XPRIZE CARBON REMOVAL | MUSK FOUNDATION

GETTING TO GIGATONNE

SCALING THE CARBON REMOVAL INDUSTRY

MAY 2024

WE GRATEFULLY ACKNOWLEDGE THE CONTRIBUTIONS OF ALL THOSE WHO MADE THIS REPORT POSSIBLE:

Authors

Nikki Batchelor, Executive Director, XPRIZE Carbon Removal – Author
Michael Leitch, Technical Lead, XPRIZE Carbon Removal – Author
Laura Franzini, Consultant – Data Analysis
Ongeleigh Underwood, Consultant – Supporting Author
Reinaldo Juan Lee Pereira, Consultant – Supporting Analysis

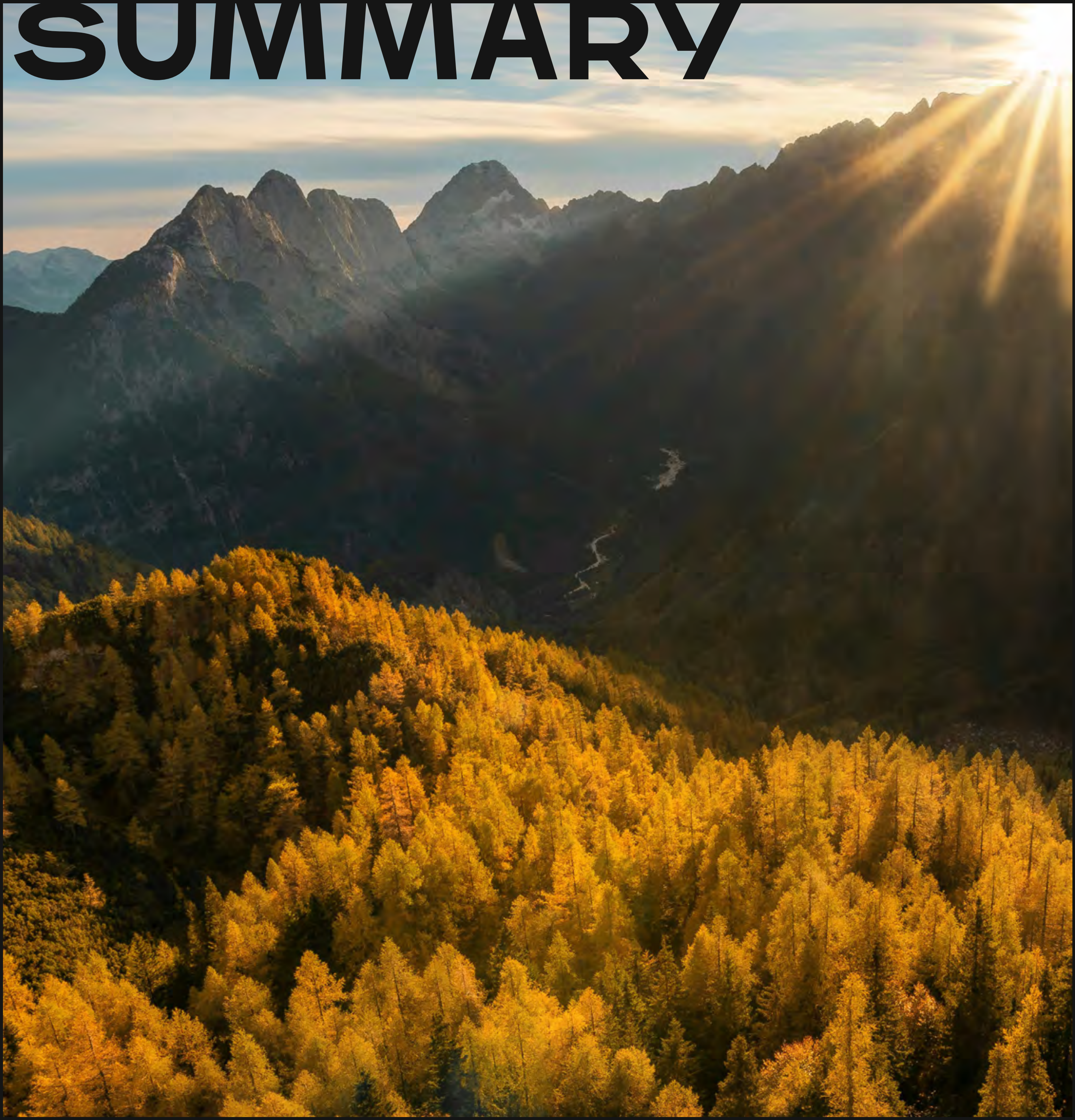
Design

Mariann Yattaw, Creative Director, XPRIZE Foundation – Creative Oversight
Michael Mahaffey, Co-Founder, Tiny Giant – Report Design

Thank you to all of the Teams who have taken on the challenge of competing for the XPRIZE Carbon Removal.

TABLE OF CONTENTS

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

GETTING TO GIGATONNE

Launched in 2021, the XPRIZE Carbon Removal was created to catalyze the growth of a new trillion-dollar industry to reverse climate change. Getting to gigatonne scale carbon removal will be one of the greatest grand challenges humanity has ever faced, and we are just getting started.

The competition has challenged Teams from around the world to remove 1,000 net metric tonnes, or one kilotonne, of CO_2 from the air or ocean over a one year demonstration period. Over 1,300 Teams from 88 countries took on the challenge and registered to compete. After three years of developing their carbon dioxide removal (CDR) solutions, several rounds of judging, and incredible accomplishments by Teams, XPRIZE announced the Top 100 most promising carbon removal innovators in April 2024. The final winners of the prize will be announced in Spring 2025.

