stripe

General Application

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

Company or organization name

Standard Gas Technologies Ltd

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

UK

Name of person filling out this application

Brian Reynolds

Email address of person filling out this application

br@standardgas.co.uk

Brief company or organization description

Carbon removal with substitute fossil fuels from wastes

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.

Standard Gas's (SG) mission is to remove 1,000,000 tonnes of CO2e per annum through the rapid deployment in the UK of the SG-100 patented pyrolysis technology. The technology is compact, economically favourable and highly efficient and creates an entirely new pathway for the world to deal with residual biomass wastes given the range of feedstocks the technology can handle. This technology creates long term carbon removal through its production of bio-char and via its syngas, a substitute to fossil fuels that enjoys additional carbon *replacement value. The SG-100 will help many hard-to-abate industries achieve net-zero through the use of its products – clean carbon-negative power or gas for heating and transport, or an economic supply of Green H2. Whatever the business model the SG-100 can make the lowest levelized cost of carbon removal and Green H2 known.*

A detailed process description is included entitled [Standard Gas Technologies Ltd Discription.docx].

We will operate our advanced thermal conversion technology (ACT) initially in the UK. The technology can process 48,000 tonnes per annum of waste biomass per SG-100 unit. Each site can have multiple units up to that site's ability to source waste and/or export electricity to the grid. The waste would otherwise be processed in an incinerator or in landfill. Each SG-100 creates p.a.:

1. Substitute fossil fuel syngas which can make net 40GWHr of electrical power for grid export.

2. 4,500 tonnes of biochar which when sequestered is equivalent to 16,750 tonnes of CO2e. Over the 20yr designed lifespan the plant will sequester 335,000t CO2e.

Studies of the process and its carbon accounting have been carried out by South Pole, Carbon Direct and Chris Meinreken. All confirmed the applicability of the methodology we employed and the quanta of potential carbon removal we claim.

Assuming Stripe purchases SG's negative emissions certificates the resultant industry confidence shown can be used to further accelerate the roll-out of the SG-100 technology to the UK and subsequently, globally, helping us to secure large industry partners and ultimately hasten the full potential SG has to remove CO2.

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.)*

We are a technology company having designed and developed our IP protected ACT process.

A study by South Pole concludes that we are eligible for a range of Carbon Removal Certificates overseen by, amongst others, VCS and Puro, either for our removals and/or our replacement carbon. These certificates form part of our offering to pioneering corporations looking to remove CO_2 whilst carbon-free electricity or gas or H_2 form the other half of our extensive benefit to the Net-Zero effort.
In terms of the acquisition of tradable certificates, we will embark on the process of detailed accreditation q2/3 2021. We are also aware of the new biochar methodology being developed by Verra and we form part of the stakeholder team in that process.
Working with South Pole we will also design a methodology and protocol specific to our waste biomass pathway to CDR, within the BiCRS system boundaries.

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

The three most important risks we foresee are:

- *Risks exist around the design of our SG-100 plant and its actual performance once commissioned. These are somewhat mitigated by the fact that we ran a 75% sized prototype 2016/17 from which we obtained a vast number of successful run-time hours.*
- *The process of pyrolysis to create a carbon char is well established both technically and chemically however, due to the wide range of wastes we can process a full analysis of any char will only be possible after the plant is built.*
- *There are risks around the permanence of the carbon stored but we are seeking to minimise these by developing pathways for the carbon char that involve sequestration in long-lived building products that will have a life of over 100 yrs. The risk that those products, when recycled, are burnt appears highly unlikely given the char will be within concrete and asphalt. An alternative, given we can produce a pure biochar suitable for soil enhancement, is to sequester it as a fertilizer. Here the risks are better understood but the likely recalcitrant values are likely to be less than the aggregate option so any future sequestration is likely to depend on the development of academic thinking around this topic.*

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

We have 6 patents that cover our process, we would like to share these under an NDA.

