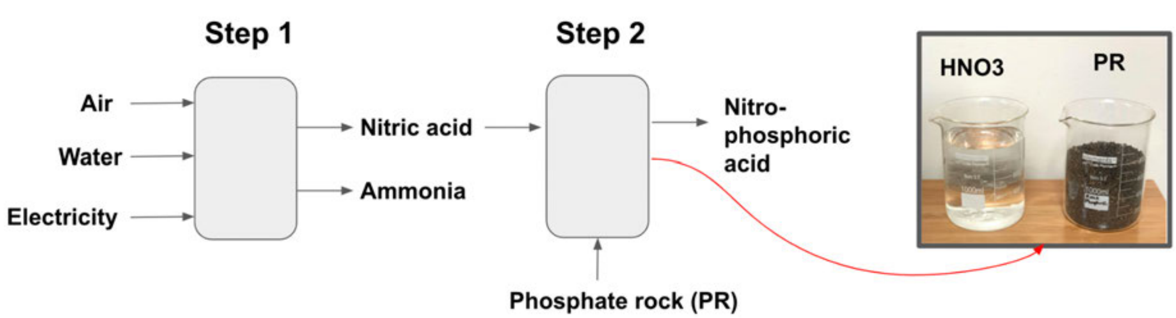


Figure 2. The first two steps in the CO2-sequestration process showing the preparation of the essential nitrophosphoric acid.

STEP 3: Third, add water (H_2O), ammonia (NH_3), and 1-80% CO_2/air. The CO_2/air stream will react with the calcium to make solid-form **calcium carbonate ($CaCO_3$)** that will precipitate out of the solution.

STEP 4: Filter out the solid-form limestone from the reactor vessel. The calcium carbonate will be set aside for permanent storage on land or in the ocean. The remaining fertilizer solution will contain diammonium phosphate (DAP - $(NH_4)_2HPO_4$) and ammonium nitrate (AN - NH_4NO_3).

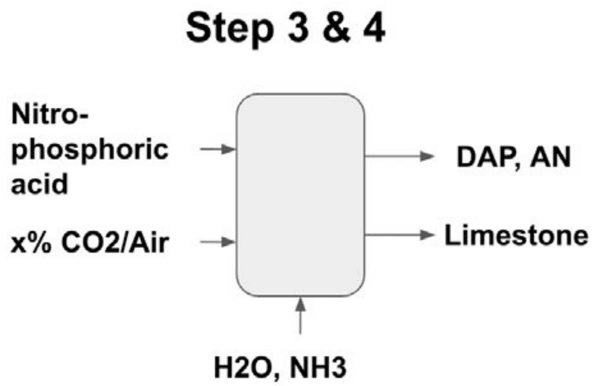


Figure 3. The combination of nitrophosphoric acid, a stream of CO_2 diluted in air, water, ammonium come together to make diammoium phosphate (DAP), ammonium nitrate (AN), and limestone.

STEP 5 (optional): add in KCL to make a full NPK - N (nitrogen), P (phosphorous), and K (potassium) - fertilizer. Representative images of the final fertilizer products (separate and combined) are shown below.

The result of the nitrophosphate process will be two-fold: first, the products are upcycled from low-cost, low-quality feedstocks (nitric acid, ammonia, rock phosphate, potash) to high-quality, high-price final products. Secondly, the process will permanently sequester the CO_2 as limestone. This process has the opportunity to be highly cost effective. The process itself increases the value of the end product, and can sell credits on sequestering CO_2.

DIFFERENTIATION: This process involves the carbonization of nitrophosphoric acid, which is a 60-yr known technique in the fertilizer industry. Nonetheless, there are several fundamental differences between this proposal and anything that has been attempted previously. (1) we are proposing the use of carbon-free nitrogen feedstock inputs (ammonia and nitric acid) manufactured using air, water, and renewable power. (2) We propose the use of CO_2 from Direct Air Capture (DAC) rather than CO_2 from the burning of fossil fuels in the production of ammonia or nitric acid. (3) Previous processes implementing the carbonization of nitrophosphoric acid have used 100% CO_2. This proposal will explore the use of lower concentration streams of CO_2, ranging from 400 ppm to 99% CO_2 diluted in air. It is known that this process can use lower CO_2 streams than 99%, but the lower limit is unknown. DAC of CO_2 at such low concentrations needs substantially less energy than 100% concentrated mixtures.

