Future Forest

APPLICATION FOR STRIPE 2020 NEGATIVE EMISSIONS PURCHASE

Section 1: Project Info and Core Approach

1. Project name

Future Forest

2. Project description. ***Max 10 words***

Commercially scalable, high-quality, transparent reforestation offset model in a developed economy.

3. Please describe your negative emissions solution in detail, making sure to cover the following points:

a) Provide a technical explanation of the project, including demonstrations of success so far (preferably including data), and future development plans. Try to be as specific as possible: all relevant site locations (e.g. geographic regions), scale, timeline, etc. Feel free to include figures/diagrams if helpful. Be sure to discuss your key assumptions and constraints.

b) If your primary role is to enable other underlying project(s) (e.g. you are a project coordinator or monitoring service), describe both the core underlying technology/approach with project-specific details (site locations, scale, timeline, etc.), and describe the function provided by your company/organization with respect to the underlying technology/approach.

c) Please include or link to supplemental data and relevant references.

Max 1,500 words *(feel free to include figures)*

Our Mission

To combat climate change by pioneering a commercially scalable, high-quality, transparent reforestation offset model suitable for developed economies.

Our Model

We buy degraded land and reforest and restore it in a commercially profitable way, sequestering carbon in the trees and soil as we do so. We are different to other purely tree-planting projects because we holistically combine reforestation with rotational grazing, manure, and biochar for increased sequestration potential, and we also produce sustainable forest-grown products. This diverse but integrated approach not only gives us the ability to capture large amounts of carbon, but it also means we can generate multiple revenue streams, making this approach more commercially sustainable than one-dimensional approaches, while also providing employment and educational opportunities for people in poor rural areas.

Our model is inherently highly scalable as it does not rely on expensive technological interventions, it is commercially sustainable, and there is a huge amount of appropriate and cheap land available in Scotland. We purchase all the land we operate on, ensuring the permanence of our offsets, and allowing us to virtually guarantee zero leakage from our projects. We believe this model and template can be rolled out internationally, once proven in Scotland.

We make money both by selling the carbon offsets and by producing sustainable forest-grown products such as birch syrup (like maple syrup), nut crops and extremely high-welfare pork. Unlike most other offsetting projects, we only sell the carbon we are sequestering now and have a thorough annual testing protocol to allow us to demonstrate the carbon increase.

Our Land & Scale

We own 174 hectares (430 acres) of land in Dalry, Scotland. It has some existing native broadleaf woodland, and we have a planting plan approved by Scottish Natural Heritage across the site to plant more trees. This is our first piece of land, and we have plans to acquire a much larger 4000+ hectare (~10,000 acre) site within a year, also within Scotland. We've raised £1.5million in seed capital and have appetite for a larger (up to £20m) round which we will start to raise in the next few months. Successful early sales of carbon offsets will accelerate this second raise.

We are near the beginning of our mission, and our aim is to acquire very large areas of land to reforest and restore, tens to hundreds of thousands of hectares, as this is the scale at which we can have a real impact on climate change. Managing land at that scale has numerous positive knock-on effects; soil erosion stops and new soil starts to build, water infiltration increases, biodiversity increases both above and below ground, habitats are restored, all whilst new jobs are created for the local community and of course and debatably most important of all we are taking carbon dioxide out of the atmosphere.

The key assumptions we are working with here include: (1) there will continue to be a supply of large areas (min 40 hectare/100 acre) of appropriate land to buy in Scotland, (2) at reasonable prices (up to £8000 per hectare). All evidence currently supports this. NB degraded land in the Scottish Highlands can currently be bought in blocks of more than 4,000 hectares (~10,000 acres) for as little as £100 per hectare.

Negative Emissions Solutions

Our methods include (1) reforestation, (2) rotational grazing, (3) manure, and (4) biochar.

These work as a system:

1. The trees grow, sequestering carbon as they do
2. The tree growth is accelerated by the fertilizing effect of the animal manure, increasing the rate of tree carbon sequestration
3. Soil carbon levels increase through the addition of organic carbon in manure, rotational grazing of livestock, and addition of biochar from forestry and agri waste.
4. Additional top soil is created from input of food to livestock

Biomass sequestration

(1) Reforestation

The key to our project is reforestation on depleted soils so begins with planting saplings of native deciduous woodland. We estimate the trees will sequester +5 tonnes of carbon (+18.3t CO2E) per year per hectare (2.47 acres) as it grows (https://www.forestresearch.gov.uk/documents/953/FCRP018.pdf). The land we are buying is degraded land that has been overgrazed and leached of nutrients, so there is little competition for the space with agriculture.

The main period of sequestration is when the trees are aged between 10 years old and 60 years old. Beyond that, we anticipate many staying in situ with harvesting of some dead wood and windblown timber for biochar, plus some selective harvesting of mature trees (over 60 years old) for semi-permanent sequestration in building materials/furniture where the carbon can be expected to remain for circa a further 100 years. All felled trees will be replaced.