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 2021 - Jun 2022. The end of this duration determines when Stripe will consider renewing our contract with you based on performance.*	*Our plants are designed to have a lifetime of 20yrs. Given the verified carbon removal status of our process we envisage an ability to provide certificates from 18months hence (completion of SG-100 build) to 20yrs from that date.*
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 2021 - Jun 2022 OR 500 years.*	*The removal occurs on a real time basis as waste is processed and char created. As detailed above, this is 18 months from project start and in the amounts proportional to the number of live projects we have running (we aim for 40 units in the UK over the next 7yrs).*
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 out-years, but this depends on unknowns re our mineralization kinetics".*	*Initially we will have one pioneering project capable of 16,000 tonnes of CO_2 removal p.a. Our aim is to exponentially grow our project number to 40x this capacity in the UK over the next 7yrs with a global roll-out beginning in year 3, culminating in a target of 1million tonnes of removal within that 7yr timeframe.* *For this tender we are planning to run*

	the SG-100 for 3months on pure biomass to generate credits for Stripe hence the offer of 3000 removal tonnes a year initially.
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.*	*200 yrs + in construction materials. 100yrs + if utilised as a soil conditioner.*

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

125 yrs – 1000 yrs see attached pdf doc.

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.)*

We have not measured this durability however we are currently producing char that will be analysed to ascertain its stability though we do not foresee any variation from industry standards given the homogenous nature of the product if both feedstock and operational temperatures are as expected. *The EBC Guidelines on this topic can be found at: https://www.european-biochar.org/en/c-sink. A brief summary of this paper would be:* *For soil application of biochar, the EBC guidelines suggest a 0.3% per annum degradation rate of organic carbon in biochar applied to soil in the first 100 years, which means that 74% remains at the end of that period. IPCC offers values for the organic carbon content factor of biochar by production type, as well as, the fraction of organic carbon that remains after 100 years (89%, 80% and 65% for high, medium and low temperature correspondingly). The IPCC method is based on all available data that allows a two-pool model to be fit over more than one year of observation, using all available data until about 2018.*

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?

Given the two options for sequestration are soil enhancement and inclusion into building material there is little scope for leakage or conversion into atmospheric CO_2 within timelines not considered within standard academic studies (e.g. through fire hazards concerning the receptive land or fire hazards concerning buildings). Mismanagement on land where char is sequestered is not likely to lead to accelerated CO_2 release as the mechanism is biological and not open to acceleration with neglect of that land. Demolition of buildings or roads containing sequestered char leads to either recycling of the resultant aggregate without loss of CO_2 or burying as an inert waste in specialised landfills, again with no impact of CO_2e estimated sink values.

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.)*

The durability and recalcitrance of biochars is affected by the pyrolysis temperature, the process produces "oxidated chars" in which the carbon has taken oxygen onto its surface. Carbon-oxygen bonds are more easily broken down by fungi and bacteria. Carbon – Carbon bonds, such as those found in olefins are very durable and are very resistant to biological break down by bacteria or fungi.
Our biochar is not oxidised and is therefore has a high pure carbon content, it is therefore very durable in soil. We will only dispose of our biochar where it used in soils or construction materials and has no risk of ever being burnt.

The science of char sequestration in soils is well documented:

It is safe to assume our biochar will have good durability and permanence with a high fixed carbon content.

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	*3,000 tonnes of CO_2 over a 5yr take off. Option for increase and extension of contract at beginning of yrs 3 and 5.*
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	*Initially contract should be for carbon removal only. Depending on the siting and counterfactuals there is scope for generation of additional avoidance credits.*

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)*

All calculations are detailed in [SG-100 Carbon Accounting.pdf]. A fraction (c.18%) of the available carbon negativity of an SG-100 is offered in this tender for conservativeness. The plant can be run on a wide range of feedstocks that contain a non-biogenic fraction but in this tender we propose to supply certificates from a 3 month per annum run on pure biomass. The SG-100 is also carbon negative on the mixed feedstock but methodologies for carbon certificates from mixed feedstocks are in their infancy so we prefer to offer a clear biomass only certificates at this stage. This treatment (partial annual running on pure biomass) has been verified as removal certificate qualifying by South Pole given the accounting numbers for the process as a whole on a number of other feedstocks. *We have attached the calculations [SG-100 Carbon Accounting.pdf], a full working version of*

the sheet (as verified by South Pole and Carbon Direct) can be supplied on signing of NDA.

