



XPRIZE
CARBON
REMOVAL



MUSK FOUNDATION

Competition Guidelines

V2.2 February 1, 2023

COMPETITION GUIDELINES

XPRIZE Carbon Removal is governed by these **Competition Guidelines**. The Competition Guidelines summarize the high-level requirements and rules of the competition.

XPRIZE may revise these Guidelines at any time during the course of the competition to provide additional information or to improve the quality of the competition. Unanticipated issues that arise may require modifications to these Guidelines. XPRIZE reserves the right to revise these Guidelines as it, in its sole discretion, deems necessary. All registered teams will be notified of revisions in a timely manner.

For further details concerning the operation of the competition, such as exact dates and locations of events, specific technical thresholds for performance testing, and operational information, please refer to the **Rules and Regulations, Competitor Agreement**, and other documents that will be forthcoming throughout the course of the competition.

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Overview

Climate science is clear that in order to avoid the worst effects of climate change we need to dramatically reduce carbon dioxide (CO₂) emissions as aggressively as possible. It has also become clear that net zero is not enough. We also need negative emissions: going beyond limiting CO₂ emissions requires innovation that actually removes and sequesters CO₂ that is already in the air and upper layers of the oceans. The world's leading climate scientists estimate that humanity must remove 10 gigatonnes of carbon dioxide per year by 2050 to avoid warming more than 1.5 to 2°C. If we do nothing, the global average temperature could increase by 6°C by the year 2100. An XPRIZE focussed on Carbon Removal can radically increase the level of innovation, demonstration, investment, and rigor of a variety of carbon removal solutions in a way that accelerates the rate of scale-up and deployment of the best solutions.

XPRIZE Carbon Removal is a four-year global competition that challenges innovators from anywhere to create and demonstrate solutions that accomplish CO₂ removal ("carbon removal") -- pulling CO₂ directly from the atmosphere or the oceans and locking it away in a durable and sustainable way that can scale massively to gigatonne levels. We have entered a key decade of climate action. In order to reach the long-term goal of 10 Gt/y by 2050, XPRIZE Carbon Removal aims to incentivize solutions whose combined capacity at scale can reach 2.5 Gt/y by 2030. There are a range of scientific estimates for carbon removal targets, each of which depend on a different set of assumptions about how quickly we can reduce our current CO₂ emissions. Scientific debate about the right target will likely continue and evolve in time, but one thing is clear: humanity will need gigatonne-scale carbon removal, and we are nowhere near there today. The field needs a nonlinear intervention to get there.

To win the prize teams must demonstrate carbon removal at the kt/y scale, model costs at the Mt/y scale, and make a case for a sustainable path to Gt/y scale. The team with the most scalable and lowest-cost carbon removal technology will win.

Any carbon-negative solution is eligible, whether related to air, oceans, land, or rocks, or any other method that can durably and reliably remove and sequester CO₂.

Impact Goal

XPRIZE Carbon Removal will challenge innovators to demonstrate the viability of durable, low-cost, scalable, and sustainable carbon removal solutions. Humanity needs a portfolio of solutions that can reach a combined installed capacity of 2.5 billion tonnes¹ (gigatonnes) of CO₂ removal **per year** by 2030 in order to be on track to meet the IPCC goal of at least 10 gigatonnes **per year** by 2050². The competition is designed to help put humanity on track to meet this goal.

Objectives of the Competition

1. Increase the global supply of cost-effective, durable carbon removal solutions
2. Prove the scientific/technical viability of a diversity of high-quality carbon removal solutions that can be deployed and maintained sustainably, including both existing and new solutions
3. Accelerate the scaling and equitable deployment of proven carbon removal solutions
4. Inspire the next generation of talent and innovators in carbon removal

¹ *Tonnes* refers to *Metric Tonnes of CO₂*

² IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. V.P. Masson-Delmotte et al.

Prizes

Grand Prizes (US\$80M Total)

After 4 years, judges will select the winners:

- US\$50 million paid to the single Grand Prize Winner
- US\$30 million to be distributed among up to 3 runners up

Milestone Prizes (US\$15M Total)

After 1 year of competition the judges will review all submissions received by that time and award up to 15 Milestone Prizes of US\$1 million each. At the discretion of the judges, these awards may be granted on a conditional basis, subject to the team's demonstrated commitment to continuing to develop and advance their solutions and to compete for the Grand Prize.

Teams that do not receive or do not compete for US\$1 million Milestone Prizes are still eligible to compete for the Grand Prizes.

Student Awards (US\$5M Total)

XPRIZE will award up to US\$5M to student teams in late 2021. These awards may fund participation in the XPRIZE Carbon Removal or the development of key supportive technologies. The areas of focus for these awards are:

1. **College & University Carbon Removal Demonstrations:** Awards of up to US\$250,000 for carbon removal demonstrations to compete for the \$50M Grand Prize.
2. **Measurement, Reporting, and Verification Technologies:** Awards of up to US\$100,000 for technology that may not directly remove CO₂, but will enable carbon removal. Priority will be given to proposals in the following areas:
 - a. Technologies and methods that improve the precision, accuracy, and time required for carbon measurement, especially in natural ecosystems.
 - b. Methodologies and toolsets which improve the standards of assessment, reporting, and accounting for Life Cycle Analyses (LCA), Cost Modelling, and Techno-Economic Analyses (TEA) of carbon removal solutions.