This report is an analysis of the Top 100 Teams, using data from their submissions to the Finals of the competition from February 2024. This data is a helpful benchmark for the industry, as it represents a diverse cohort of "novel" CDR solutions from 25 countries across many pathways that we broadly categorize within four tracks: Air, Oceans, Land, Rocks. These Teams are all currently removing CO_2 or working to do so for the first time this year, a significant milestone for the industry. In addition to analyzing real kilotonne scale operating data, this report looks at scaling trajectories and projections around reaching the first megatonne scale carbon removal projects.

Although the accomplishments of these Teams to date are impressive, we have a long way to go. The first gigatonne of CO_2 removed will be the hardest, and we will need to work together to get there. We hope this report will be helpful in supporting the industry develop and grow, and share learnings as quickly as possible. We will continue to publish real-time data throughout and after the prize to support this mission.

MEET THE TOP 100

MEET THE TOP 100

AIR

8 Rivers Capital LLC
AC Carbon Capture
Air Company
Airhive
Carbon Atlantis
Carbyon
DeCarbon Tech
Direct Air Capture LLC
Ecomerit Technologies of the Pacific

EPFL Carbon Team
Global Thermostat
Heirloom
Holocene
Noya
Octavia Carbon
Origen Carbon Solutions
Partanna Global, Inc
Project Arrow

Project Hajar (44.01+Air Capture)
Skyrenu Technologies
Spiritus
Sustaera
Team Lichen
Terrafixing
YOUWAN Method for CO_2 Removal

LAND

Alaska Future Ecology Institute
All Power Labs
Answer of Biochar (AOB)
ARTi
Bamcore
BioCapture
BioCarbon
Biochar Now
Bioeconomy Inst. Carbon Removal Team
BIOSORRA
Blusky
Carba
Carbo Culture

Carbon4Climate
CarbonStar Systems
Charm Industrial
Climate Robotics
ClimateAdd
Consolidated Carbon
Cowboy Clean Fuels
Gigafex
Global Algae Innovations
Hago Energetics
HempOffset - Tao Climate
Loam Bio
MASH Makes

