

1- Application Information

Organization Legal Name: Pina Technologies GmbH

Please state your organization's mission

Pina Earth leverages the power of tech to enable effective climate action.

We are the proud winner of Microsoft's 10togo Thinkathon to leverage artificial intelligence for the United Nations Sustainable Development Goals.

One of the most important types of climate projects does not yet exist today. A large number of projects cover the areas of afforestation, reduced logging and forest protection.

However, there are no methodologies and established projects to make existing forests biodiverse and climate-resilient. Pina Earth fixes this, turning endangered monocultures into mixed and future-proof forests which remove additional carbon from the atmosphere.

This award winning approach has tremendous potential to remove carbon on the scale of Gigatons. Pina Earth shares insights into latest research, using artificial intelligence and what companies can do to support these projects.

As a leading developer of certified climate projects in Europe, Pina Earth uses artificial intelligence and remote sensing data to offer high quality carbon removals to buyers.

Pina Earth is incubated in Y-Combinator and supported by the German government, as well as European Space Agency (ESA). Further, Pina Earth is a spin-off from the renowned Technical University of Munich.

Please tell us the number of full time employees you have at your organization. (Confidential)

12

Organizational Classification (Confidential)

Privately Held Company

Does any entity control 10% or more of your organization? (Confidential)

Yes

please list the entity or entities that own more than 10% of your organization

Pina Technologies Inc

Has any legal action been brought against your organization in the past 7 years? If applicable, please provide comprehensive details. Organizations which do not disclose such information may be disqualified. (Confidential)

No

Indicate whether your organization meets any of the US diversity classifications as defined by the corresponding organizations below. Read more about [Microsoft's Supplier Diversity Program](#). (Confidential)

Women Owned

Please briefly (less than 100 words) describe your organization's own emission reduction targets or clean energy targets, and/or how your core business overall aligns to addressing climate change. (Confidential)

Pina is an impact company. The core business of the company is the removal of carbon emissions. Additionally, we aim for carbon neutrality ourselves each year since incorporation.

2- General Project Information

Describe your project in 10 words or less

The project turns a monoculture forest into climate-resilient, biodiverse forest.

Project Title. This title should be a unique identifier that we can use throughout the procurement process.

Luckaitz Valley

Please indicate the carbon dioxide removal (CDR) type that best describes your project. You can only select one. To see relevant project definitions, please review the [User Guide](#).

Forestry (removal only)

You selected your project as 'forestry'. Please choose the project type subcategory. To see relevant project definitions, hover over the project type choice.

Improved Forest Management

Please provide a summary of the project. Include how it will deliver CDR, its history, its major participants, and how Microsoft's payments for CDR will be used. If this is a land use project, please discuss the land use and ownership history. (400 Words Maximum)

European forests face imminent climate risks. Most of them consist of monocultures that are heavily affected by bark beetles, droughts, and storms. To illustrate, according to the German government, 4 out of 5 trees in the country are ill [1], with a huge projected value loss of up to EUR 500 billion on a European level [2]. However, until now, climate-resilient forest adaptation has not been incentivized: there is no law in place that prevents monoculture forests, there is a distressing lack of public funding, and no other support mechanism for forest owners.

The solution to this problem is to turn endangered monocultures into climate-resilient, biodiverse forests. To achieve this, Pina Earth develops climate projects which remove carbon from the atmosphere. In particular, Pina Earth supports forest owners with forest-adaptation projects by quantifying the additional carbon storage, qualifying the projects against carbon credit certification criteria and methodology (ISO 14064-2) and ensuring transparency with a registry.

In Germany alone, there are two million forest owners. Pina Earth therefore focuses on developing solutions which are scalable and enable small forest owners to participate in the voluntary carbon market (VCM) in order to finance their forest adaptation practices.

We achieve this by combining AI-based technology with high-quality forest data. This approach was already recognized by the German Federal Government and the European Space Agency (ESA). Our technology is characterized by a data-driven certification process:

1. Data collection, e.g. via inventory and/or remote sensing data
2. Creation of a digital twin of each forest
3. Simulation of carbon stock using artificial intelligence and climate models
4. Validation by third-party auditors and credit issuance

The scalability of our approach allows us to offer volumes from multiple projects under a Program of Activities to Microsoft. For our lighthouse project, Luckaitz Valley, the area was dominated by 94 % pines at the start of the project. It now gets restructured by (1) planting diverse tree species to increase biodiversity, (2) single-tree harvesting to stimulate natural rejuvenation, and (3) wildlife management to prevent serious game damage to young trees. In total, 6 new species are introduced and biodiversity is increased by 470% (Shannon-Index), with the project boosting water quality and flood prevention. Our novel approach reduces certification costs per mtCO₂ and removes barriers to scale climate projects.