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Soil Sequestration

(2) Rotational grazing

Once the native woodland is established (+5 years old) we start introducing livestock to graze in the forest. Our grazing cycles are very short 1-5 days and have a very long rest period (+90 days). This allows 2 things to occur. Firstly, plants can fully regrow after grazing (including root systems) thus on the next grazing cycle the root drop that results from grazing increases soil carbon (this is an area of some scientific debate though evidence does support this http://carbonfarmingsolution com/carbon-sequestration-rates-and-stocks so we are conducting our own experiment with test and control sites, and measuring soil carbon each year). Secondly, plants can complete a full flower seed cycle every year leading to much increased biodiversity.

We currently have 40 mangalitsa pigs, a hardy forest breed. They get 90% of their food from foraging in the forest, and are supplemented on locally sourced grain which in the very near future we will be sprouting on site to increase its nutritional value and reduce the inputs. The sprouting system uses electricity to provide heat and light for the sprouting of the grain which will be generated by a micro-hydro powered by a stream on the site.

(3) Manure

Our pigs are born in the forest and spend their whole lives there, and naturally spread their manure around the site. This adds organic carbon back into the soil, and has other beneficial effects such as plant available water capacity http://randd.defra.gov.uk/Document.aspx?Document=SP0530_10030_FRP.pdf.

(4) Biochar

Biochar production is done on site with a state-of-the-art retort. The feedstock for the retort is thinnings from the forest and bought in forestry/agricultural waste if there is opportunity to do so. To distribute the resulting biochar we feed it to the livestock. Our pigs are derived from naturally forest dwelling ancestors and eat charcoal from forest fires as part of their diet in the wild. The livestock activate the biochar and distribute it in their feces across the site.

There is evidence to suggest that biochar increases soil organic carbon https://www nature com/articles/srep25127, and has further beneficial effects such as reduced soil N2O emmissions https://acsess.onlinelibrary.wiley.com/doi/abs/10.2134/jeq2016.10.0396.

Data

We measure the carbon in both the trees and the soil every year. Our data collection is led by Sarah McCormack, a PhD Ecologist, and is based on the methodology the Australian government uses to measure soil carbon, and allometric equations to calculate the tree carbon. We currently have our baseline data for our first site and we are waiting on getting our first measurements. We conservatively estimate that we will sequester 10 tonnes of carbon (36.7t CO2E) per hectare per year across the site (6380t CO2E total). Our estimate for the amount of carbon we can sequester this year is based on UK Government Forestry Commission data where tree carbon has been historically measured and on other long rest rotational grazing systems (https://www.forestresearch.gov.uk/documents/953/FCRP018.pdf & http://carbonfarmingsolution.com/carbon-sequestration-rates-and-stocks.

This breaks down to:

5-7 tonnes tree carbon per year per hectare (18.3-25.7t CO2E)
2-7 tonnes soil carbon per year per hectare (7.3-25.7t CO2E)
3-6 tonnes biochar per year per hectare (11-22t CO2E)

Our model is only to sell carbon that has already been sequestered, avoiding risks of project non-delivery/overestimation of our carbon stocks. We are in our first year, so for this year only, before we have measurements to compare to our baseline, we will sell on the above assumption. A best case scenario would see us storing double this amount. Then once we have our first measurement we will calibrate; if it turns out we’ve undersold, we will make extra credits available the next year, and conversely if we’ve oversold we will stop selling until we have sequestered what we have sold.

Timeline

2020
- Implement all activity at Brodoclea forest that we already own.
- Acquire 1 or 2 additional sites of a similar sort of size in the same geographic area so we have more space for new planting
- Raise £20m funding round

2021
- Purchase 1or 2 +4,000 hectare estates and apply the above model

2022
- Raise £300m funding round to expand to landscape scale - the ambition being tens to hundreds of thousands of hectares.

Section 2: 2020 Net-Negative Sequestration Volume

See Stripe Purchase Criteria 1: The project has volume available for purchase in 2020.

4. Based on the above, please estimate the **total net-negative sequestration volume** of your project (and/or the underlying technology) in 2020, in tons of CO2. (Note: We're looking for the net negative amount sequestered here, net lifecycle emissions. In Section 3; you'll discuss your lifecycle and why this number is what it is).

6350.28t CO2E

5. Please estimate how many of those tons are still available for purchase in 2020 (i.e. how many tons not yet committed). This may or may not be the same as the number above.

6270.28t CO2E

6. (Optional) Provide any other detail or explanation on the above numbers if it'd be helpful. ***Max 100 words.***

We have only just started selling the carbon so nearly all is still available for the current year right now.

Section 3: Life Cycle Analysis

See Stripe Purchase Criteria 2: The project has a carbon negative complete lifecycle (including energy use, etc).