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.

5 - Nitricity has never directly performed this chemistry. However, this process has been done at scale in the 1960s in multiple locations around the world. This process can be found in numerous historical fertilizer textbooks and from intellectual property filings from 60 years ago. There are numerous expired patents and process designs referring to the carbonization of a nitrophosphoric acid solutions. This fertilizer chemistry has been extensively explored and de-risked.

Ref 1 - link

Ref 2 - link

Ref 3 - link

Ref 4 - link

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?
Concentration of CO_2 in air to be used	100%	400 ppm up to 99% will be tested	Nitrophosphoric acid is a highly energetic mixture. Furthermore, this mixture will not react with anything in the air except for CO_2.
maximum foam volume (MFV)	uncharacterized	___	Bubbling low-concentration CO_2 through a nitrophosphoric acid solution is possible and will sequester CO_2. However, a common challenge to be aware of in phosphoric acid plants is mixture foaming. This is solved through the use of anti-foaming agents. While 5% CO_2 (or even 400 ppm) in air may react when bubbled through a nitrophosphoric acid solution, the solution may foam to a degree that makes such low concentrations unfeasible. Measuring and characterizing the MFV provides practical limits to the process design. Alternatively, this will help track the amount of anti-foaming agents that need to be used.

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?

Dr. Motahare Athariborougeny has a Ph.D. in chemical engineering and is the lead process engineer on Nitricity's innovative nitrogen fixation systems. Dr. Athariborougeny has coordinated with many of Nitricity's third party partners to scale up our systems and make them ever more efficient. She has been a mentor for many of our team members and has been instrumental in successfully executing multiple projects at the company including NSF grants to improve absorption efficiency and process design of a pilot plant system to be operational next year.

Dr. Joshua McEnaney is the President and CTO of Nitricity Inc. Josh received his Ph.D in Chemistry from the Pennsylvania State University developing novel nanocatalyst materials for water electrolysis. He continued his studies as a Postdoctoral Researcher at Stanford University, developing several new nitrogen fixation and conversion technologies. Josh is driven to work on sustainable technologies, particularly with respect to climate change, to preserve our planet for future generations. He believes Nitricity provides an outstanding opportunity to mitigate up to gigaton scale global emissions.

Dr. Nico Pinkowski is co-founder and CEO of Nitricity. Prior to Nitricity, Nico received a PhD in Mechanical engineering (energy systems) from Stanford.

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
International Fertilizer Development Center Pilot Plant	Nitrophosphate expert and pilot plant operator	Host site for phosphate testing. Staff for running tests. Consultations for fast development. *Discussing potential collaboration*

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?

5 years. We are building a 3-tpd nitric acid system in Summer of 2023, and will add a system to perform this process. This should be fully operational in Winter of 2024. With results of a successful pilot scale system, we will aim to build a full plant within the following 2 years. Years of CDR will occur after the end of this initial project.

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.

Phase I - Jan 2023 - Aug 2023 - CO2 sequestration with varying concentrations of CO2/air tested in nitrophosphoric acid solutions. Lock in optimal concentration and source of CO2.

Phase II - Sept. 2023-Sept. 2024 - Pilot-scale sequestration of CO2 in solution.

Phase III - plant retrofit or new-build construction at scale. This retrofit will take 2 years.

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	1 ton
2024	3 tons
2025	0.1 MMT/yr
2026	1 MMT/yr
2027	5 MMT/yr
2028	10 MMT/yr
2029	15 MMT/yr
2030	40 MMT/yr

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	CO2 concentration and source determination	Aug. 2023
2	First ton	Sept. 2024.

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

<200 words

Our IP strategy involves a strategic mix of patents and trade secrets. We have patents and provisional patents on the overall process, subsystems, as well as key components to allow the system to work well. Several provisional patents are not yet publicly available, but here are our publicly available patents:

US20210360847A1 - Device and method for combined generation and fertigation of nitrogen fertilizer

US20210331135A1 - Systems and processes for producing fixed-nitrogen compounds

WO2021247589A1 - A device and method for combined generation and fertigation of nitrogen fertilizer

k. How are you going to finance this project?