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).

Zero at present however, we are about to commence our 18month construction phase for the first SG-100, the carbon removals of which form the offer within this tender document.

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.)*

The calculations are based on a real system that operated in 2012- 2016 but then projected to the new slightly larger system that should be operational in q 3 2022. We thus have a direct link between the Heat-Mass-Energy-Balance calculations for biogenic waste, specifically biomass, and char production and syngas production and real situation sampling. Our engineering design partners are confident that our accounting numbers for carbon char production are correct within a small margin of error and we are undertaking consultancy work to take a real sample of our char to verify its sequestration pathway and confirm it's assumed long term stability. Given we are looking to forward sell 18% of our potential sequestrable carbon in any given year all figures supplied are achievable and 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.

www.standardgas.co.uk

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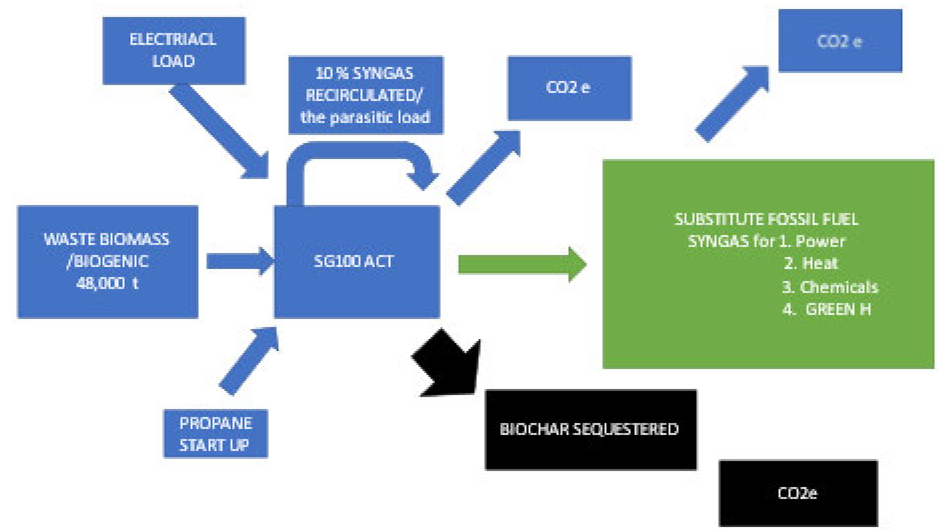
4. Net Capacity / Life Cycle Analysis (Criteria #6 and Criteria #8)

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	*16,766 (assuming full year on biomass) of which we are offering 3,000*
Gross project emissions	*2,284*
Emissions / removal ratio	*13.6% (emissions are 13.6% of removed)*
Net carbon removal	*14,482 (not including electricity counterfactual or incineration counterfactual which are usually counted within ISO-14064 guidelines and clearly add benefit to the environment).*

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 last year 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.



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?

The boundary conditions include all inputs and outputs – we have no exclusions see [SG-100 Carbon Accounting.pdf]

d. Please justify all numbers used 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](#).

Both South Pole and Chris Meinreken have reviewed and confirmed the numbers under ISO 14064 methodology.

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. (We may request such an audit be performed.)

We can share our full calculations sheet as well as a third-party report on NDA or subsequent contractual progression. [SG-100 Carbon Accounting.pdf] provides a detailed analysis of all our inputs to the SG-100

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 your progress.)

a. Please define and explain your unit of deployment. *(E.g. # of plants, # of modules) (50 words)*

The unit will be one SG100 unit processing wood waste for 3 months per annum.

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 if necessary.

Year	Units deployed (#)	Unit cost ($/unit)	Unit gross capacity (tCO_2/unit)	Notes
2021	N/A			*<50 words*
2020	N/A			*<50 words*
2019	N/A			*<50 words*
...				