7. Provide a life cycle analysis of your negative emissions solution demonstrating its carbon negativity, as complete as possible given limited space, and making sure to cover the following points:
   a) Include a flow sheet diagram of direct ingoing and outgoing flows (GHG, energy, materials, etc) that bear on the LCA.
   b) Please be explicit about the boundary conditions of your LCA, and implications of those boundaries on your life cycle. Let us know why the conditions you've set are appropriate to analyze your project.
   c) Make sure to identify assumptions, limitations, constraints, or factors that relate to ingoing and outgoing flows, citing values and sources (for example: land and resource scarcity, limitations on a required chemical, energy requirements). Also identify key sources of uncertainty in determining these values.
   d) If your solution results in non-CO2 GHG emissions, please be sure to separately specify that (e.g. in units of GWP 20 or 100 years, ideally both).

e) For solutions that rely on modular components (for example: incoming energy flows or outgoing CO_2 streams), feel free to cite values associated with those interfaces instead of fully explaining those components. For these values, please identify the upstream and downstream life cycle emissions of the component.

f) Explain how you would approach a more comprehensive LCA by citing references and underlying data needed for the analysis.

Max 1,000 words *(feel free to include figures or link to an external PDF)*

At this point in time we restrict our LCA to CO_2 and Non-CO_2 GHG emissions. We have started work on a much more thorough LCA that will account for many more categories including, water use, land use, acidification, marine eutrophication and freshwater eutrophication amongst others but we have not completed that work yet.

Flow sheet diagram

Our current LCA is limited to the following inputs and assumptions

Core operation annually (transport, 2x home office)

- Car:
    - 5,000 miles per year 2.5l Ford ranger diesel releases 2.03t CO2E (data based on an average diesel up to 3.5 tonne using https://www.carbonfootprint.com/calculator.aspx)
    - 5,000 miles per year Ford Fiesta 1.25l petrol releases 1.37t CO2E (data based on a EU 2008 FORD Fiesta, 2008 Model Year Onwards 1.25 Duratec (75PS), M5 using https://www.carbonfootprint.com/calculator.aspx)
    - Total 3.4t CO2E per year
- Train:
    - Glasgow to London return which is 411 miles each way 12 times a year = 9864 miles
    - Bristol to London return which is 118 miles each way 18 times per year = 4248 miles
    - Total train miles = 14112 travelled by national rail
    - Total 0.9t CO2E per year
- Home office:
    - 9.2t CO2E per home office per year, we have 2 home offices (https://www.wsp.com/en-GB/insights/office-vs-home-working-how-we-can-save-our-carbon-footprint)
    - This is a very conservative estimate. We plan to conduct a more tailored assessment and we expect this result to be lower.
    - Total 18.3t CO2E per year
- Total **22.6t CO2E per year**

Fencing for the land

- This is a one-off on a per site basis so we break it down to an estimate per acre, and then multiply it up by the area of the site and divide it by 60 years to give us an annual cost
- 2870kg CO2E per 50 acres so for the 430 acre site 24.7t CO2E
- **411.4kg CO2E per year**

Saplings & Planting

- Saplings:
    - A preliminary analysis of the GHG emissions from producing nursery stock in commercial tree nurseries was undertaken by Elsayed, Matthews and Mortimer (2003) for Delamere nursery (Cheshire). Suggested that a value of 68kg CO2E per 1000 seedlings was appropriate.
    - Transport was assumed over a distance of 25 miles (40.3km). A small lorry (3.5 – 7.5 tonne) was assumed, of relatively modern construction and engine emission levels (EURO5). The transport of one tonne of saplings was assumed and an assumption that seedlings are 100g each. This adds 21kg of CO2E per 10,000 saplings for transport or 2.1kg per 1000 giving us

70kg total for the saplings on site.

- Planting:
    - It was assumed that two people were required to plant 1000 saplings. It was assumed that people travel 25 miles (40km) to and from the site for two days. One car is assumed, with two occupants.
    - The footprint of planting 1000 saplings is 107kg carbon
- Planting density:
    - We plant at a density of 1235 saplings per hectare so at the current 174 hectare site 214890 saplings are planted in total.
- Total Sapling and Planting CO2E:
    - Saplings = 214890*(70/1000)= 15.04t CO2E
    - Planting = 214890*(107/1000) = 22.99t CO2E
    - Total (Sapling + Planting) = 38.03t CO2E
    - Apportioned over 60 years = **630kg CO2E per year**

Local grain for the pigs

- 539.3kg CO2E per tonne of grain
- Pigs fed at a rate of 0.4kg per pig per day
- 50 pigs on the land year 1
- 7.3 tonnes of food per year = **3.9t CO2E per year**

Amount emitted by pigs

- 37.5kg CO2E/swine/year (converted from 1.5kg methane/swine/year https://swine.extension.org/pork-production-and-greenhouse-gas-emissions/)
- **1.9t CO2E in total per year**

Embedded energy in the microturbine + plastic piping (anticipate this lasting on average 15 years)

- 3390kg CO2E total
- **226kg CO2E per year**

Embedded energy in the sprouter (anticipate this lasting 15 years)

- 803.1kg CO2E total
- **53.5kg CO2E per year**

Thinning trees

- There is no forestry management required at this stage in the project but we will in future calculate the energy used in thinning and harvesting operations.

Tree sequestration

- Trees both store carbon during photosynthesis and emit CO2 during respiration but as we only measure the stored carbon i.e. net positive so we do not need to concern ourselves with measuring the respiratory emissions.

Soil sequestration

- Soil both stores carbon and emits CO2 as microbes respire but as we only measure the stored carbon i.e. net positive we do not need to concern ourselves with measuring the respiratory emissions.