We expect to finance this project with a combination of Frontier funding and cash-match SAFE notes, contingent on acceptance of this application. Nitricity will approach several of our existing investors (for example Lowercarbon capital) for matching the funds. The nitric acid production system on the front end will be financed via a federal grant or prior VC equity capital.

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.).

No, however, we are keenly interested in creating carbon offsets via the N2O emissions reduction associated with both our production process versus the industrial Ostwald process, and with reductions in N2O field emissions from the application of our more climate-smart fertilizers versus ammoniacal, highly emitting fertilizers. Any assistance here would be appreciated!

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

Sale of climate-smart nitrophosphate products. This process converts low-value fertilizer feedstock into high-value finished fertilizers. The revenue source will be from the sale of ammonium nitrate, diammonium phosphate, and NPK (nitrogen, phosphorous, and potassium) fertilizer blends. This project is highly profitable without the carbon credits. The carbon credits can increase plant margins.

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

Risk	**Mitigation Strategy**
Chemical processing (new process inputs and safety)	Work with IFDC, experts in fertilizer production with a pilot plant designed to mitigate risks of new processes.
Plasma scaleup	Applying to other grants and VC funding to assist with this and achieve a functional product as quickly as possible
Supply chain issues	There are significant delays in many global supply chains currently, however, we are already identifying long lead time items for our system, and ordering them in advance.

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?

This process results in the production of limestone from CO2, which is stable and permanent storage.

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?

Will will need to ensure that the limestone is not used in the production of cement or another industrial process.

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	1.9-3.5 tpd of CO2 for every tpd of Nitricity's HNO3. Nitricity is planning on production of 100 tpd of N or 450 tpd of HNO3 which leads to use of 850-1600 tpd of CO2.
Describe how you calculated that value	For the proposed process, the HNO3/Ca3(PO4)2 ratio of 6:1 is proposed to ensure the formation of water soluble reaction products in the acidulation step. The conversion of acidulation effluent is affected by the mole ratio of CO2/H3PO4. This process is operable at any CO2 content. However, it is proposed to maintain the CO2/H3PO4 between 8 and 15. For every ton per day of produced Nitric acid in Nitricity's process, between 1.9 and 3.5 tpd of CO2 is required to produce calcium carbonate.

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.

0 - Nitricity has not sequestered CO2 from this process to date.

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.

> **First (mitigation):** There is a 2.8 gigaton CO2eq mitigation opportunity (>6% of global emissions) in the production, distribution, and application of nitrogen fertilizer. Nitricity's process addresses all three avoided emission opportunities, by producing fossil-free fertilizer near the point of use which has significant potential to decrease N2O field emissions.
>
> **Second (nitrous oxide):** Furthermore, this process and credits would incentivize the production and further use of high quality fertilizers that are shown to reduce field-based N2O. For example ammonium nitrate leads to substantially less N2O from fields than ammonia.
>
> **Third (sequestration)**: On top of the incentives and decarbonization of the nitrogen fertilizer landscape, the processing of rock phosphate in the proposed strategy leads to direct sequestration (drawdown) of 100+ MT CO2/year.

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.