For additional information, please refer to the Student Award Guidelines (Appendix A).

Solution Scope

Note: tonnes means Metric Tonnes of CO₂.

Solutions In-Scope for the Prize

Any carbon-negative project is eligible to win prize money provided it removes CO₂ from the air or the surface/sunlight layer of the oceans, and sequesters it in a durable way. Teams may compete in any of the major carbon removal pathways listed below, or some combination of the pathways. This list of pathways is not intended to be exhaustive:

- **Air:** direct air capture (DAC) plus sequestration.
- **Oceans:** algae, kelp, plankton, ocean alkalinity enhancement, or other methods of removing CO₂ from the epipelagic sunlight zone (the uppermost, or surface, ocean layer) and sequestering it durably.
- **Land:** Trees, agricultural solutions, soils, soil microbes and fungi, roots, grasslands, large-scale outdoor natural ecosystem solutions, biochar, etc.
- **Rocks:** Mineralization, enhanced weathering, mine tailings, subsurface geologic sequestration combined with CO₂ removal from the air and/or the ocean, etc.

Solutions Out of Scope for the Prize

- Solutions that do not remove CO₂ from air or oceans.
- Solutions that result exclusively in short-term re-release of CO₂ without sequestration, e.g. CO₂ to fuel. Solutions must demonstrate durable sequestration of CO₂.
- Utilization-only technologies that demonstrate conversion of CO₂ but not removal of CO₂ from the air and/or the ocean.
- Solutions that may capture CO₂ from the air and/or the ocean but cannot demonstrate net negative emissions.
- Solutions that remove CO₂ but are not net negative on a lifecycle basis, e.g. enhanced oil recovery.
- Solutions that result in avoided CO₂ emissions, but that do not demonstrate net negative carbon removal.
- Solutions whose CO₂ benefits are only theoretical or cannot be directly measured with adequate precision over the course of the competition.
- Solutions that deplete existing natural carbon stores, including old growth forests, existing standing biomass, CO₂ sequestered in the deep ocean, etc.

Novel Solutions vs. Solutions That Already Exist

There is no restriction on existing solutions competing for the prize, provided they can meet all the competition requirements. Similarly, there is no restriction on never-before-demonstrated

carbon removal solutions competing for the prize, provided they can meet all the competition requirements.

Demonstration Locations

Teams may demonstrate their carbon removal solution at any location of their choosing throughout the competition. Teams must be prepared to have XPRIZE visit their project site as needed throughout the competition and in the final year of the competition to validate the team's performance claims.

Solutions that are demonstrated across multiple separate geographic locations are in scope, provided that:

1. The team can explain clearly why a demonstration in a single physical location is not feasible;
2. each physical location represents an instance of the same CO₂ removal solution (not a collection of distinct CO₂ removal solutions);
3. The team presents a feasible plan for validation of their performance across multiple locations.
4. The team can make a case that the scalability of the solution (through MT and GT scale) is not hindered by the distributed nature of the solution.
5. The solution can be adequately verified in a single site visit.
6. The team can provide evidence that a sufficient number of solutions are operating to satisfy the required scale of removal (1000 tonnes of removal in the final year of competition).

Net-Negative CO₂ Removal

Solutions must demonstrate net-negative and durable CO₂ removal to be considered in-scope. It is the responsibility of teams to prove through their demonstrations and a life cycle analysis that they meet this requirement. Negative emissions may be established on a net basis over the lifetime of the demonstrated carbon removal project. In addition, teams must demonstrate how the sequestered carbon will be maintained (on a net basis) for at least 100 years to ensure that more carbon is removed than re-emitted. Finally, teams must demonstrate how they will achieve net negative CO₂ removal in the 1 Mt/yr and Gt/yr scenarios.

Durable CO₂ Removal

The durability threshold for the competition is 100 years. This means that to be considered removed, CO₂ must be sequestered (on a net basis) over at least 100 years. A cradle-to-grave life cycle analysis will be required to validate claims of 100 year durability in addition to net negativity. In particular, establishing 100 year durability should be a function of inherent verifiable and quantifiable durability of the CO₂ removal solution (i.e. the stability of the sequestered carbon) and any required repetition, long-term management, and/or monitoring

that may be required to ensure that removed CO₂ remains sequestered on net through 100 years. For example, CO₂ mineralized into rock may be known to be inherently stable (e.g. geologic sequestration), but any monitoring and verification requirements during that 100 years must still be explained and costed. Similarly, a standing forest may be known to have much more dynamic CO₂ flux over time and less inherent durability, so proposed methods of ensuring long-term net sequestration through 100 years and any associated costs must be explained in detail.

Confidentiality

All details relating to team technology, innovations, or methods submitted to XPRIZE at the submission deadlines of October 1, 2021 (student awards), February 1, 2022 (milestone awards), February 1, 2024 (site visit application), and February 11, 2025 (Grand Prizes) will remain strictly confidential unless clearly and specifically noted. Please refer to sections 9, 10, and 11 of the Competitor's Agreement for more details.

Eligibility

XPRIZE believes that solutions can come from anyone, anywhere: Scientists, engineers, academics, entrepreneurs, and other innovators from all over the world are invited to form a team and register to compete. To participate, a team is required to first create an account in the [Prize Operations Platform \(POP\)](#) and pay a registration fee of \$250 (\$25 for Student Teams, see Appendix A). POP is an online platform through which teams will register for the competition, pay the registration fee, and submit important documents throughout the competition. Teams are expected to maintain their POP profiles throughout the competition, ensuring their profile is up to date with the most recent team information. A Team may recruit and add additional team members at any time throughout the Competition.