Total emissions volume - 29.72t CO2E
Total expected sequestration volume - 6380t CO2E
Total net-negative sequestration volume - 6350.28t CO2E

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8. Based on the above, for your project, what is the ratio of emissions produced as any part of your project life cycle to CO2 removal from the atmosphere? For true negative emissions solutions, we'd expect this ratio to be less than 1.

0.005

Section 4: Permanence and Durability

See Stripe Purchase Criteria 3: The project provides durable, long-term storage of carbon.

9. Provide an upper and lower bound on the likely durability / permanence of sequestered carbon provided by your project, in years:

Lower 100 years, Upper 1000 years

10. Please provide a justification for your estimates, and describe sources of uncertainty related to: the form of storage, effects of environmental or climatic variability, difficulty in monitoring or quantification, etc. Specifically, discuss the risks to permanence for your project, the estimated severity/frequency of those risks (e.g. 10% of the acres of forest in this forest type are burned by fire over a 100 year period), and the time-horizon of permanence given those risks.
Max 500 words

Land Use change
- Crucially, we own our land. We have no intention of changing land use within our lifetime, and we are working on placing binding covenants on the land to protect the carbon sequestered (such covenants being widely recognised and enforceable under Scottish law).
- We are operating in the UK where a stable democracy and the rule of law reduce the political risk to changes of land use very significantly.

Use of harvested biomass
- Our trees will be in place for a minimum of 60 years whilst they are in their prime years for sequestering carbon (age 10-60). Beyond that, we anticipate the vast majority staying in situ (oak trees can live for 1000 years), with some selective harvesting (and replanting) of timber and of deadwood & windblow timber for biochar.
- A good selective harvesting model beyond the initial 60 years will see us taking circa 1% of timber from the plot every year. This will allow for us to create a mixed-age forest, beneficial for increased biodiversity (https://academic.oup.com/forestscience/article/53/3/443/4604061).
- We will only sell our timber to companies focused on producing buildings/furniture and other long lasting products.
- We are able to reprocess forest waste back to biochar, ensuring it doesn't release the carbon again (however we will still leave some deadwood in place for biodiversity purposes). Biochar carbon is likely to be locked up for hundreds of years (https://onlinelibrary.wiley.com/doi/full/10.1111/gcbb.12266).
- We are registering for the FSC global forest certification system (https://www.fsc-uk.org/en-uk/about-fsc/what-is-fsc) which promotes environmentally appropriate, socially beneficial, and economically viable management of forests.

Natural Disturbance
- Wind, ice & snow damaged 0.3% of North Europe's forests, so is not considered to be a significant risk (https://www foresteurope org/docs/fullsoef2015 pdf)
- Forest fires have not been considered a significant problem to date. Scotland is low risk in the McArthur Forest Fire Danger Index http://randd.defra.gov.uk/Document.aspx?Document=CCRAfortheForestrySector.pdf
- Chance that some trees will be affected by pest and disease, but we have a forestry manager in place to detect this early and our polyculture forests are less susceptible

(https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1461-0248.2011.01679.x).

Climate Change

- The below is taken from the climate change risk assessment for the forestry sector in the UK report http://randd.defra.gov.uk/Document.aspx?Document=CCRAfortheForestrySector.pdf :
    - The risk of damaging effects from pests and pathogens is likely to increase, although it is difficult to project these effects with confidence.
    - Drought may increase. The change will be least prominent in Scotland compared to the rest of the UK. By the 2080s, there is estimated to be up to a 15% loss in northern Scotland. This risk is reduced in mixed species forests (eg http://waldwachstum.wzw.tum.de/fileadmin/publications/2012_Pretzsch_Resistance.pdf)
    - There is a low but slightly increased risk of forest fire in Scotland up to 2080.

Section 5: Verification and Accounting

See Stripe Purchase Criteria 4: The project uses scientifically rigorous and transparent methods to verify that they're storing the carbon that they claim, over the period of time they claim to.

11. Provide detailed plans for how you will measure, report, and verify the negative emissions you are offering. Describe key sources of uncertainty associated with your monitoring, and how you plan to overcome them.
Max 500 words

Soil sampling

Across the site, 20 randomised GPS points will be created using random number generation of UK National Grid coordinates.

At each coordinate, a central point will be established and marked with GPS location, what3words location and metal peg inserted into the ground. Four replicate undisturbed soil cores will be taken, 2 meters to the N, S, E and W of the central point. Each core will be sampled at 0-7, 7-14, 14-21 and 21-28 cm depth (16 samples in total), using sampling rings of known volume to allow bulk density to be determined.

Soil samples will be dried at 105 C for 24h and weighed for bulk density calculation.

Soil samples will be homogenised into a fine powder using a ball mill, and passed through a 1mm sieve, then re-dried at 105 C. Any material which does not break down within the sample will be weighed and subtracted from the total sample weight.

For each sampling point, soil samples from the same depth (e.g. the four samples taken at 0-7 cm depth) will be bulked, homogenised and subsampled (1 mg) total carbon analysis.