Forest adaptation is expensive. Therefore, the largest part of Microsoft's payments goes directly to the forest owners to finance the adaptation measures of the project. Pina Earth uses a smaller share to cover the project costs for the certification, third-party validation, monitoring, administration, developing our technology further and scaling project development across Europe. As Pina Earth works directly with forest owners, no intermediary is involved and Microsoft's payments have a higher impact, with more transparency and direct contact.

[1 - German Government, 2021 -

<https://www.bmel.de/SharedDocs/Downloads/DE/Broschueren/waldbericht2021.pdf>

[2 - Nature Climate Change, 2013 - <https://www.nature.com/articles/nclimate1687>]

To the extent known, please provide an overview of the project's governance structure, all organizations involved in project design and implementation, and their roles and responsibilities. Please provide an overview of management's capacity to secure all planned carbon, environmental, and social benefits (highlight relevant management skills and experience).

Examples of other organizations would include project developers, owners, and operators, measurement and verification providers, as well as any key engineering or consulting firms. For those projects dealing with sequestered carbon dioxide gas, this should also include any upstream capture partners and downstream storage partners.

Organizations involved:

- **Pina Earth Technologies GmbH:** methodology development, data-driven project development, creation of project design document and organization of validation and verification. Pina Earth's team consists of experts in forestry, data science, software engineering, carbon markets and management leading in their respective fields.

- **TÜV Nord Cert GmbH:** auditing the methodology, as well as validating and verifying the project. Being an internationally established validation and verification body accredited by Verra, TÜV Nord acts as independent third-party auditor for the projects of Pina Earth.

- **Boscor Gruppe GmbH:** implementing the project activities. Boscor is a leading forest management provider in Germany and a thought leader for sustainable forest adaptation. As the largest forest management company in Germany, they have the capacity, skill and experience to implement the planned forest adaptation activities in a reliable manner.

- **Forest Owner:** ensuring that carbon removal takes place and project activities are implemented. Over the project period of 30 years with a potential extension, the forest owner is contractually responsible for overseeing the forest management company and to making sure that planned project activities are implemented.

Please provide a detailed discussion of the history of the project to date, including how it was conceived, financed, and implemented. Please include timing of key events, list key partners in the project, the role each has played / is playing. If the project is still in development and/or you expect there to be major changes in future, then please detail your plans for the project here.

- 07/2021 - 12/2021: Data were acquired via remote sensing and terrestrial inventory to quantify the GHG emissions removed

- 01/2022: Project activities begun and continue over the life of the project

- 05/2022: The project description 'Forest Restoration Project Luckaitz Valley' was finalized and submitted to the validator TÜV Nord Cert GmbH.

- 02/2023: The project was successfully validated by the accredited Verra VVB TÜV Nord Cert GmbH. Carbon removal volumes were issued after successful validation

- 01/2022 - 01/2052: The period of the GHG project is 30 years. An extension is possible as long as a total duration of 60 years is not exceeded. The monitoring of the GHG project takes

place after 3, 6, 10, 15, 20, 25, and 30 years after the project start. The results are then published in a monitoring report each time.

- 01/2052: After the project ends, the project impact is expected to continue to be carried out, as it is unlikely that a forest owner would return to monocultures after a biodiverse forest has been established.

Project Start Date. When did, or when will the project begin removing carbon?

01/2022

Location details of the project:

Closest city or town

Luckaitz

State/Province

Brandenburg

Country

Germany

Latitude

51.664449

Longitude

13.944473

URL for Shapefile, if available (if not available, enter n/a).

https://drive.google.com/drive/folders/1fyrbbKiSIRV3trnf4gqFy_ws_sEn4AzR?usp=share_link

3-Volume, Pricing, and Delivery

What is the total removal volume in metric tons of carbon dioxide that you are offering to

Microsoft in FY24 (July 1, 2023 to June 30, 2024)? [Enter a numeric value]

96.000

What is the total expected number of tons you will take to market from this project in the FY24 period (please include the tons offered to Microsoft in this total number)? If no volume is offered in FY24 you may enter 0. [Enter a numeric value]

114.000 (Microsoft has the opportunity of being an exclusive offtaker. The deviation between the two figures results from the deducted avoidance volume of the project [15.79%, 18.000 t). The same applies to the following questions, where the volumes offered to the market are higher than the volumes offered to Microsoft, because we don't offer the avoidance share to Microsoft.