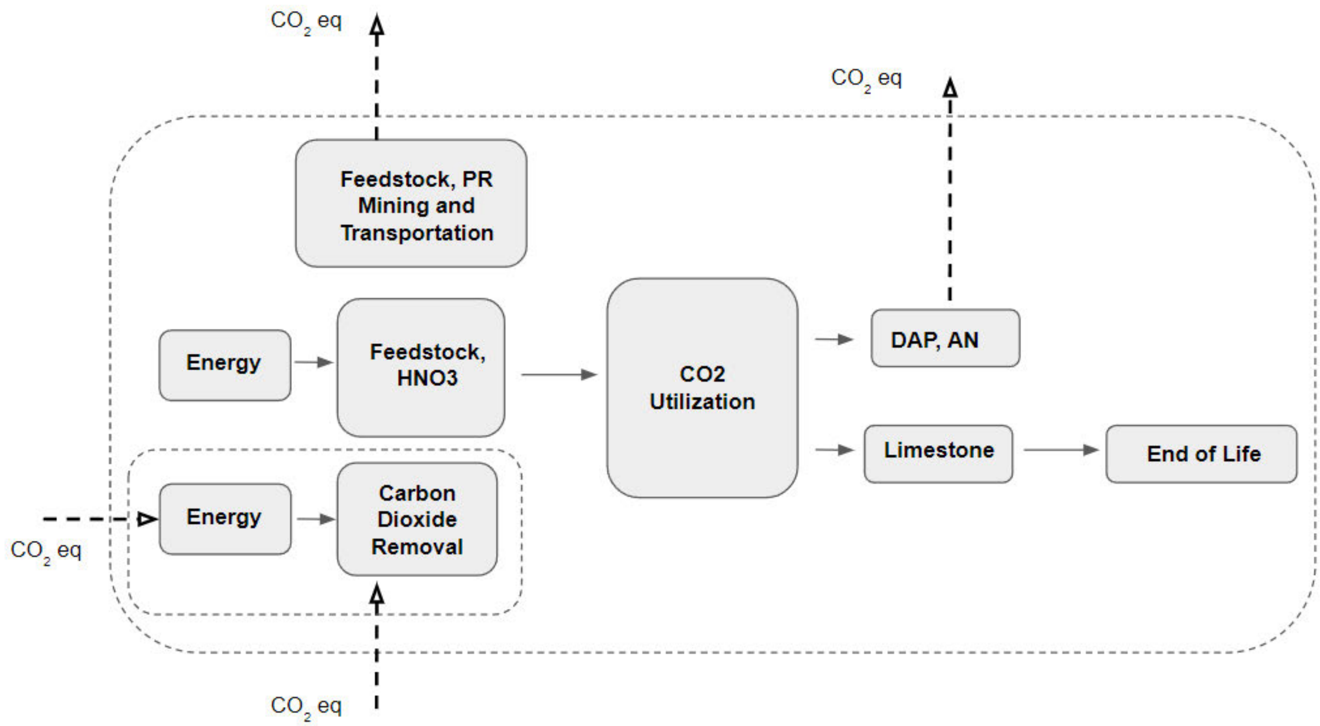
Gross project emissions over the project timeline *(should correspond to the boundary conditions described below this table)*	Zero. This process is not projected to emit any CO2eq to the environment. Further studies are required to understand the gross emission during rock phosphate mining of specific sources and use of the final fertilizer products.
Emissions / removal ratio *(gross project emissions / gross CDR–must be less than one for net-negative CDR systems)*	Zero
Net CDR over the project timeline *(gross CDR - gross project emissions)*	850-1600 tpd of CO2

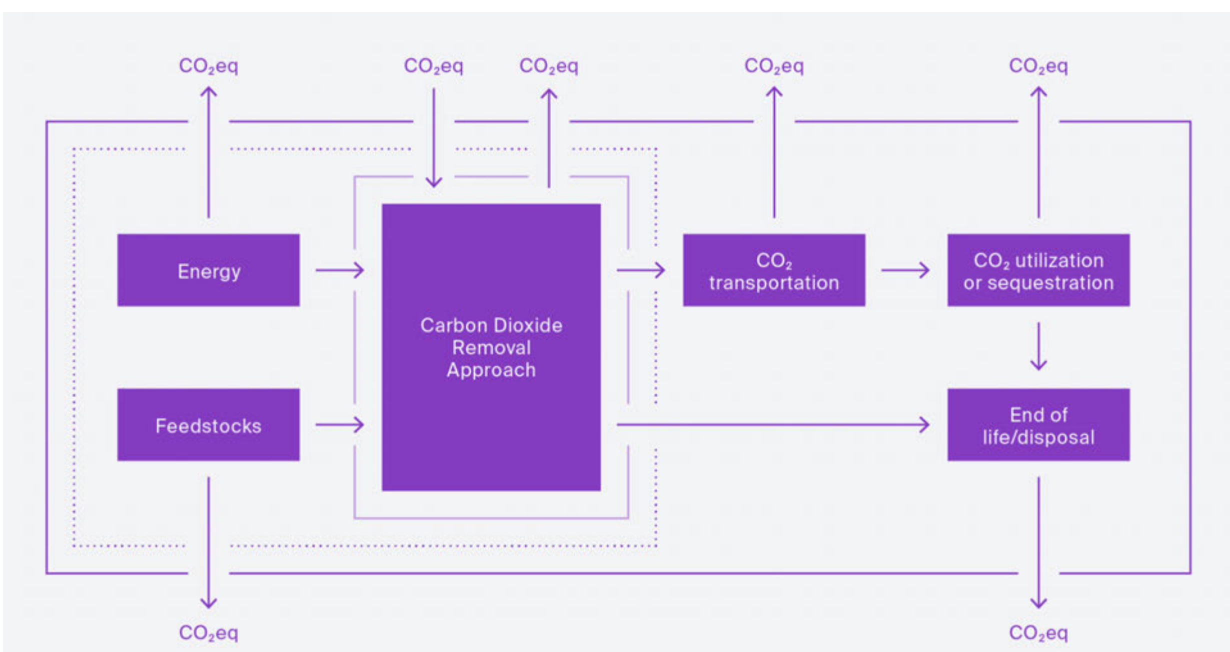
e. Provide a process flow diagram (PFD) for your CDR solution, visualizing the project emissions numbers above. This diagram provides the basis for your life cycle analysis (LCA). Some notes:

- 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.





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?

Nitricity uses renewable power to produce nitric acid, or uses carbon-free feedstock for this process. Depending on the concentration of CO2 required for this process, energy required for DAC substantially decreases. Depending on the source where rock phosphate is mined, various processes might be used for processing the rock phosphate. Beneficiation processes such as crushing and grinding does not produce any emission. Depending on the organic content of the rocks, drying or calcination might be necessary. Emissions from the drying step, if necessary, should be taken into account. Application of the produced fertilizers might contribute to N2O field emissions. The limestone produced in this process will be permanently stored and does not emit any CO2.

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.**
Feedstock production, HNO3	Zero	"Solar on-farm fertilizer production for subsurface-irrigated tomatoes" 142f34_bc5fa8b90ac647dab4b0d794c8828b03.pdf (nitricity.co)
Feedstock, Phosphate Rock	Zero	AP-42, CH 11.21: Phosphate Rock Processing (epa.gov)
Limestone storage	Zero	Carbon Sequestration via Mineral Carbonation: Overview and Assessment (mit.edu) Newall P.S., S.J. Clarke, H.M. Haywood, H. Scholes, N.R. Clarke, P.A. King, and R.W. Barley, CO2 Storage as Carbonate Minerals, IEA Greenhouse Gas R&D Programme Report IEA/PH3/17, February (2000)
CO2eq released from applying Fertilizers	Nitricity will mitigate 1800 tpd of CO2eq for every tpd of N compared to application of traditional fertilizers.	AN and DAP each produce 4 lb of CO2 eq per lb of N (Which comes from N2O release when applying these fertilizers). In this process for every mole of calcium phosphate (from rock phosphate), 1 mole of DAP and 1 mole of AN is produced. If these fertilizers are produced from this process, 1800 tpd of CO2eq can be mitigated.

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.

> Nitricity will provide equipment to produce nitric acid as well as deliver fertilizer products to its partner, IFDC, who is an expert in fertilizer research and has extensive background in fertilizer chemistry. The ratio of $HNO3/Ca3(PO4)2$ for acidulation of rock phosphate is easily quantifiable. The amount and concentration of CO2 needed to react with acidulation products will also be determined by IFDC.
>
> This process to produce calcium carbonate and NPK fertilizers does not release any CO2 to the environment as the unreacted CO2 can be recycled back to mix with acidulation products.
> Nitricity will work with partners (IFDC) to determine the CO2eq emission of produced fertilizers versus commercially available fertilizers produced from Haber-Bosch processes, which use natural gas to produce ammonia or nitrogen based fertilizers.