Homogenised soils will be analysed for total soil organic carbon by elemental analysis using total CN analyser and/or loss on ignition testing.

Aboveground plant biomass sampling

We have identified the potential for uncertainty in scaling up tree biomass measurements to a site-wide estimate, caused by natural variation in tree distribution and size. To address this, and ensure that we can quantify a statistically significant change in tree biomass, we are running a pilot study to quantify variation in tree biomass values per land area (as detailed in the UNFCCC protocol) and thereby determine the sample size necessary to detect annual change in tree carbon stocks.

Method: stratified systematic sampling on a grid with a random start using fixed-area sampling plots.

Pilot study (phase one)
To determine variation in tree biomass and planting density across the site.

At each of the 20 randomised soil sampling points, a 10 x 10m quadrat will be established. Within each 100 m2 quadrat, all trees present will be identified to species level, and diameter (DBH) and crown height will be measured.

Variation in tree biomass values per land area will be determined using UNFCCC protocol to confirm final number of sampling points for phase two of the tree survey.
https://unfccc.int/resource/docs/publications/cdm_afforestation_field-manual_web.pdf

Full-site survey (phase two)

Sampling points will be established on a grid (e.g. every 200m across the site, roughly 50 points in total, contingent on results of pilot study).

At each sampling point, a 10 x 10m quadrat will be established. Within each 100 m2 quadrat, all trees present will be identified to species level, and diameter (DBH) and crown height will be measured.

Above-ground dry-weight biomass will be calculated for each surveyed tree using allometric equations obtained from the literature (see below). For standing dead trees, leaf biomass will be removed from the total above-ground biomass by reducing the estimate by 2.5 % or 3.7 % for broadleaf and coniferous trees, respectively (Nowak, 1993). Total aboveground tree biomass will be transformed to a carbon storage figure using conversion factors of 0.48 for broadleaf and 0.42 for coniferous trees (Milne & Brown, 1997).

Mean tree density for each tree species will be estimated across the site using the known area cover of each species mix and the overall planting density of trees on site as determined by the survey (Davies et al 2011).

<u>General citations</u>

Davies, Z.G. et al., 2011. Mapping an urban ecosystem service: quantifying above-ground carbon storage at a city-wide scale. Journal of Applied Ecology, 48, 1125-1134.

Milne, R. & Brown, T.A. (1997) Carbon in the vegetation and soils of Great Britain. Journal of Environmental Management, 49, 413–433.

Nowak, D.J. (1993) Atmospheric carbon reduction by urban trees. Journal of Environmental Management, 37, 207–217.

UNFCCC Measurements for estimation of carbon stocks in afforestation and reforestation project activities under the clean development mechanism - A Field Manual.
Measurements for Estimation of Carbon Stocks in Afforestation

Allometric equation citations

Aboal, J.R., Arévalo, J.R. & Fernández, A. (2005) Allometric relationships of different tree species and stand above ground biomass in the Gomera laurel forest (Canary Islands). Flora, 200, 264-274.

Muukkonen, P. & Mäkipää, R. (2006) Biomass equations for European trees: addendum. Silva Fennica, 40, 763-773.

Snorrason, A. & Einarsson, S.F. (2006) Single-tree biomass and stem volume functions for eleven tree species used in Icelandic forestry. Icelandic Agricultural Science, 19, 15-24.

Ter-Mikaelian, M.T. & Korzukhin, M.D. (1997) Biomass equations for sixty-five North American tree species. Forest Ecology and Management, 97, 1-24.

Zianis, D., Muukkonen, P., Mäkipää, R. & Mencuccini, M. (2005) Biomass and stem volume equations for tree species in Europe. Silva Fennica Monographs, 4, 63.

12. Explain your precise claim to ownership of the negative emissions that you are offering. In particular, explain your ownership claim: 1) in cases in which your solution indirectly enables the direct negative emissions technology and 2) when, based on the LCA above, your solution relies on an additional upstream or downstream activity before resulting in negative emissions. Please address the notion of "double counting" if applicable to your project, and how you'll prevent it.
Max 200 words

Claim to Ownership

We own the land that the forest grows on, we also own the trees, soil and the livestock so additional carbon that is on our land or within the forest is a result of our management.

Double counting

To avoid double counting we manually measure the change in both soil and tree carbon on an annual basis to determine the increase and sell only the increase in carbon. The record of carbon sequestered is to be made available in a public record in the next couple of months and will form part of our carbon registry. We keep a registry of all sales of carbon which we will make available publically in an anonymised form so that all customers can see the proportion of carbon they have purchased and ensure that we have not double sold the carbon. In addition to this we will be publishing all our measuring methodology and the underlying measurements so that our processes are available for outside scrutiny.

We are in discourse with the Scottish and UK government on a number of matters, including ensuring that the carbon sequestered by our project will not be counted towards their Paris Agreement NDCs.

Section 6: Potential Risks

This section aims to capture Stripe Purchase Criteria 5: The project is globally responsible, considering possible risks and negative externalities.