Multiple entries by a single team: One group may choose to submit multiple solution entries to the competition. In this case, each entry must be registered as a separate Team, complete with its own team profile, description, and entry fee in the Prize Operations Platform. The capacity of multiple entries may NOT be added together for the purposes of reaching the 1000 tonne per year demonstration threshold; each solution must meet that scale on its own. Please refer to section 4.4 of the Competitor's Agreement for more details.

Ownership of Intellectual Property used in the competition: As of the date of submission, each Team must own, or hold appropriate license rights to, all technologies, methods, resources,

and Intellectual Property included in the Team's submission. Please refer to section 12.1.5 of the Competitor's Agreement for more details.

Any person or entity can participate in the Competition, no matter their citizenship or nationality, as long as they are not organized or ordinarily resident at the time of participation in Cuba, Iran, North Korea, Syria, or the Crimea region of Ukraine (or where otherwise prohibited by US law -- See [Sanctions Programs and Country Information | US Department of the Treasury](#)). If a Team does have a Team Member who is ordinarily resident in such destinations, it will be up to the team to obtain a license of authorization issued under U.S. Law.

Interested Teams and individuals are encouraged to collaborate and share skills. A team may recruit additional experts and can add new members to their team at any time throughout the competition. Teams may also merge with other teams during the competition. Teams must notify XPRIZE of a merger before it takes place. In the case of mergers, teams must register under one legal entity and assign one team leader. Additional details regarding team mergers are provided in section 3.4 of the Competitor Agreement.

Throughout the registration period, XPRIZE will host a series of webinars and other programming for all Registered Teams. XPRIZE webinars will allow teams to get to know each other and also to receive important competition updates. Participation in these programs, while not mandatory, is strongly encouraged.

While global in focus, the competition will be conducted in English. All teams must be prepared to communicate with XPRIZE and make their submissions in English.

Competition Calendar

The competition takes place in two phases over 4 years. All dates are provided for planning purposes only and are subject to change until confirmed by XPRIZE.

PHASE ONE: PROOF OF CONCEPT (YEAR 1, 2021-2022)

- Team Registration Opens April 22, 2021
- Prize Guideline Public Comment Period April 22 - May 13, 2021
- Final Guideline Publication June 21, 2021
- Student Award Submission Deadline October 1, 2021
- Student Award Judging October 2021
- \$5M Student Awards Announced November 2021
- Milestone Registration Deadline December 1, 2021
- Milestone Submission Deadline February 1, 2022
- Milestone Judging February - March 2022
- \$15M Milestone Prizes Announced April 22, 2022

PHASE TWO: FULL DEMONSTRATION (YEARS 2-4, 2022-2025)

- **Intent to Compete Submission Portal Open** **July 11, 2023**
- **Intent to Compete & Registration Deadline** **September 7, 2023**
- **Finalist Application Submission Portal Open** **October 4, 2023**
- Finalist Application Deadline February 1, 2024
- Finalist Judging and Selection February - March 2024
- Public Announcement of Finalists April 2024
- **Final Demonstration Period** **Feb 1, 2024 - Jan 31, 2025**
- Finalist Measurement & Verification Site Visits March 2024 - January 2025
- **Grand Prize Submission Portal Open** **September 1, 2024**
- **Grand Prize Submission Deadline** **February 11, 2025**
- Grand Prize Judging February - March 2025
- Grand Prize Announcement April 2025

Team Registration

Interested teams are required to register for the competition in the [Prize Operations Platform \(POP\)](#) and share a brief overview of their carbon removal concept with the community. Registration for the prize will remain open through September 7, 2023. To be eligible for a Milestone Prizes, teams must register by December 1, 2021.

NOTE: Registration will remain OPEN throughout the entire competition. The Student Awards, Milestone Awards, and Grand Prize Awards each have their own registration deadlines, but they are not mutually exclusive. If you miss one or do not receive an award, you can always catch the next one. Or you can do all three. Each team can also

have multiple entries in the competition at each phase, so long as each submission is distinct.

Student Awards (Year 1)

XPRIZE will award up to \$5M to student teams in late 2021. These awards may fund participation in the XPRIZE Carbon Removal, as well as the development of key supportive technologies. Applications for student awards will be due on October 1, 2021, with first awards to be announced in November 2021.

Phase 1 - Proof of Concept (Year 2):

To be eligible to win a Milestone Prize, teams are required to submit a proposal for their carbon removal solution and participation in the prize, including data and evidence of progress to date, cost modeling, and pathway to achieving full scale. Submissions are due on February 1, 2022. See “Evaluation Criteria” for more details.

Phase 2 - Full Demonstration (Years 2-4):

To be eligible to win a Grand Prize, teams must demonstrate their entire carbon removal solution end-to-end in the final year of competition (February 1, 2024 through January 31, 2025). Demonstrations must qualify for a site visit, during which XPRIZE will verify each Finalist team’s performance. Teams must apply for a site visit by the Finalist Submission Deadline (February 1, 2024) by submitting data and evidence of their carbon removal solution’s ongoing operations, a cost model, and evidence that the competition’s sustainable scalability criteria are met. Twenty (20) teams will be granted site visits, which will be conducted between May 2024 - January 2025. Qualifying for a site visit signifies a team as an XPRIZE Carbon Removal Finalist.