Mercurius Rising
NetZero
NForests
Plantd
PlantVillage
PyroCCS
Rizome
Sonnenerde
SPSC GmbH
Takachar
Tierra Prieta
Vaulted Deep
Wood Vault

OCEANS

Butterfly Carbon
Captura
CarbonQuestX
Ebb Carbon
Gigablue
Kelp Blue
Kepler Carbon ReCapture

KFC (KelpFarmCareer)
Marine Permaculture Seaforestation
Ocean Nourishment
Planetary
PRONOE
Pull To Refresh
Rewind

ROCS
RubisCO2
Running Tide Technologies
Seafields
SeaO2
Sinkco Labs
Vesta

ROCKS

Arca
Aspiring Materials
Be CDR - BioEnergy X
BICOS
Carbonaught

K - Carbon Mineralization Flagship Center
Lithos Carbon
Mati Carbon
MCI Carbon X Carbon Collect
Metalplant

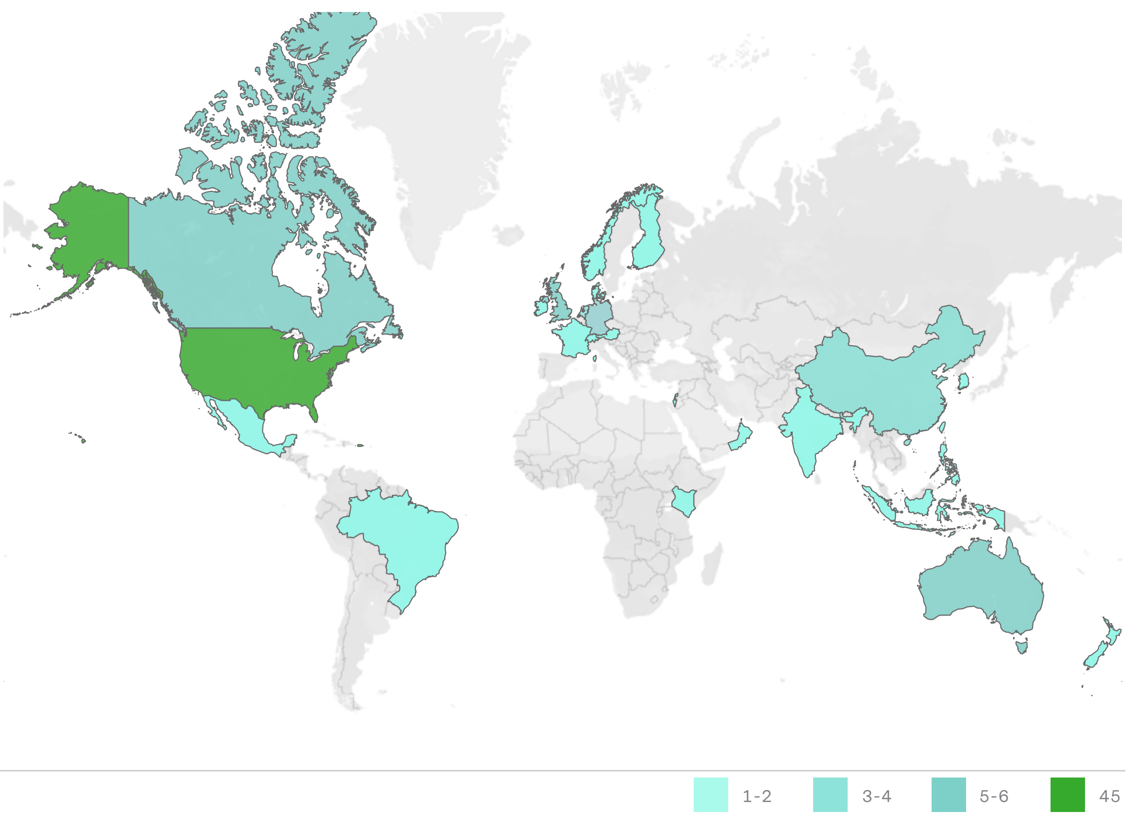
Neustark x Carbfix
Silicate
UNDO Carbon
Verde Agritech
Yuanchu