13. Describe any risks or externalities, any uncertainties associated with them, and how you plan to mitigate them. Consider economic externalities, regulatory constraints, environmental risk, social and political risk. For example: does your project rely on a banned or regulated chemical/process/product? What's the social attitude towards your project in the region(s) it's deployed, and what's the risk of negative public opinion or regulatory reaction?

Max 300 words

Economic externalities

- In times of economic uncertainty (we are finding this out now with coronavirus), investors seek out asset-backed investments. We have a strong hypothesis that economic externalities will increase appetite for investment into land and forestry. The uncertainty here for us is around the timber, luxury food products and biochar markets downstream that may impact on how fast we can grow

Regulatory constraints

- Tree planting regulatory boost: The government has just announced a plan to plant an additional 30,000 hectares of trees over the next 5 years, so they are seeking to support and fund projects that do this. https://www.carbonbrief.org/budget-2020-key-climate-and-energy-announcements
- We have some regulatory risk i.e. if a country creates a national/regional trading system (such as the ETS or California program) that places obligations on potential consumers of carbon offsets, this may significantly reduce the demand for voluntary carbon offsets (if the voluntary offsets are not recognised under the mandatory regime).

Environmental risk (see section 4 for detail)

- The risk of damage from pests and pathogens, wildfires and drought is likely to increase with climate change http://randd.defra.gov.uk/Document.aspx?Document=CCRAfortheForestrySector.pdf

Social risk

- The general public view is that we need more woodland and forest especially native woodland, so this works to our advantage.
- The feelings towards carbon offsets may change to be more negative (as some schemes are shown to be very poorly managed the whole industry may be tarnished).

Political risk

- Political risk is typically one of the biggest barriers to reforestation projects as many countries are still relatively unstable. We are fortunate in operating in the UK which has strong democratic structures, a relatively stable economy and well established rule of law.

Section 7: Potential to Scale

This section aims to capture Stripe Purchase Criteria 6: The project has the potential to scale to high net-negative volume and low cost (subject to the other criteria).

14. Help us understand how the cost and net-negative volume of your solution will change over time. Note that we aren't looking for perfect estimates. Instead, we're trying to understand what the long-term potential is and what the general cost curve to get there looks like. (Note: by "cost" here we mean the amount Stripe or any other customer would pay for your solution):

	Today	In ~5 years	In ~20 years
Est. Cost per net-negative ton (in $)	$20	$20	$20

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Est. Net-negative volume (in tons of CO2)	6350	125,000	50,000,000

15. What are the drivers of cost? Which aspects of your costs could come down over the next 5 years, and by how much? Do you think your eventual scale potential is limited by cost or by volume? Why? Refer to any relevant constraints from question #7, like land or materials scarcity, and specify the boundary conditions for which you consider those constraints.

Max 300 words

<u>Cost Drivers</u>
Our key cost drivers are land price, tree costs (the tree & any guards / fencing) and labour.

There are 3 big benefits to us in terms of scale:

1. Land bought at scale in Scotland is circa ¼ of the price that we paid for our first purchase so there is a significant saving to be had in the future on the land purchase which constitutes circa ⅓ of the total cost of tree planting.
2. Natural regeneration is our other big benefit in terms of cost saving at scale as there is no longer any cost of planting labour or tree purchase.
3. The cost of fencing reduces as the area to be enclosed increases because with larger areas the ratio of boundary length to land enclosed reduces.

<u>Limits to scale</u>
At this point in time there are no limits to scale as there is plenty of available land at the right price but this could of course change. In time and at a much larger scale potential we could be limited by both volume and cost, although this is very far in the future. The key to our project is cheap, readily available land, which is why we have started in Scotland. Beyond this we could expand to most countries that have land above 50 degrees latitude in the northern hemisphere, although we would need to explore the amount and price of land that can be purchased.