Participant is expected to provide all pricing in U.S. Dollars, as requested through the application. While specific project-level pricing data will not be made public by Microsoft, Microsoft will use aggregate procurement cycle pricing information with no reference to source in median, average, and other anonymized analyses. Microsoft may share the aggregated datasets broadly in the public domain. The applicant understands and consents Microsoft to proceed. (Note: Marking 'no' does not influence whether your proposal will be accepted)

Yes

What is the price per metric ton (U.S. Dollars) you are seeking for your FY24 removal volume? (Confidential) Answer format: 12.00 (for \$12/mtCO₂e).

69.26 (64.13 if Microsoft pays until December 2023)

What removal tonnage will be completed and saleable in the following future periods?

Microsoft's fiscal years are from July 1st – June 30th. Example: FY24 is July 1, 2023 to June 30, 2024. When filling out, please complete the fiscal years for which you have clear data. If you are offering tons in a given fiscal year, please provide a price estimate. Please enter '0' for years that you are not offering tons.

Metric Tons Offered:

	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36
Microsoft	182,000	274,000	412,000	580,000	750,000	942,000	1,134,000	1,308,000	n.a.	n.a.	n.a.	n.a.
Market	216,000	326,000	490,000	682,000	886,000	1,110,000	1,330,000	1,540,000	n.a.	n.a.	n.a.	n.a.

What is your projected price per ton in the following future periods? (Confidential)

	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36
Microsoft	74.80	80.79	87.25	92.48	98.03	103.91	110.15	116.76	n.a.	n.a.	n.a.	n.a.

What percentage of total carbon sequestered remains after life cycle emissions are discounted? An estimate is acceptable. Answer format: 50.0%. We will request information on full life cycle assessment should this project reach the Due Diligence phase.

100 (Note that life-cycle assessments are critical primarily for engineered solutions)

Please indicate whether you are willing to offer volume-based price discounts based on credit purchase amounts. (Confidential)

	for 1-10,000 mtCO ₂	10,001-50,00 0 mtCO ₂	50,001-100,0 00 mtCO ₂	100,001-200, 000 mtCO ₂	>200,000 mtCO ₂
Discount rate	0	9	22	30	37

Microsoft expects pricing offers to be firm for 90 business days from the day of your submission. Please indicate any exceptions. Please enter a value of '90' if you agree to keep pricing firm for 90 business days Exception (enter the number of business days, from the day of your submission, that you will hold pricing firm (Confidential))

90

Describe relevant delivery terms for the tonnage you are offering for this current fiscal year, including date(s) of delivery. If delivery terms vary for future years included in this offer, please specify those in the section on offtake opportunities later in this application. (Confidential)

Until 31.12.2023

Microsoft is only interested in removals. Provide a breakdown for any projects that achieve both reductions and removals. What percentage of the total credits generated by the project constitute removals (as opposed to emission reductions or avoided emissions)? Answer format: 50%

77%

Based on the previous question, upload supporting models or data (within the Collaboration/Uploads panel below) to clarify how the disaggregation of removals and emission reductions/avoided emissions was determined. Specify below how you measure or measured the mix of removals versus avoidance/emission reductions for combined projects.

- *Example methods could include: overall calculations in the PDD, remote sensing/machine learning, percent derived from modeling, an assumed percent, etc.*
- *Reduced emissions: The reduction of greenhouse gas emissions that would occur as a result of a carbon project.*
- *Avoided emissions: The avoidance of greenhouse gas emissions that would have occurred in the absence of a carbon offset project*

Pina Response:

The amount of additional carbon storage is quantified based on the comparison of two forest growth, mortality, and yield simulations (on a single tree level): Baseline & Project.

The amount of carbon removals is derived from comparing the amount of carbon stored in newly planted, seeded or naturally rejuvenated trees in both scenarios.

We are available to further deep dive into the topic in a joint conversation.

4-Certification and Registration

Will your project be independently certified by June 2024?

Yes/No

Please check each formal certification that will be received by June 2024. If none, select 'no certification.'