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
>
> The sequestered CO2 will be permanently stored as limestone. Storage silos or domes are commonly used to store limestone. Design and structure of lime silos or domes, which will be taken into considerations, could easily guarantee the safety, anti-corrosion and air tightness of these storage solutions. Reaction of CO2 to form highly stable, environmentally benign, and non hazardous carbonate compounds greatly reduces or eliminates concerns about increased ocean acidity, leakage from geologic reservoirs to human water supplies or the atmosphere, and safety.

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.
Materials	Uncertainties remain related to the mining and preparation of Phosphate rock from different sources and relevant emissions. Uncertainties remain related to the concentration and amount of CO2 as well as phosphate rock needed for limestone production.
Transportation	Uncertainties remain related to transportation of calcium carbonate to storage sites.
Energy	If low-concentration CO2/air can be used for this process, significant energy decrease for DAC is projected. Uncertainties remain related to the energy required for DAC.

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?

> 10%

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.?

> This project will help quantify the amount and percentage of CO2/air required to complete production of limestone from rock phosphate and nitric acid. This project will determine the grade of rock phosphate (the concentration of X) and its effect on CO2/air use required processes for rock phosphate preparation/transportation.

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)?

Nitricity's NPK fertilizer factories draw down CO2 from the atmosphere and permanently store the carbon in the form of calcium carbonate (limestone). Nitricity partners with a third party supplier and construction companies for design and construction of limestone storage sites.

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).

40 - 100 \$/tonne CO_2

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

The nitrophosphate process as defined above is profitable without carbon credits. It would make sense to dispose of the calcium carbonate if the price per ton covers tipping fees and transport. At 100 \$/ton, the value of carbon sequestration would be about 10% of the value of outputs less the cost of inputs (the basic value proposition). While we are unable to obtain a detailed cost breakdown at this time, we expect the capital needs of a nitrophosphate plant to be on the order of \$10 million and that this could be financed as a typical chemical plant. In the table below, we consider the changes from what a typical design would be to accommodate carbon capture, essentially just the cost to dispose of the calcium carbonate (tipping fees)

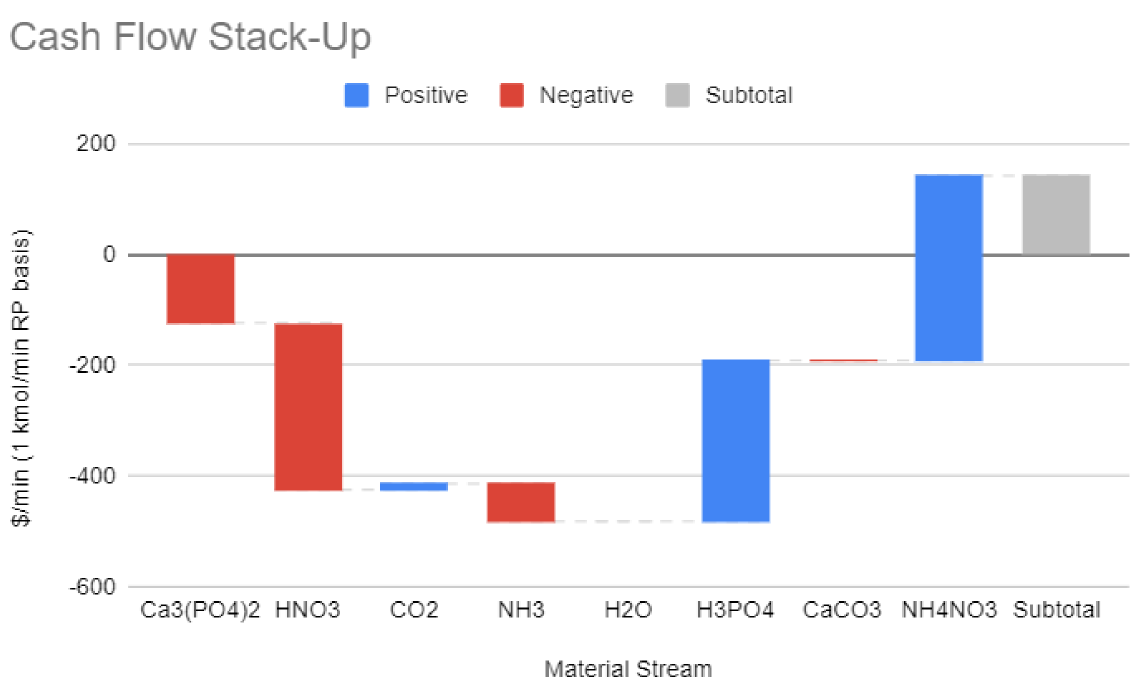
Component	Levelized price of net CDR for this project (\$/tonne)
Capex	Minimal modification of existing designs
Opex (excluding measurement)	\$30/ton (tipping fee + transport)
Quantification of net removal (field measurements, modeling, etc.)[2]	We believe tipping fee includes weighing the trucks as they enter the disposal site. Additional
Third party verification and registry fees (if applicable)	
Total	(should match 5(a))