Section 8: Only for projects with significant land usage

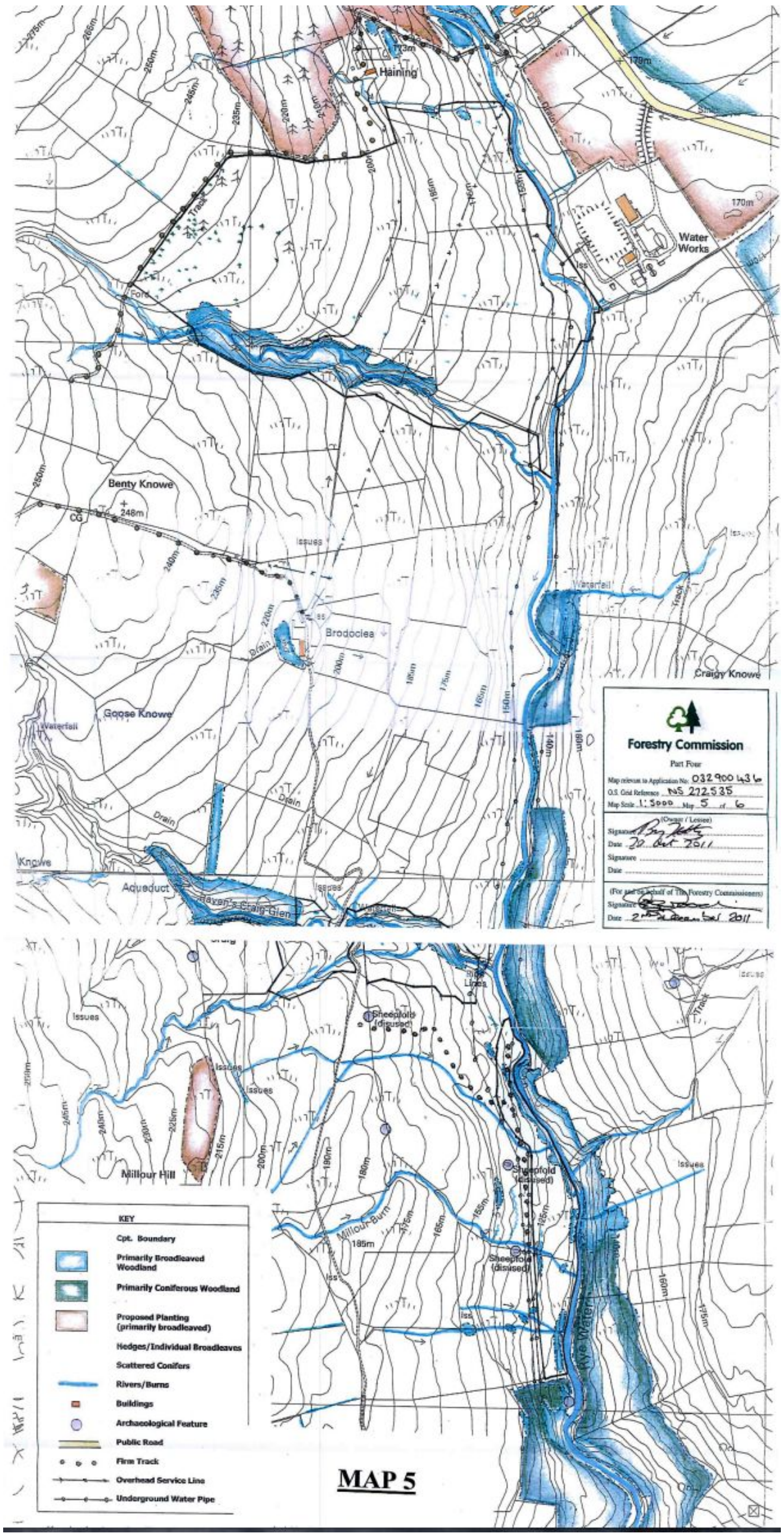
See Stripe's Purchase Criteria 2: The project has a net cooling effect on the climate (e.g. carbon negative complete life cycle, albedo impact, etc.) ***This section is only for projects with significant land usage requirements: Forest, Soil, and BECCS/Biochar/Biomass sequestration projects.***

16. Location: Please provide baseline information about the geographic location(s) of your project; and link shapefile(s) of project area(s).
Max 100 words

Overview - Scotland is initially our target but we are also looking at feasibility of Ireland, with a view that the model can ultimately be expanded to include most countries that have land above 50 degrees latitude in the northern hemisphere. Canada, northernmost USA, Scandinavia, Baltic countries and Russia.

Our land specifically - Brodoclea Farm is situated on the lower slopes of the Dalry hills, south of Glasgow in Scotland. It sits at 210 metres above sea level and virtually all of the land on the farm slopes to the east, with an average gradient of 1 in 4.

We don't currently have a shapefile of the land, but this map shows the landscape features:


Haining
Water Works
Benty Knowe
Brodoclea
Goose Knowe
Craigy Knowe
Aqueduct
Raven's Craig Glen
Millour Hill
Millour Burn
Rye Water
Sheepfold (disused)
Forestry Commission
Part Four
KEY
Cpt. Boundary
Primarily Broadleaved Woodland
Primarily Coniferous Woodland
Proposed Planting (primarily broadleaved)
Hedges/Individual Broadleaves
Scattered Conifers
Rivers/Burns
Buildings
Archaeological Feature
Public Road
Firm Track
Overhead Service Line
Underground Water Pipe
MAP 5

17. Land ownership: Please describe the current (and historical as relevant) land ownership and management for the area(s) provided in (16). If your project is not the landowner, describe your relationship to the landowner.
Max 150 words

Historical Ownership
Historically Scotland has been and remains dominated by large estates. These are predominantly used for 3 purposes, (1) as deer grazing and for deer shooting, (2) as sheep grazing pastures and (3) as grouse moors. The land is nearly always degraded.

Current ownership
We are at this stage moving to operating solely on land we buy and own as this gives us security over the future land use and management of our land and trees and being in a developed jurisdiction with a strong rule of law we can be extremely confident that we can protect these areas going forward.