ACR, CAR, Verra, Gold Standard, Other (please specify), None of the above

Text: TÜV Nord Cert GmbH, ISO standard 14064-2

If your project is registered with a third party carbon credit registry, what is the registry and project number? If not registered, please answer 'N/A.' Examples could include Verra, Gold Standard, American Carbon Registry, Climate Action Reserve, etc.

N/A

Please indicate how this project's net negative tons will be independently verified. Please provide links to any scientific literature that demonstrates empirical validation for this approach.

TÜV Nord Cert GmbH is validating and verifying the project. They act as a third-party auditor for the project and as the external validation and verification body.

For the carbon formulas, we rely on biomass formulas for trees using tree height and tree diameter, e.g., [3] GlobAllomeTree for a global source of biomass or allometric formulas or [4] rBDAT. The formulas are also used for the German national forest inventory.

[3] - Riedel & Gerald (2016). Nationale Treibhausgasberichterstattung: Neue Funktionen zur Schätzung der oberirdischen Biomasse am Einzelbaum.

[4] - Vonderach (2022) - rBDAT. <https://gitlab.com/vochr/rbdat>

Will all removal tons proposed be measured and delivered to Microsoft on an ex post basis (i.e. the removal will have physically taken place before the credit is issued and transferred to Microsoft)? If not ex post, explain the status of the removal tons at the time of delivery to Microsoft, including any pathway to becoming ex post verified.

Answer should be text with 1000 words maximum

All the credits are issued ex-ante. The forest adaptation activities are monitored after 3, 6, 10, 15, 20, 25, and 30 years. Once the additional carbon sequestered is validated in each monitoring period, the status of carbon credits changes to ex-post.

5-Durability, Risks, and Reversals

Overall, what are the three most important risks your project faces?

First, there is a general project implementation risk stemming from the 30-year contract run-time. However, the risk of failure or reversal is limited, because forest owners and forest management companies have significant experience in implementing forest adaptation practices. Additionally, there is a very low rate of insolvencies among agricultural organizations in Germany (less than 0.1% [5]), which makes it highly unlikely that our project partners default. In our lighthouse project Luckaitz Valley, the overall risk is lower than average because of Boscor's involvement as a professional forest management company.

Second, there is a natural, environmental risk as is the case with all nature-based solutions: wildfires, storms, pests and diseases could deteriorate forests under contract. Pressure from climate change is increasing globally. If forests die off, even though they are adapted as part of our project scheme, we will lose biomass which was potentially already sold as a carbon credit. That is why Pina Earth provides a buffer pool to mitigate risks from droughts, fires, pest infestations etc. All of our projects are required to deposit around 20% of the carbon credits in a buffer pool for all projects. In our lighthouse project Luckaitz Valley, the specific risk buffer is 18.5 %.

Third, the regulatory risk affecting Pina stems from the high uncertainty of how the VCM may be regulated in the future. Regulation could lead to a completely regulated (compliance) European or domestic carbon market including forest carbon (comparable to the model of California, USA). Detailed legislation with regard to establishing and regulating domestic (voluntary) carbon markets or policies for offsetting are still in their infancy and Pina Earth considers the regulatory risk feasible.

It is worth noting that Germany has very low risks of developing climate projects compared to projects in other countries. Allianz, one of the world's largest insurers, classifies Germany with the lowest risk ratings in terms of economic risk, business environment risk, political and financing risk [6]. Many risks associated with the development of climate projects are not present or limited for Pina Earth, including the risk of displacement, political instability, leakage and project accessibility.

[5] Destatis (2022). Insolvenzverfahren (Unternehmen) - <https://www-genesis.destatis.de/genesis//online?operation=table&code=52411-0001&bypass=true&levelindex=0&levelid=1658818124341#abreadcrumb>

[6] Allianz - https://www.allianz.com/en/economic_research/publications/country-risk/germany.html#structure

Specify the number of years over which functionally all the carbon will remain sequestered from the atmosphere. This is the durability term. Answer format: 10000.

100

If different from above, specify the number of years for which you will guarantee to Microsoft that the carbon remains sequestered and during which you will offer compensation in the case of a reversal. This is the durability guarantee.

Answer format: please include the number of years and any additional explanation, if needed.