Phase 2 -- Winner Selection (Year 4)

In February 2025, Finalists will have an opportunity to submit a final data set and updated cost model to XPRIZE judges before being considered for the Grand Prizes. The Grand Prize Winners will be announced on Earth Day, April 22, 2025.

How To Compete: Submission Requirements

Following registration, teams should develop, build, and operate their CDR demonstrations.

The performance of each CDR solution must be established in a written submission.

Submissions must be submitted to the POP platform by the submission deadline. Submissions will cover each of the three main competition requirements:

	COMPETITION REQUIREMENTS	TARGET SCALE
Demonstrate a working CDR solution	In Phase 1: Provide evidence, including 3rd party verification, of successful operation of the key enabling component, prototype, or proof of concept of a carbon removal solution.	Any
	Submit a technical proposal for the fully operational (1000 tonne/year) carbon removal project the team will demonstrate for Phase 2.	
	In Phase 2: Provide evidence, including 3rd party verification, of a complete fully operational carbon removal project.	1000 tonnes CO ₂ / year ³
Calculate Cost at Full Scale	Phase 1 & 2: Calculate the fully considered cost per tonne at 1 Mt/yscale.	1 megatonne CO ₂ / year
Make a Case for Massive and Sustainable Scalability	Phase 1 & 2: Provide evidence that the solution is sustainable today, can achieve gigatonne scale in future, and can remain sustainable at gigatonne scale.	1 gigatonne CO ₂ / year

XPRIZE will provide detailed submission templates and additional guidance in advance of each submission deadline (October 1, 2021; February 1, 2022; September 7, 2023). This will include detailed instructions on how to complete and upload the submission, specific data submission requirements, instructions for cost calculations & Lifecycle Analysis, expectations for 3rd party verification, etc.

³ Tonnes refers to Metric Tonnes of CO₂

How to Win: Evaluation Criteria

To win the prize teams must demonstrate CO₂ removal at the kt/y scale, model costs at the Mt/y scale, and present a plan to reach Gt/y scale.

Teams will be judged based on their **Fully Considered Cost**, their **Operational performance**, and against the **Sustainable Scalability** requirements. Teams who meet or exceed the ambitious Operational and Sustainability requirements will be ranked by their “Fully Considered Cost” of CO₂ removal. The teams with the lowest cost - after meeting or exceeding the Operational and Sustainable Scaling requirements will win. In the event of a tie, or where a winner cannot be selected due to uncertainties in the cost model, judges will use the Operational and Sustainable Scaling requirements, and in particular the scale demonstrated during the competition, in their final selection of winners. Teams that can best control and reduce uncertainties in their measurements and calculations will have a competitive advantage.

1. Calculation of Fully Considered Cost

COST CALCULATION	DESCRIPTION
Full Cost of CO ₂ removal	<p>Costs must be modeled at a hypothetical project scale of 1Mt/y (average net CO₂ removal capacity). The calculation must include all costs over the life of the project on a levelized basis. Costs must include:</p> <ol style="list-style-type: none">1. Materials (feedstocks, other raw materials)2. Transport (movement of matter and energy)3. Processing (opex & energy costs)4. Longitudinal management (durability/storage -- per year maintenance costs) <p>Teams must provide cost estimates that are reasonably accurate and precise, and presented in such a way that the major cost factors can be broken out and analyzed for error, uncertainty, and sensitivity.</p> <p>XPRIZE will publish standardized costs for use in cost calculations (i.e. cost of land (by region, by type)), labor (person-hours, skill level), energy (electricity, heat), discount rate, etc.</p>

Cost of Risk and Externalities

Any significant liabilities and risk factors beyond the expected technical project costs must be identified and quantified wherever possible.

Since the precision of these factors is expected to be lower than the cost calculation presented above, it will be considered separately by the judges and at their discretion, including the extent to which the team has holistically evaluated the potential sources of risks and external impacts of their proposed activities.

Revenue & Value

Any factors which may offset the cost of Carbon Removal can be specified, including the sale of valuable goods (ie CO₂ derived products or valuable co-products, provided the resulting end-use does not re-emit the captured carbon) and any tangible & measurable environmental co-benefits (eg improved biodiversity, improved crop yields, improved fisheries, ecosystem services, removal of other greenhouse gasses, etc.). Teams may not count the value of social benefits derived from slowing climate change for this exercise. Teams may not count government or philanthropic subsidies as revenue.

The judges will consider claims of revenue and value creation at their discretion.

2. Operational Requirements

OPERATIONAL REQUIREMENT	PHASE 1 (MILESTONE REQUIREMENTS)	PHASE 2 (GRAND PRIZE REQUIREMENTS)
Demonstration Requirements	Submit a technical proposal detailing the intended ‘Phase 2’ demonstration, highlighting any work completed to date. Teams will be assessed on the quality and credibility of this proposal.	Operate a full carbon removal project (or projects) at a combined scale of 1000 tonnes of CO ₂ removed per year. Demonstrations must include: <ol style="list-style-type: none"> 1. Removal of CO₂ from air or ocean 2. All steps in the carbon removal process 3. Durable sequestration of CO₂, including any required monitoring & management of the CO₂ store.
	Operate the key component of the carbon removal solution. Demonstrate the team’s ability to field a successful demonstration in Phase 2.	Remove 1000 cumulative tons of CO ₂ in the final year of competition. Teams must be prepared to sustain operations during the demonstration period to accommodate XPRIZE verification.
3rd party Verification	Performance of the demonstration must be verified by a qualified 3rd party of the team’s choosing.	Performance of the demonstration must be verified by a qualified 3rd party of XPRIZE’s choosing.
Confidence in the solution’s efficacy	Teams must show how they intend to measure their net CO ₂ flux and sequestration durability with adequate precision.	Teams must demonstrate their solution’s performance with adequate precision, meeting or exceeding current best practices.