[2] This and the following line item is not included in the TEA spreadsheet because we want to consider MRV and registry costs separately from traditional capex and opex.

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?

Cash flow stack up:

As you can see, the nitric acid and ammonia inputs are offset by the value of ammonium nitrate output. The value is created by upgrading rock phosphate to phosphoric acid. Carbon credits for CO2 are a nice additional source of cash flow.



Parameter with high impact on cost	Current value (units)	Value assumed in NOAK TEA (units)	Why is it feasible to reach the NOAK value?
Nitric acid cost	$400/ton HNO3 (55%)	$400/ton (HNO3 55%)	Note: this cost is sensitive for all fertilizer plants and independent of the CO2-sequestration equipment and process.

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

> The current nitrophosphate process, when implemented with carbon dioxide to remove the calcium, uses the CO2 produced by an industrial stream. If such a stream is accessible, then we can use solely existing technology. If we need to use a more dilute CO2 stream, we may need to modify the chamber used to react calcium ions with CO2. This would likely involve the addition of a compressor and additional pressure rating of a few vessels.

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.).

> NA - This process requires the decision of the percentage of CO2/air that will be used before plant economics in the TEA sheet can be determined. Nitricity can support frontier sequestration companies with the sequestration of 5% CO2/air or 99% CO2/air; however, each will affect the cost structure.

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.)

> This process has been implemented at scale before in the 1960's. There are no additional inventions required for widespread re-adoption.

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.

> The International Fertilizer Development Center, headquartered in Alabama, is both a partner and a key bridge builder to community stakeholders. Through a combination of research, project

deployment, and community engagement, IFDC is working at the forefront of agricultural innovation in order to build more sustainable food production systems and increase global food security.

The successful deployment of this project will provide workforce opportunities to the immediate community in which the facilities are constructed, provide farmers with increased access to vital soil amendments, as well as benefit communities facing food insecurity and frontline communities experiencing disproportionate consequences of climate change.

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.*

Nitricity is currently partnering with IFDC to study the nitrous oxide field emissions of nitrate vs. ammoniacal fertilizers. Nitricity has installed a pilot system at IFDC in Alabama, and the system is producing nitric acid to be used in these field trials conducted by IFDC. The results of these field trials will help inform future research as well as greenhouse gas emission mitigation potential of different forms of nitrogenous fertilizers.

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?

IFDC helped us understand the huge value that can be created for developing nations by implementing the nitrophosphate process with our nitric acid technology. Their feedback on the need for finding ways to more economically access phosphate rock across sub-Saharan Africa led us down the path to the nitrophosphate process.

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?

Based on feedback from IFDC, we have incorporated specific technology developments that include: more ruggedization of the plasma reactor, system improvement for acid product collection, and improvement of the system's integration with downstream fertilizer chemistry.

As the technology scales and mitigation metrics increase, public engagement will require personnel dedicated to working with community stakeholders at each project site. Collaboration with community stakeholders is key for the project's ability to address local priorities, concerns, and goals.

7. Environmental Justice[3]

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.

> Due to the nature of industrial chemical processing and the power requirements for these types of facilities, this project will likely need to consider deployment in regions where the local community already has or continues to experience the impact of industrial manufacturing. While we cannot assume what that impact has been or how the community would react to this project deployment, we can formulate a community engagement strategy to help understand local concerns, priorities, and mitigate against unintended consequences.
>
> An effective strategy requires identifying key community stakeholders in order to trust and meaningful relationships. Once those relationships are established, needs and priorities can be understood, and mutually beneficial goals can be determined.