- For many nature-based solutions and depending on methodology, this should be the lesser of
 1. the period between the current year and the last year of monitoring for reversals, and
 2. the period between the current year and the last year when reversals will be insured in some way and replaced (i.e., by a buffer pool).
- For projects using geologic or mineralization storage of CO₂, please state the period for which you will guarantee the carbon will remain stored either in geologic reservoirs or in a mineralized form, following the final credited year of the project.

The durability guarantee spans 30 years, in which monitoring takes place after years 3, 6, 10, 15, 20, 25 and 30. This is also the overall project lifespan.

How did you determine the expected durability term of the project(s)? Describe in detail how you account for the risk of physical reversals in this estimate.

Pina accounts for the risk of physical reversals in four ways:

First, we mitigate the risk via an internal cross-project insurance mechanism, and train our AI accordingly to optimize for prevention and risk-adjustments. Pina Earth uses a risk buffer, withholding carbon removals from being sold. We based the calculation of risk buffer size on the AFOLU Non-Permanence Risk Tool of Verra. Pina Earth refined the tool to the specific circumstances in Germany. Thus, Pina Earth conducts a similar risk analysis as described in the VCS methodology for the project forests and requires the risk to be below a certain threshold to develop the project. Independent of the specific region within Germany, Pina Earth deposits around 20% of credits in a carbon buffer pool for all projects. This risk buffer volume is shared amongst all projects.

Second, we use conservative assumptions: For the Luckaitztal project, we calculate with around 1.5 tCO₂/hectare/year. Industry experts assume a carbon sequestration around twice as high as our calculations, confirming the approach to be conservative. We conduct monitoring (including re-baselining) every 3-5 years for the entire runtime of the project to ensure that the realized additional carbon sequestration is frequently updated and reflected in the carbon assessments.

Third, we have a thorough contractual framework with forest owners: In case a monitoring would show a deviation from the planned carbon sequestration other than caused by natural calamities, the forest owner is contractually obliged to adapt their project activities so that the carbon sequestration goals are reached. The contract applies to the entire project runtime of 30 years and includes liability clauses as additional security guarantees.

Fourth and last, Pina Earth focuses on a scientific baseline. We don't use own assumptions or statements from forest owners for the baseline. Instead, we rely on forest data used for the federal tax office, as well as data from the federal forest inventory and peer-reviewed studies.

How will the project monitor for reversals of sequestered carbon to the atmosphere? How will a buyer be alerted to such reversals? We define reversals as when carbon that is stored by a project is rereleased into the atmosphere by either avoidable (i.e., intentional) or unavoidable (i.e., extreme weather) events.

The monitoring takes place after year 3, 6, 10, 15, 20, 25 and 30. Based on new data gathered during the project run time, an updated version of our digital twin is created and our calculations are re-evaluated. In the unlikely event that the amount of sequestered carbon in a particular project would differ more than 20% from our projections, and, hence, exceed our risk buffer, we compensate for the credits from our total risk buffer volume shared among all projects. Once the monitoring and risk assessment report are complete, the buyer will be alerted via email of any reversals experienced.

Please describe salient risks of reversal to the project (both intentional/avoidable and unintentional/unavoidable) for the project. What, if any, project activities directly reduce these risks below common practice for similar projects in your region? Which project activities, if any, increase those risks?

Avoidable risks originate from our contract partners. Specifically, this would be the case if forest owners do not implement contractually agreed forest adaptation measures. As forest owners are legally obliged to implement the defined measures, we can account for this risk by penalties for contract breaches.

Unavoidable risks originate from climate change itself as wildfires, storms, and diseases become more and more severe. Pressure from climate change is increasing globally. This can clearly be seen also for EU forests, e.g. carbon emissions from wildfires in the EU and UK in summer 2022 were the highest in 15 years, largely driven by wildfires in southwestern France and the Iberian Peninsula [7].

Our projects have increasing climate-resiliency of forests as a core goal. Climate risk is something that is only regarded as an external factor in virtually all other forest methodologies. Forest adaptation transforms monocultures, which are heavily affected by bark beetles, droughts, and storms, to more climate-resilient mixed forests. Mixed forests not only store additional carbon, but are also more resilient to diseases, storms and droughts because different tree species have diverse characteristics. Furthermore, nature rejuvenation increases

the overall stability and self-replication abilities of the forest. In this way, our project activities directly reduce the unavoidable project risks stemming from climate change.