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.)*

The new unit has a total Capex (inc. civils) of £20m. This will be a commercially operational site where the carbon credit revenue will ensure viability. Other revenue streams will include electricity generation and a gate fee for waste that is in the 9month period not considered in this proposal.

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)
Zero but the purchase will help investment and our ability to build further units.	*# tCO_2/unit*

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

We ask these questions to get a better understanding of your growth trajectory and inflection points, there are no right or wrong answers. If we select you for purchase, we'll expect to work with you to understand your milestones and their verification in more depth.

a. What is your cost per ton CO_2 today?

It is less than $0 / T of CO_2 as we are paid to process waste biomass, our process is cheap to run and we sell our syngas or power so have a positive revenue WITHOUT putting a value on the CO_2 removal certificates.

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."

We make a return from the sale of electrical power, char and the receipt of gate fees. The sale of carbon removal certificates will be approx.15% of revenue.

c. 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	***Factory test of SG100***	The test will be the point at which we can test the actual performance of the plant	Q4 2021	We will have a 3rd party verify the test is complete and has been passed.	
2	Site acceptance test	Once the plant is relocated to a site it will be tested again	Q1 2023	As above	
3	Stable running conditions	This will define how the long term performance and hence carbon removal tonnes that will be created by SG100's	Q3 2023	*<100 words*	

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*		*<100 words*
2			*<100 words*
3			*<100 words*

d. 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			*<100 words*
2			*<100 words*
3			*<100 words*

e. 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?

We would ask a committed wealthy environmentalist for a loan of £20m on normal infrastructure-build terms. We would use this to build the first commercial plant, once operating we will be able to roll out fast with other sources of capital and repay them their initial loan. Our engineering design is proven to work and our carbon accounting is both robust and extremely advantageous to the planet. What we need is a critical mass of finance to get us over the line. We have 60% of funds required committed already.

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

Use its PR to help us complete the financing and link us to corporations that might want to purchase an SG-100, the plant will provide them with an excellent Return on Capital and the Carbon removal at zero cost.

7. Public Engagement and Environmental Justice (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 some mechanism 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. There are no right or wrong answers, and we recognize that, for early projects, this work may not yet exist or may be quite nascent.

a. Who are your external stakeholders, where are they, and how did you identify them?

We have engaged with South Pole. Microsoft, Hanson, Air Liquide
We have engaged with Carbon Direct over the new BiCRS methodology

"Biomass Carbon Removal and Storage (BiCRS)", explores ways:

· *to use biomass to remove CO_2 from the atmosphere,*

· *to store that CO_2 underground or in durable products and*

· *to promote CO_2 removal without compromising food security, farmers' living, biodiversity, and other important values.*

USE WASTE
DO NO HARM.

b. If applicable, how have you engaged with these stakeholders? Has this work been performed in-house, with external consultants, or with independent advisors?

A lot of work was done in-house with 2 director investors completing the ISO-14064 GHG accounting course. We then engaged with SOUTH POLE, BIOCHAR WORKS AND CHRIS MEINREKEN

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?

They provided verification and detailed analysis to our internal accounting numbers which were recast in the format you have been sent. We have been in detailed conversation about the forefront of counterfactual treatments and wherever possible have been found to be conservative and well informed in our approach.

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?

none

e. What environmental justice concerns apply to your project, if any? How do you intend to consider or address them?

We will operate within the BiCRS methodology – do no harm, no competition to land use. Our overarching guide has been to be conservative and to make sure that our removal claims are robust. It is our aim to see a rapid extensive roll out of our process to treat both biomass and general waste so that existing polluting practices stop and are replaced by one of the few economically viable carbon-negative pathways known.