MEET THE TOP 100

GEOGRAPHIC DISTRIBUTION

The Top 100 Teams join the competition from 25 countries. 52% of the companies are headquartered in North America, 26% in Europe, 11% in Asia, 7% in Oceania, 2% in Africa, and 2% in Latin America. This distribution is both a reflection of where there is significant startup activity relevant to CDR and general access to funding opportunities. There is a small but growing community of CDR innovators in the Global South, several of whom have continued to advance through the competition. We hope to see continued growth in the Global South moving forward.

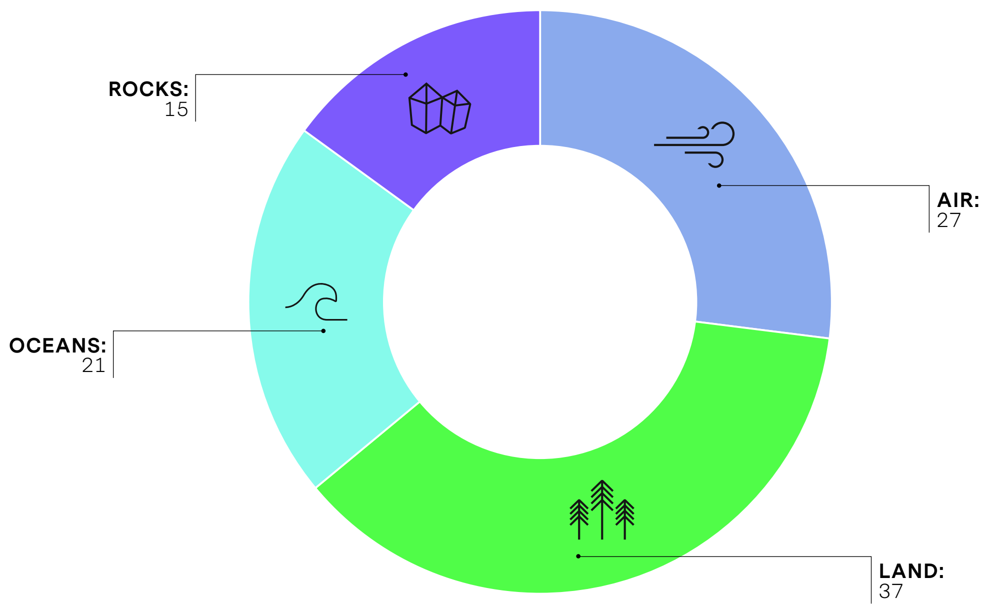
HQ Country	
United States	45
Germany	6
United Kingdom	5
Canada	5
Australia	5
China	4
Netherlands	3
Switzerland	2
Philippines	2
New Zealand	2
Mexico	2
Kenya	2
Israel	2
Ireland	2
France	2
Brazil	2
Taiwan	1
South Korea	1
Oman	1
Norway	1
Indonesia	1
India	1
Finland	1
Denmark	1
Austria	1
Total	**100**



SOLUTION TYPES

XPRIZE Carbon Removal describes four “tracks” within the scope of the competition: Air, Land, Oceans, and Rocks. Within each track, a wide variety of pathways exist that are outlined in more detail on the following page.