[7] Copernicus (2022) -

<https://atmosphere.copernicus.eu/europes-summer-wildfire-emissions-highest-15-years>

Please indicate how you propose to compensate Microsoft, should any CDR tons fail to be sequestered from the atmosphere, for the specified term. If there is a difference for intentional/avoidable and unintentional/unavoidable reversals, please specify. Potential responses may include (but are not limited to) project-level or registry-level buffer pools, clawback provisions, or risk-of-reversal discounts in original crediting, or other compensatory mechanisms.

Unavoidable reversals including major weather events are covered by a 20% risk buffer, which is shared amongst projects.

Avoidable reversals originate from forest owners that do not implement forest adaptation practices in the mutually agreed way. They are legally obliged to adjust their project activities as soon as our monitoring reveals the malpractice. Otherwise, they have to refund the carbon credits, which we, in turn, will refund to Microsoft. We would then propose to Microsoft alternative volumes as a replacement.

If there is a buffer pool, specify the composition of this pool. Include whether it is composed of credits only from this project, whether it is intermixed with credits from other projects, and whether it differentiates between removal tons and reduction/avoidance tons. You can skip this question if a buffer pool is not used.

For the insurance mechanism, approx. 20% of the total carbon credit volume is held back as a risk buffer. The risk buffer percentage is specific to each project location and the total risk buffer volume is shared amongst all projects. Therefore, the more carbon credits get issued from the forest adaptation projects, the more secure the mechanism becomes. The buffer pool does distinguish between avoidance and removal tons. Further information for the specific risk categories of the buffer pool can be found in the PDD.

If there is a buffer pool, what percentage of credits generated by the project are put into the buffer pool? For projects still in development, what percentage of credits generated by the project will be contributed to the buffer pool? You can skip this question if a buffer pool is not used.

The buffer pool includes approximately 20% of the credits, determined individually per project. In our lighthouse project Luckaitz Valley, the specific risk buffer is 18.5%.

6-Conditional Questions

Multi-Year Offtakes

What best describes what you seek with this proposal?

Current Fiscal Year sale only, Current Fiscal Year sale and a multi-year contract (offtake or similar), Multi-year contract (offtake or similar) only

Current Fiscal Year sale and a multi-year contract (offtake or similar)

In general, what is your ideal outcome from this proposal? What sort of multi-year contract are you seeking? What are the minimum and maximum annual volumes you would consider? What length of tenure (i.e. how many years of offtake) would you consider? What is your timeline to arrange such an offtake?

Pina Earth seeks a multi-year contract, starting in the current Fiscal Year. Ideally, the contract length would be 8-10 years (until 2033). Our minimum annual volumes are 500t and our maximum annual volumes are stated in section 3. The ideal timeline to arrange the offtake and sign a contract is 2-3 months.

Please specify any nuances of your delivery terms as they relate to an offtake, for example if such terms are different from those for any FY24 tons available now or if price/ton would be different with a longer or shorter deal tenure.

Volume discounts stated in section 3 apply to our pricing.

For payment, Microsoft has two options of upfront payment or payment upon delivery. For payment upon delivery, a price increase per year applies (highlighted in section 3). Prices given for each financial year assume delivery and payment to take place before December 31.

Nature based solutions

Given your selection of a nature-based carbon removal solution, we ask that you provide some additional insights. How is your carbon removal/sequestration measured in the project scenario?

Describe the roles of in-situ sampling, modeling, and remote sensing. Include what specific sampling, modeling, and sensing technologies you use or plan on using.

Our methodology works as follows:

First, we create a digital twin of the forest: We use forest owners' terrestrial inventory data (plot based data containing tree positions, species, age estimations, height and diameters) which is the same data source used for the German federal tax office and if required, fuse it with aerial remote sensing data (multispectral camera images with infrared data and LiDAR scans) from public authorities. In this way, we achieve 100% area coverage to detect and measure tree heights, crown area, etc.

Second, we use this digital twin data as the input for our AI-based simulation to forecast forest growth under climate change 30 years into the future. The simulation is run twice, once with the "business-as-usual" forest management setting and once for the forest adaptation scenario

(measures include planting climate-resilient tree species, selective harvesting for a more diverse height structure and a continuous forest cover compared to clear cutting).

Third, we calculate the carbon credit volume based on the difference between the two simulated scenarios. After starting the project, the project areas are then monitored frequently using additional terrestrial and/or aerial data. This data is used to update the digital twin of the forest and to compare the calculated with the actual carbon removal amount.

How many hectares are involved in the project area?