NOTE: Only measurable, direct CO₂ removal capacity should be counted toward the 1000 t/y minimum requirement. Any other CO₂ impacts can be discussed in Sustainable Scalability, and considered by the judges on a case-by-case basis.

3. Sustainable Scalability

SUSTAINABLE SCALABILITY REQUIREMENT	DESCRIPTION
Scale Demonstrated during Competition	Teams must report cumulative net tonnes of CO ₂ removed during the competition.
Scalable to Gigatonne scale	Teams must convince judges of the credibility of their plan to achieve gigatonne scale removal, including the estimated time horizon for achieving gigatonne scale given demonstrated scale to date, and detailed accounting of any key limiting factors.
Durable CO ₂ Sequestration	Teams must demonstrate, and include in their cost calculations, a credible plan to maintain their CO ₂ stores for at least 100 years, taking into consideration all existing best practices relating to measurement reporting and verification.
Net Negative Performance	Teams must demonstrate using a Lifecycle Analysis that their solution results in net CO ₂ removal (“negative emissions”) on a lifecycle basis annually, and that net negative performance can be sustained as the solution scales to 1 Mt/y and 1 Gt/y.
Environmental Sustainability	Teams must explicitly address energy, land, water, and other natural resource needs, benefits, positive or negative impacts on biodiversity and other ecosystem services, and constraints of their solutions.
Social Licence & Environmental Justice	Teams must discuss their plan for achieving broad social license and acceptance, equity, and environmental justice that will allow the solution to achieving low-cost and gigatonne scale. Teams must address the social and policy implications of their carbon removal demonstration as it reaches the Mt/y and Gt/y scale, including impact on local communities.

Roles and Responsibilities

Competing Teams

- 1. Good Standing:** Teams must register their intent to compete on the XPRIZE Prize Operations Portal (POP), sign the Competitor's Agreement, and pay the registration fee ahead of the deadline in order to be eligible for an award. Each team must specify a legal entity (ie individual or corporation). After being named a winner by the judges XPRIZE will pay the award to the specified legal entity.
- 2. Fundraising:** All costs of competing in the XPRIZE Carbon Removal are the responsibility of the competing team.
- 3. Safe and Ethical Behavior:** Teams are responsible for maintaining the health and safety of their teams and the environment over the course of their participation in the prize. Teams must comply with all laws and regulations which apply to their participation in the prize. XPRIZE reserves the right to expel teams who do not uphold reasonable standards of safety and ethics.

Advisory Board

- 1. Selection of Advisors:** XPRIZE and its Partners and Sponsors will collaborate to appoint a panel of subject matter experts, and big-picture thought leaders to serve as the Advisory Board for the competition. The Advisory Board will remain in place throughout the competition to advise XPRIZE regarding the scientific, economic, social, and other elements of the competition.
- 2. Independence:** The Advisory Board will be independent of XPRIZE, Sponsors, and all teams and team members. No Advisor, nor any member of the Advisor's immediate family, shall participate, nor have any financial or other material interest, in XPRIZE, the Sponsor(s), and/or any team or team member. All members of the Advisory Board shall promptly disclose to XPRIZE any such current, former, or expected future conflict of interest with XPRIZE, the Title Sponsor, or any team or team member.
- 3. Role of Advisory Board:** The duties and responsibilities of the Advisory Board may include, but not be limited to: (i) assisting with the establishment of qualifications for prospective Judges; (ii) recommending members of the Judging Panel; (iii) assisting with development of testing protocols and judging criteria; (iv) and providing input toward the development of these Competition Guidelines.

Judging Panel

- 1. Selection Of Judges:** The Judging Panel (as defined in the Competitor Agreement) will be composed of highly-qualified subject matter experts from a diversity of fields and professional backgrounds, selected and vetted by XPRIZE, Sponsors, and the competition Advisory Board.
- 2. Independence:** The Judging Panel will be independent of XPRIZE, the Title Sponsor, any other prize sponsors, and all teams and team members. No Judge, nor any member of Judge's immediate family, shall participate, nor have any financial or other material interest, in XPRIZE, the sponsor(s), and/or any team or team member. All members of the Judging Panel shall promptly disclose to XPRIZE any such current, former, or expected future conflict of interest with XPRIZE, the sponsor, and/or any team or team member.
- 3. Role Of Judging Panel:** The duties and responsibilities of the Judging Panel will include, but not be limited to: (i) evaluating teams' compliance with the Competitor Agreement as they relate to prize operations, these Competition Guidelines, and the Rules and Regulations for the purposes of the competition; and (ii) the awarding of points and selection of teams that will proceed to each subsequent round of the competition.