11. Legal and Regulatory Compliance (Criteria #7)

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

We have had South Pole and Chris Meinreken of Columbia both study the carbon accounting of our process.
The UK EA have issued an End Waste certificate for the Syngas created.

b. What permits or other forms of formal permission do you require, if any? 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 planning and environmental permitting but we are confident these are all achievable.

c. 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 have engaged with an expert to report on char sequestration and the regulation surrounding that process. As yet there is not a fully developed protocol to cope with the varying recalcitrant values within different sequestration pathways for the char. We are committed to understand these and in line with our overall accounting approach take a conservative view of any sequestration assumptions. As these standards develop, and we hope to help develop them, we aim to steer our business model to achieve the best outcome for the planet to preserve the high quality of our carbon removal claims.

12. Offer to Stripe

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

	Offer to Stripe
Net carbon removal (metric tonnes CO_2)	*3,000 tonnes*
Delivery window (at what point should Stripe consider your contract complete?)	*Should match the first row in table 2(a), "Project duration"*
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.*	*$120 t CO2e which is the market price for biochar removals, the price Swiss re will pay in 2022.*

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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?

Biomass waste

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

We will procure the biomass from local waste contractors.

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 2021	**Competing/existing project area use (if applicable)**
Feedstock cultivation	*None*	
Processing	*none*	
Long-term Storage	*none*	

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	*None*	

Processing	none	
Long-term Storage	*none*	

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.)

The Char will be sequestered and blended in construction materials (replacing fossil fuels) or in solis .

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.)*

Landfill or incineration are the only options.

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)*

There are none as we take the waste of waste.

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.

The merits are we take waste biomass so no competition for land use and we divert it from going to landfill or incineration.

Our technology captures carbon while simultaneously generating clean, renewable energy.

Our technology captures carbon while simultaneously generating clean, renewable energy.

We have a way to harness the energy in the rich resources society currently discards, removing carbon to help protect the planet. Today, most non-recyclable plastics and other wastes are burnt or buried, adding to environmental issues and atmospheric CO_2. We provide a low-cost, sustainable alternative to landfill and incineration.

Our SG 100 advanced thermal cracking technology transforms waste into a clean synthesis gas (syngas) and biochar, which captures and removes carbon. And because it doesn't burn waste, the process has no problematic emissions.

The SG-100

Process Description

There are five key elements that are unique to the SG-100 and patents cover those five core systems. They are:

1. The pyrolysis island (the retort and cracking pipes).
2. Gas scrubbing and cooling system.
3. Char collection and cooling system
4. Water cooling (jackets)
5. Water cooling (system).

Given the wide range of acceptable feedstocks, various feed systems will be used to ensure continuous flow and safe delivery into the retort. The SG-100 is designed to run continuously and produces a syngas rich enough to power standard burners and (if electricity is to be generated) generators. It is designed (by a separate specialist engineering firm utilising gas flow modelling software) to minimise parasitic load thus maximising the quantity of useable output. The lack of O_2 in the system (as only atmospheric O_2 enters) minimises CO_2 production, ensures the syngas is more calorific than other thermal treatment processes (e.g. gasification) and simplifies the product mix in the gas (H_2, CO, CH_4 and some C_2H_4). The temperature range of the cracking pipes ensures no tar build up (a key advantage over all other known pyrolysis technologies) and no production of complex aromatics, furans or dioxins as these simply cannot exist at the temperatures within the cracking process. The relative low temperature of the retort also reduces, to near zero, the heavy metal contaminants downstream. These end up in the char. If the feedstock is metal free the char is likely to be mostly carbon and has many uses from aggregate to soil conditioners.

Given the richness of the syngas (due to minimal loss of H_2 through oxygenation, the CV is c.18MJ/M3 compared to pure methane which is c.40MJ/m3) subsequent methanation (if CH_4 not electricity or green hydrogen is the preferred output) produces a lower mol. fraction of CO_2 than other processes (gasification) as the mol. fraction is dependent on the amount of H_2 sourced from the feedstock. If the char is also taken into account (as it can be sequestered and treated as a carbon sink) our process is substantially carbon negative (the exact values depend on the biogenic percentage content of the feedstock: at 50% the SG-100 has a carbon removal rate of 8700 tonnes p.a.) if we include the replacement value of counterfactuals such as incineration or if the biogenic content of the feedstock is above a certain threshold.

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