632 (Luckaitztal) and +30,000 (in 2032)

What is your project's sequestration rate in metric tons of CO₂/hectare/year? How does that rate change over time during the project, if at all?

1.5 t CO₂ per hectare per year

In the beginning less carbon is sequestered, over the course of the project the sequestration rate increases with the new tree species planted growing over time.

7-Additional Questions

Technology innovation

Specify any technology needs that your project may have. (Confidential)

Besides the already existing technologies that we use for the development of forest adaptation projects, technology throughout the project is used to monitor the project areas. Technology support for more concise and cost effective monitoring would help Pina Earth to excel, including your planetary computer: <https://planetarycomputer.microsoft.com/>

Specify whether and how your project offers a technology innovation (i.e., to improve market efficiency, inclusivity, and removal outcomes). (Confidential)

Combining a digital certification process with high resolution forest data and climate models allows for lower entry barriers, higher quality and project focus on climate-resiliency. We use the latest technologies and scientific approaches from the emerging field of climate modeling. The groundbreaking character of the research in this field was recognized with the 2021 Nobel Prize in Physics for Syukuro Manabe's modeling of Earth's climate and global warming. We developed a brand-new, AI-based simulation that allows us to predict forest growth and carbon stocks under climate change impacts for more than 30 years into the future. This simulation takes into account varying combinations of tree species and provides detailed recommendations for forest owners to adapt their forests in the most climate-resilient way. To make use of these adaptations in the most profitable way, our service enables forest owners to get access to the voluntary carbon market, a process which was formerly too costly, complex, and time-consuming.

Co-Benefits and/or Harms

List the measurable co-benefits of this project in the following categories: water stewardship, waste reduction, ecosystem protection, social equity and justice, and climate resilience. You may wish to note any alignment with UN Sustainable Development Goals and any other standards (i.e., Gold Standard, SDVista, FSC, Fair Trade).

Spotlight SDG 6: Our projects promote the conversion to mixed forests and thus actively contribute to the achievement of SDG 6, in particular sub-goal 6.6: Protect and restore water-connected ecosystems. Forests are a crucial guarantor of clean drinking water: numerous microorganisms in the forest soil clean and filter rainwater. In addition, the forest soil can absorb precipitation like a sponge and thus provide natural storage. Groundwater from the forest can usually be used as drinking water without costly purification. For this reason, about one third of German forests are designated as water protection areas. The water protection and storage function is particularly pronounced in mixed forests with a high proportion of deciduous trees.

Spotlight SDG 8: 2.6 million people are employed in the European forestry sector, especially in rural areas. Forest loss is accelerating at an alarming rate. With its project activities, Pina Earth safeguards employment in the forestry sector. In this way, we contribute to SDG 8: decent work and economic growth.

Spotlight SDG 13: Forests serve as huge CO₂ reservoirs and thus make a decisive contribution to climate protection. In Germany alone, forestry reduces the burden on the atmosphere by more than 120 million tons of CO₂ every year. In addition, as a supplier of the renewable raw material wood, forests make an important contribution to the energy transition. However, the forest is facing major challenges due to climate change. Drought, storms and insect infestations are putting increasing pressure on the forest. An important approach to stabilizing and vitalizing stands and maintaining forest functions is large-scale forest adaptation. This involves converting susceptible pure coniferous stands into diverse mixed forests that disperse risk. With our projects we enable cost-intensive forest adaptation and thus help to maintain or increase the forests and their CO₂ sink function.

Spotlight SDG 15: Intact terrestrial ecosystems are essential for our health and for economic and social stability. Covering 30.7% of the Earth's surface, forests not only provide food security and shelter, but are also important for combating climate change and protecting biodiversity. Nevertheless, 13 million hectares of forest and much biodiversity are lost worldwide every year. With our projects, we are actively helping to restore forests to sustainable management and prepare them for future climatic challenges. In addition, the introduction of new, climate-resilient tree species leads to a significant increase in biodiversity. Hereby, we actively help to achieve SDG 15 and in particular sub-goal 15.2.

Provide a brief (less than 100 word) narrative characterizing the co-benefits identified above and how they are measured. Attach the most recent verification report for any certifications of co-benefits via the Collaboration/Uploads panel (button below).