18. Land use: For forest projects, please provide details on forest composition as well as forest age and basal crop area/density. For soil projects, please provide details on land use and crop type (if agricultural), soil organic carbon baselines, and regenerative methodology. For BECCS, biochar, or wooden building materials projects, please provide details on biomass crop type and methodology as applicable.
Max 500 words

Forest composition
- We work with Scottish Natural Heritage (SNH) to develop planting plans where there are no existing seed banks. We are planting a mixed deciduous forest (what the native forest would have been). All saplings are sourced from local nurseries where they are able to give us proof of provenance of the genetics of the stock to ensure that localised genetic variations are respected.
- On our land, Brodoclea, there were two major plantings before we acquired it in 2007 & 2012/13. Additional significant planting has commenced (once acquired) in 2019 and continuing into 2020.

Biochar
- Our feedstock for biochar will come from 3 sources, our own thinnings and windblown timber on our sites, forestry waste that will otherwise be left to rot and release the stored carbon and thirdly we are exploring the possibility of agricultural waste e.g. straw but we have yet to satisfy some concerns we have over this.

Soil Organic Carbon
Baselines
- Our soils are measured on a site specific basis so we are not relying on a generalised baseline measurement but have site specific data upon which to build. We put as much of our soil under tree cover as is ecologically appropriate. Specifically we avoid planting on deep peat soils and where these have been drained we block the drainage to rewet them to prevent further damage to this precious ecosystem and valuable carbon store.

Regenerative methodology
- As detailed previously, we use manure, biochar and rotational grazing to regenerate soil.

19. Net effect on climate: Please discuss the non-CO2 impacts of your project that may not be covered in your LCA, such as your impact on albedo.
Max 150 words

Albedo
- There is very little albedo effect on reforesting in Scotland as the ground is already covered in woody

vegetation in the form of heather in most areas.
Related benefits
- Water quality downstream
- Flood prevention downstream
- Biodiversity benefits both on our land and downstream
- Job creation in poor rural areas
- Amenity value to local population

Section 9: Other

20. What one thing would allow you to supercharge your project's progress? This could be anything (offtakes/guaranteed annual demand, policy, press, etc.).
Max 100 words

Having a significant customer that buys our carbon will not only provide a very important piece of validation for our model but will also help cashflow dramatically and will in turn allow us to raise far more investment and start scaling up much much faster.

If a customer were to give us a guaranteed volume of carbon to supply for the next 5 years or underwrite our carbon sales for the next 5 years (even at a discounted price) we may well be able to further accelerate our plans. This may become increasingly important because of a potential Covid-19 recession.

21. (Optional) Is there anything else we should know about your project?
Max 500 words

Our project is not just about removing carbon dioxide from the atmosphere. Through our reforesting and restoring of land, the soil rapidly starts to recover, water infiltration increases, biodiversity increases both above and below ground, soil erosion stops and new soil starts to build. Previously unproductive land returns to the rich diverse ecosystem that it should be with a beautiful range of long absent microorganisms, fungi, flowers, plants, insects, mammals and birds returning that can support both nature and profitable agriculture and forestry enterprises. About a quarter of all UK Biodiversity Action Plan priority species are associated with trees and different types of woodland. We re-establish riparian areas, wetlands, forest, scrub and wild meadows. Local people work the land hand in hand with the ecosystem that supports them. They are happy, they have a stress free life in a nice environment, are paid a good wage and are proud of what they do and the products and food they produce. All the energy consumed is produced on site from renewable sources and the surplus is sold to the national grid reducing the nations reliance on fossil fuels. We ensure that our employees have access to good quality affordable housing. Within the local community people are offered our products at a price that they can afford to pay with wealthier people supporting the costs to enable even the poorest members of society access to high quality products and food. Our land is always open allowing people to freely explore in nature and reap the health benefits that brings with it. A better integration between society, the environment and our local ecosystem reduces financial inequality in the community, increases happiness and leads to a more equitable society.

As a result of our focus being much wider than just carbon we contribute towards many of the United Nations Sustainable Development Goals. Whilst this is not directly relevant to Stripe it is to many of our other potential customers and may in some cases allow us to access grant funding to expand faster.

Section 10: Submission details

*This section **will not** be made public.*

stripe

22. Please insert below the name and title of the person submitting this application on behalf of your company (or, if you are submitting this application on your own behalf, your own details). By submitting this application, you confirm that you have read and accept the Project Overview (available HERE), as well as the further conditions set out below. As a reminder, all submitted applications will be made public upon Stripe's announcement. *Once you've read and completed this section, submit your application by March 20th by clicking the blue "Share" button in the upper right, and share the document with* ***nets-review-2020@stripe.com****.*

Name of company or person submitting this application

[redacted]

Name and title of person submitting this application (may be same as above)

[redacted]

Date on which application is submitted

[redacted]

We intend to make the selection process as informal as possible. However, we do expect that (a) the content of your application is, to the best of your knowledge, complete and correct; (b) you do not include any content in your application that breaches any third party's rights, or discloses any third party's confidential information; (c) you understand that we will publicly publish your application, in full, at the conclusion of the selection process. You also understand that Stripe is not obliged to explain how it decided to fund the projects that are ultimately funded, and - although extremely unlikely - it is possible that Stripe may decide to not proceed, or only partially proceed, with the negative emissions purchase project. Finally, if you are selected as a recipient for funding, Stripe will not be under any obligation to provide you with funding until such time as you and Stripe sign a formal written agreement containing the funding commitment.