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

> Concerns will be identified through collaboration with community stakeholders, and the response to these concerns will be devised in a similar fashion.
>
> If need be, we intend to engage with a consulting engineering firm that specializes in chemical and manufacturing safety, in order to ensure the safest possible facility and operations. This will protect both the workforce and local community members.

8. Legal and Regulatory Compliance

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

> We have not performed legal analysis outside of the permitting and compliance described below. Our technology is similar to existing fertilizer infrastructure and will likely fall into existing regulatory frameworks.

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.

[3] 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

Nitricity has performed regulatory analysis for air permitting and general safety compliance regarding our process at scale. We have identified the main air quality regulation as the new source performance standard for nitric acid plants, and have technology selected to meet this requirement. For the development of the technology, we are working with our general contractor (SEG) for the permitting and regulatory aspects of our new facility, including but not limited to national fire code, national electric code, and the appropriate safety programs in line with our Cal/OSHA injury and illness prevention program. We plan to pull permits and have this new facility operational in January/February of next year.

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?

We have not developed an international regulatory strategy. We expect the general requirements to be similar to the regulatory aspects listed above.

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.

We are operating technology that is very similar to what is deployed in the fertilizer industry today. We do not expect any major differences in the regulatory environment.

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.

We do not plan to receive any tax credits related to carbon sequestration. We may be eligible for certain R&D tax credits, renewable energy generation credits, or credits through agricultural efficiency programs.

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))*	A successful project will be a plant commissioned in 2026 that sequesters 850(min) -1600(max) tpd CO_2. Accounting for the uncertainty discount of 10% on the minimum, this is 765 tpd CO_2 sequestered. Assuming a 10-yr plant lifetime - 2.8 MMT CO_2.
Delivery window	2026-2036

(at what point should Frontier consider your contract complete? Should match 1(f))	
Levelized Price (\$/metric tonne CO_2) *(This is the price per tonne of your offer to us for the tonnage described above)*	\$50

Application Supplement: CO_2 Utilization

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

CO_2 Feedstock

1. How do you source your CO_2, and from whom? If your approach includes CO_2 capture and it's described above (e.g., general application and one of the supplements), simply respond N/A here.

   For initial testing, we will source CO_2 from gas tank suppliers, such as praxair or airgas or even startup DAC companies like Noya. In the long term, we are partnered with energy suppliers who can help us to source a large supply of sequestered CO_2 for this process.

2. What are alternate uses for this CO_2 stream?

   This CO_2 stream may be otherwise used for soft-drink production, metal fabrication, cooling, fire suppression, or the production of urea (another fertilizer). Otherwise this CO_2 may be geologically stored pumped into limited-use/small capacity sequestration caves or emitted to the atmosphere.

   Notably, Nitricity is proposing an alternate pathway for permanent storage than geological storage.

Utilization Methods

3. How does your solution use and permanently store CO_2? What is the gross CO_2 utilization rate? *(E.g. CO_2 is mineralized in Material at a rate of X tCO_2 (gross) / t storage material).*

   Our solution stores the carbon in the form of calcium carbonate (limestone). Calcium carbonate is a thermodynamically stable mineral and can offer permanent storage. CO_2 can be stored In this material at a rate of 0.44 tCO_2/t $CaCO_3$.

4. What happens to the storage material (e.g. concrete) at the end of its service life, and how does that impact its embodied carbon storage over time? How do you know?

   Our storage material is non-industrial limestone, specifically stored for carbon sequestration rather than for industrial purposes. If there is an industrial use where permanent storage is equally guaranteed, we would consider it.

5. How do you ensure that the carbon benefits you are claiming through a CO_2 utilization process are not double counted? *(E.g. If sourcing CO_2 from a DAC system, or selling your product to a user interested in reducing their carbon footprint, who claims the CDR benefits and how could an independent auditor validate no double counting?)*

We will negotiate the carbon benefits up front with potential partners, so that it is clear and contractual who will receive the benefit and how it will be counted. We can provide an independent auditor with this information and provide accurate data as to how much total CO_2 was sequestered with our process.