Grounds For Judging Panel Decisions

Official decisions made by the Judging Panel will be approved by a majority of the Judges that vote on each such decision after careful and impartial consideration of the testing protocols, procedures, guidelines, rules, regulations, criteria, results, and scores set forth in the Competitor Agreement, these Competition Guidelines, Rules and Regulations, and all other applicable exhibits to the Competitor Agreement. If any vote of the Judges results in a tie, then the Judging Panel shall determine, in its sole and absolute discretion, the mechanism to settle the tie. Similarly, if one or more teams are tied at any stage during the competition, the Judging Panel shall have the sole and absolute discretion to settle the tie.

Decisions of Judging Panel are Final

The Judging Panel shall have sole and absolute discretion: (i) to allocate duties among the Judges; (ii) to determine the degree of accuracy and error rate that is acceptable to the Judging Panel for all competition calculations, measurements, and results, where not specified in the Rules and Regulations; (iii) to determine the methodology used by the Judging Panel to render its decisions; (iv) to declare the winners of the competition; and (v) to award the prize purses and other awards. Decisions of the Judging Panel shall be binding on XPRIZE, teams, and each team member. XPRIZE and teams agree not to dispute any decision or ruling of the Judging Panel, including decisions regarding the degree of accuracy or error rate of any competition calculations, measurements, and results. Teams shall have no right to observe other teams'

testing or evaluation, or to be informed of other teams' calculations, measurements, and results, unless such information is made publicly available by XPRIZE, or by a team choosing to release their own data publicly.

APPENDIX A: STUDENT COMPETITION GUIDELINES

The XPRIZE Carbon Removal is a four-year global competition inviting innovators and teams from anywhere on the planet to create and demonstrate solutions that accomplish carbon dioxide removal ("CDR") -- pull carbon dioxide directly from the atmosphere or oceans, ultimately scaling massively to gigaton levels, locking away CO₂ permanently in an environmentally benign way.

Of the US\$100M prize purse, XPRIZE will award up to US\$5M to student teams in the Fall of 2021 as part of the Carbon Removal Student Competition. The objectives of this award program are to:

- Increase participation of young people in carbon removal
- Fund early-stage ideas from the next generation of carbon removal innovators
- Remove barriers to the competition for students that need funding for their demonstration

The XPRIZE Carbon Removal Student Competition is governed by these Student Competition Guidelines. The Competition Guidelines summarize the high-level requirements and rules of the competition.

XPRIZE may revise these Student Competition Guidelines at any time during the course of the competition to provide additional information or to improve the quality of the competition. Unanticipated issues that arise may require modifications to these Student Competition Guidelines. XPRIZE reserves the right to revise these Student Competition Guidelines as it, in its sole discretion, deems necessary. All registered teams will be notified of revisions in a timely manner.

These awards may fund participation in the XPRIZE Carbon Removal, as well as the development of key supportive technologies.

Award Areas

1. **Student Carbon Removal Demonstrations:** Awards of up to US\$250,000 as seed funding for student teams with carbon removal solutions intending to compete for the XPRIZE Carbon Removal Grand Prizes. Student teams will need to make a compelling case to the judges that they will be competitive applicants in the overall competition. Student teams will be required to meet all demonstration requirements outlined in the main competition guidelines.
2. **Measurement, Reporting, and Verification Technologies:** Awards of up to US\$100,000 for technology that may not directly remove CO₂, but will enable carbon removal. XPRIZE invites proposals in the following areas:
 - a. Technologies and methods which improve the precision, accuracy, and time required for carbon measurement, especially in natural ecosystems.
 - b. Methodologies and toolsets which improve the standards of assessment, reporting, and accounting for Life Cycle Analyses (LCA), Cost Modelling, and Techno-Economic Analyses (TEA) of carbon removal solutions.

Eligibility

To qualify as a student, applicants must:

- Be enrolled in at least one course at an educational institution at the time of application, or show proof of recent completion of the 2020-2021 academic year.
- Not exceed 35 years of age at the time of application.

Student teams may be formed out of existing research groups, student clubs, or they may be independently incorporated, provided they meet the eligibility criteria listed below.

Student Teams must:

- Be composed of ≥50% students enrolled at an educational institution for the 2021-2022 academic year or show proof of recent completion of the 2020-2021 academic year.
- Be led by a student who is enrolled for the 2021-2022 academic year.
- Identify an academic advisor or business leader who will act as a formal mentor to the team.
- Provide a letter of support from their academic institution. This may come from faculty or an administrator.
- Identify the legal entity to which the award will be paid: This may be the student's academic institution or a registered private organization. Note: teams may change or update their legal entity at any time, with 10 business days notice to XPRIZE (see Competitor Agreement section 3.1.10). Student Teams may choose to use their academic institution as a legal entity, but this is not required by XPRIZE.

- Example student teams could be research groups or extracurricular student groups.

Student Awards are made at the discretion of XPRIZE and the XPRIZE Carbon Removal Student Award Judges. XPRIZE reserves the right to redistribute any unallocated funding following review of the October 2021 applicants. This redistribution may come in the form of a second future call for student applications or a redeployment of unallocated funds to the XPRIZE Carbon Removal Milestone Awards, or any reasonable redeployment determined by XPRIZE.

All submissions must be uploaded through the XPRIZE Carbon Removal Prize Operations Portal (POP). Applications transmitted via postal mail, fax, and/or email will not be considered. Applications are due October 1, 2021 at 11:59 PM (Pacific Standard Time).