By turning monocultures into mixed forests, Pina Earth not only saves our forest from the increasingly severe challenges resulting from climate change, but also increases their carbon storage capacity in the long run. In this way, we protect our forest ecosystems and increase our climate resilience as a whole, because forests are gigantic carbon stores in our fight against climate change. Mixed forests with a high proportion of deciduous trees are home to numerous microorganisms that filter rainwater, guaranteeing our drinking water. Ultimately, our climate projects also provide co-benefits to people who spend quality time in nature for their wellbeing as well as people who rely economically on the forestry sector for their livelihoods. These benefits can be measured by monitoring the project areas and comparing them against nearby monoculture forest areas, activities can include soil sample analyses, recreation surveys, analysis of water and air quality, etc.

Pina Earth won Microsoft's 10togo Thinkathon to leverage artificial intelligence for the United Nation's Sustainable Development Goals and is part of Microsoft's initiative "Entrepreneurship for Positive Impact", where startups were selected based on whether they work towards one of the SDGs.

Transparency disclaimer: Biodiversity was assessed as part of the validation report. On other UN SDGs, Pina Earth would yet have to conduct a detailed SDG assessment to quantify further co-benefits.

– Shortened to 100 words:

Pina Earth protects forest ecosystems and increases their climate resilience as a whole, because forests are gigantic carbon stores in our fight against climate change. Mixed forests with a high proportion of deciduous trees are home to numerous microorganisms that filter rainwater, guaranteeing our drinking water. Our climate projects also provide co-benefits to people who rely economically on the forestry sector for their livelihoods. Climate impact and biodiversity was assessed as part of the validation report.

Pina Earth won Microsoft's 10togo Thinkathon to leverage AI for the United Nation's SDGs and is part of Microsoft's initiative "Entrepreneurship for Positive Impact".

Please specify whether and how your project advances equity and environmental justice for populations in and around the project area.

Germany lost 500,000 ha, equivalent to 5% of its total forested area, in the past 4 years [8]. Forest loss is accelerating at an alarming rate, which is also problematic for Europe's economy, especially in rural areas. Meanwhile, the forestry sector accounts for more than 2.6 million employees in Europe [9] and with its projects, Pina Earth safeguards the employment in this sector.

Further, Pina Earth directly engages with forest owners and lets forest owners decide with a bottom up approach, which project activities suit their forest the best. Each forest is different and with this approach, Pina Earth provides the forest owners with freedom and lets the person with

the most knowledge decide on the measures, while continuing to adhere to scientific recommendations on forest adaptation. The screened project activities are then contractually agreed to ensure carbon removal permanence.

Finally, 90% of people like to spend time in the forest as they serve as relaxation places, with some local national parks having millions of visitors, and our work ensures this remains possible by making forests future-proof [10]. Spending time in forests increases positive emotions and decreases stress, blood pressure, depression, fatigue, anxiety and tension [11].

[8] German Aerospace Center (2022) -

https://www.dlr.de/content/en/articles/news/2022/01/20220221_concern-about-german-forests.html

[9] Forest Europe (2020) - https://foresteurope.org/wp-content/uploads/2016/08/SoEF_2020.pdf

[10] Frankfurter Allgemeine Zeitung (2023). Der Wald von oben. Abgerufen am 10.02.2023 von <https://www.faz.net/aktuell/wirtschaft/klima-nachhaltigkeit/der-deutsche-wald-ist-in-gefahr-18502742.html>.

[11] Food and Agriculture Organization of the United Nations (2023).

<https://www.fao.org/international-day-of-forests/key-messages/en/>

Specify any real or foreseeable negative environmental or social impacts of the project. Include how you plan to mitigate them. Please consider and include any local co-pollutants, human displacement, perverse incentives, and/or any new emissions sources that will be required to complete the project.

In the beginning less carbon is sequestered because we need to rejuvenate the forests and plant new tree species in order to adapt the forests over time. This is why, temporarily, carbon stock may be reduced for certain projects from Pina Earth to achieve a longterm benefit. Over the course of the project, the sequestration rate increases with new tree species planted and growing over time. Over the whole project lifetime, the carbon delta then exceeds the reference scenario without forest adaptation practices. Any negative emissions are always subtracted from the total volume. Other than that, there are no foreseeable negative environmental or social impacts of the project.

Additional Information

Identify any additional information you would like to provide. If this information pertains to a specific question in this application, refer to the question title in your response. Attach any new material in the Collaboration/Uploads (button below) that provides additional information for your project application that hasn't been captured in the application. There will be an opportunity to submit additional information during the Due Diligence phase. (Confidential)

...[comment field]