Please note that applications must be written in English only. Applications written in languages other than English will not be considered for award.

**ALL SUBMISSIONS DUE OCTOBER 1, 2021
APPLICANTS AWARDED NOVEMBER 2021**

Student Carbon Removal Demonstrations

Individual awards up to \$250,000.

Scope: These grants will help finance participation in the XPRIZE Carbon Removal competition. Applicants must register as a competing team and are subject to the rules & regulations of the competition. Please refer to the XPRIZE Carbon Removal Competition Guidelines for more details.

While we expect that proposals for these awards will involve some amount of prior work on carbon removal technologies, **please note that we expect proposals for demonstrations that may not yet exist and would be funded with the award money. An existing demonstration is not a requirement of the student award proposals.**

Proposal Requirements:

1. Applicant Biographies

Submissions should include a brief biography of each team member and the relevant experience that would contribute to the success of the proposal.

2. Proof of Student Status

Applicants must provide some documentation proving their enrollment at an educational institution for the 2021-2022 academic year.

a. Upload one of the following:

- i. a scanned copy of each team member's student identification card demonstrating that you will be enrolled in the 2021-2022 academic year.
- ii. a letter from your school's student affairs or admissions office confirming your team member's standing as a student for the 2021-2022 academic year.
- iii. Other proof that you are enrolled in a post secondary academic program.

3. Letters of Support

Applicants must obtain two letters of support for their project:

- a. A brief letter of support from an academic advisor or administrator confirming the academic institution's support of the team's participation in the competition.
- b. A letter of support from an academic advisor or business leader who will act as a mentor to the team. The letter should state clearly the mentor's area of expertise, relationship between the letter writer and the team, the letter writer's connection to the project if any, and comments about the proposal and team

from the letter writer.

4. Project Description

Brief narrative describing the project for which you are seeking funding.

- a. Describe how you intend to compete for the XPRIZE Carbon Removal competition.
- b. Describe your demonstration objective for the milestone round (Phase 1) (optional)
 - i. What will the Phase 1 demonstration entail?
 - ii. Why is the Phase 1 demonstration important?
- c. Describe your demonstration objective for the Grand Prize
 - i. What will the demonstration accomplish?
 - ii. Where will it be located?
 - iii. Why do you believe this concept is a strong contender for the XPRIZE Carbon Removal?

5. Project Drawings & Supporting Files

- a. Submit a Process Flow Diagram and corresponding Stream Table, or other comparable diagrams, for the proposed XPRIZE Carbon Removal demonstration.
- b. Submit any additional engineering drawings, schematics, or renderings of your project design (for both Phase 1 and Phase 2 of the competition as needed), demonstrating how the process will remove CO₂ from the air or ocean and sequester it durably.
- c. Include any additional charts, diagrams, graphs, spreadsheets, etc. to support the proposal.

6. Literature to Support Approach

Submissions should point to relevant academic literature to support the underlying premise of the proposal.

- a. Cite and summarize any key literature that supports the underlying premise of your proposed demonstration.
- b. If any experimental work has been conducted by the team to date, please describe it here.

7. Project Plan including Timeline, Budget, and Key Milestones

Submit a four-year plan for developing a carbon removal solution for the competition.

- a. Submit a brief narrative describing the major milestones of the project. Submit a detailed explanation of the milestones at the six month point, when a progress report will be due for consideration of the second 50% award.

- b. Submit a detailed project plan (Gantt chart or similar), mapping the major milestones onto a timeline.

8. Project Budget

A full project budget must be included, showing how the XPRIZE funds will be used as well as any other funding requirements

- a. What funds are you requesting from XPRIZE? (maximum US\$250,000)
- b. Submit a budget narrative describing the major costs associated with the project, justification of the requested amount, and describe how the XPRIZE funds would be used.
- c. If additional funding beyond the XPRIZE award will be required (or if resources have been secured already), describe them here, along with your fundraising strategy.
- d. Submit a detailed budget spreadsheet that breaks the proposed project into subsections and phases (as needed), and shows the resources required for each.

9. Ability to Execute

Provide the judges confidence that your team is capable of executing the project

- a. What projects has your team completed in the past which demonstrate your team's ability to complete your proposed project?
- b. What key skills does your team possess?
- c. What mentors or supporting infrastructure does your team have access to support your project?
- d. How will the XPRIZE award guarantee the success of your project?

Evaluation: Expert, third-party judges from business, government, and academia will review proposals in October 2021. Judges will consider innovation, the ability to reach gigaton scale, team resources, and capabilities, and project plan feasibility when evaluating proposals. Judges may reach out for further clarification or additional information if needed.

Conditions of Award: Award payments will be made in two tranches. The first tranche will deliver 50% of the award at the time of award in November 2021. The second tranche will deliver the remaining 50% of the award following the completion of predetermined project milestones after six months, to be decided by the selection committee. Teams will be required to submit a progress report after six months to receive their second award payment.

Analytical and Measurement Tools

Individual awards up to \$100,000.

Scope: These grants will finance development of carbon measurement innovations and novel tool kits which directly benefit the carbon removal space. In particular, we are interested in:

1. Soil GHG monitoring & verification technology
2. Ocean GHG monitoring & verification technology
3. Life Cycle Analysis Tools
4. Techno-Economic Analysis Tools, and specifically methods and tools for estimating cost at scale of early-stage carbon removal solutions.

We expect that proposals for these awards will involve prior work on carbon removal measurement technologies and that these awards will fund further development of these tools.

In order to make use of funded technologies in the context of supporting the XPRIZE Carbon Removal, preference will be given to projects whose final deliverables will be ready by March 1, 2023 or sooner.

Submission Requirements:

Proposal Requirements:

1. Applicant Biographies

Submissions should include a brief biography of each team member and the relevant experience that would contribute to the success of the proposal.

2. Proof of Student Status

Applicants must provide some documentation proving their enrollment at an educational institution for the 2021-2022 academic year.

a. Upload one of the following:

- i. a scanned copy of each team member's student identification card demonstrating that you will be enrolled in the 2021-2022 academic year.
- ii. a letter from your school's student affairs or admissions office confirming your team member's standing as a student for the 2021-2022 academic year.
- iii. Other proof that you are enrolled in a post secondary academic program.

3. Letter of Support

Applicants must obtain two letters of support for their project:

- a. A brief letter of support from an academic advisor or administrator confirming the academic institution's support of the team's participation in the competition.

- b. A letter of support from an academic advisor or business leader who will act as a mentor to the team. The letter should state clearly the mentor's area of expertise, relationship between the letter writer and the team, the letter writer's connection to the project if any, and comments about the proposal and team from the letter writer.

4. Project Description

Brief narrative describing the project for which you are seeking funding.

- a. Describe the technology you plan to advance with this award, and the final deliverable you will develop.
- b. Describe how the technology will advance the Carbon Dioxide Removal field.
- c. Provide a justification for why this project should be considered a priority for Carbon Removal.

5. Project Drawings & Supporting Files

- a. Submit engineering drawings, schematics, or renderings of your project design which demonstrate your proposed technology and its use.
- b. Include any additional charts, diagrams, graphs, spreadsheets, etc. to support the proposal.

6. Literature to Support Approach

Submissions should point to relevant academic literature to support the underlying premise of the proposal.

- a. Cite and summarize any key literature that supports the underlying premise of your proposal, including any studies on the core technology, current state of the art, or describing the need for your proposed technology.
- b. If any experimental work or development has been conducted by the team to date, please describe it here.

7. Project Plan including Timeline, Budget, and Key Milestones

Describe the project timeline, milestone schedule, and budget for the duration of the project proposal

- a. Submit a brief narrative describing the major milestones of the project. Submit a detailed explanation of the milestones at the six month point, when a progress report will be due for consideration of the second 50% award.
- b. Submit a detailed project plan (gantt chart or similar), mapping the major milestones onto a timeline.

8. Project Budget

A full project budget must be included, showing how the XPRIZE funds will be used as well as any other funding requirements

- a. What funds are you requesting from XPRIZE? (maximum US\$100,000)
- b. Submit a budget narrative describing the major costs associated with the project, justification of the requested amount and describe how the XPRIZE funds would be used.
- c. If additional funding beyond the XPRIZE award will be required (or if resources have been secured already), describe them here, along with your fundraising strategy.
- d. Submit a detailed budget spreadsheet which breaks the proposed project into subsections and phases (as needed), and shows the resources required for each.

9. Ability to Execute

Provide the judges confidence that your team is capable of executing the project

- a. What projects has your team completed in the past which demonstrate your team's ability to complete your proposed project?
- b. What key skills does your team possess?
- c. What mentors or supporting infrastructure does your team have access to support your project?
- d. How will the XPRIZE award guarantee the success of your project?

Evaluation: Expert, third-party judges from academia, business, and government will review proposals in October 2021. Judges will consider innovation, measurement approach, the impact of improved ability to measure carbon removal and sequestration for a given pathway, team resources and capabilities, and project plan feasibility when evaluating proposals. In order to make use of funded technologies in the context of supporting the XPRIZE Carbon Removal, preference will be given to projects whose final deliverables will be ready by March 1, 2023 or sooner. Judges may reach out for further clarification or additional information if needed.

More detailed evaluation criteria will be provided following the selection of the Judging Panel.

Conditions of Award: Award payments will be made in two tranches. The first tranche will deliver 50% of the award at the time of award in November 2021. The second tranche will deliver the remaining 50% of the award following the completion of predetermined project milestones after six months, to be decided by the selection committee. Teams must provide a progress report after six months to receive their second award payment.

APPENDIX B: GUIDELINES CHANGE LOG

Record of changes to the Guidelines document.

Updates in version 2.2, February 1, 2023

- Established a new requirement for a “Letter of Intent”, due September 7, 2023. See the [Phase 2 Rules](#) for more detail about this requirement.
- Changed the Final Registration deadline to September 7, 2023.
- Changes to the Phase 2 Calendar:
 - Finalist Application Submission Portal open on October 4, 2023.
 - Grand Prize Submission Portal open on September 1, 2024.
 - Grand Prize Submission Deadline on February 11, 2025.
- Clarified that the final demonstration period is February 1, 2024 through January 31, 2025.
- Fixed a few spelling errors.

Updates in version 2.1, July 14, 2021

- Removed broken hyperlink to “Student Award Guidelines” on p.6, replaced with text reference to Appendix A
- Removed references to caps on student award pools from p.22 and p.25
- Addition of this Appendix B change log

Updates in version 2, July 1, 2021

- Summary and discussion of changes are in [this blog post](#)