BREAKDOWN BY TRACK



HYBRID SOLUTIONS

The lines between these four categories are not solid, nor is the competition limited to those tracks and pathways listed here. In fact, our data suggests that nearly half (48%) of the Teams are pursuing what may be considered “hybrid” solutions. The following 2-track combinations were most commonly reported:

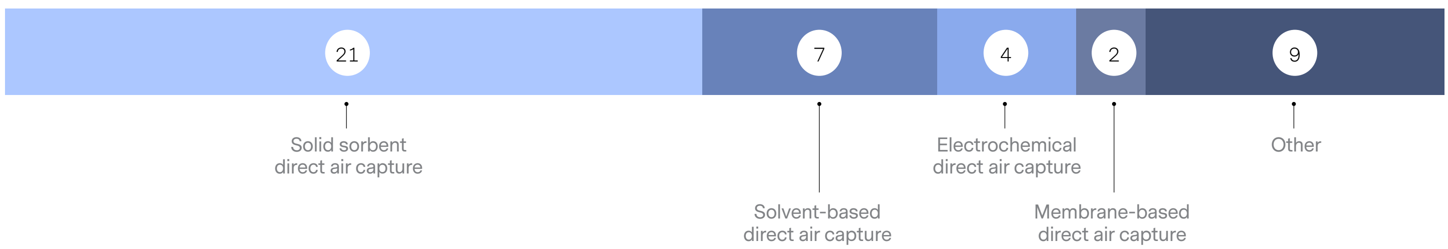
13	9	8	7	7	4
AIR + ROCKS	AIR + LAND	LAND + ROCKS	LAND + OCEANS	AIR + OCEANS	OCEANS + ROCKS

48
TOTAL

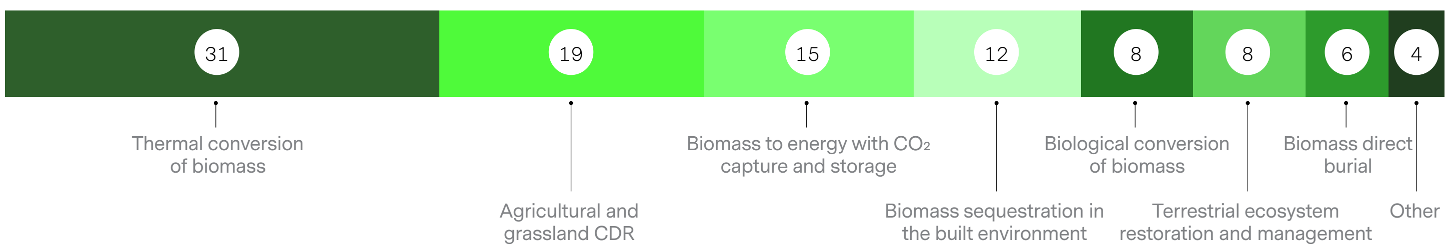
MEET THE TOP 100

BREAKDOWN BY PATHWAY

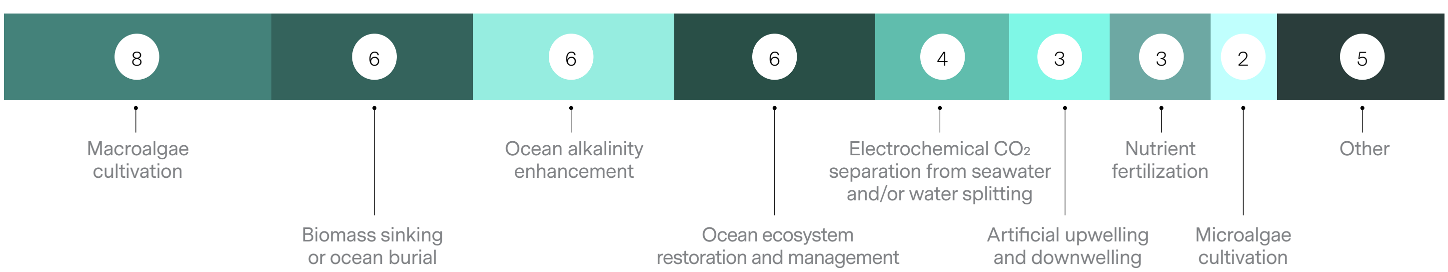
AIR PATHWAYS



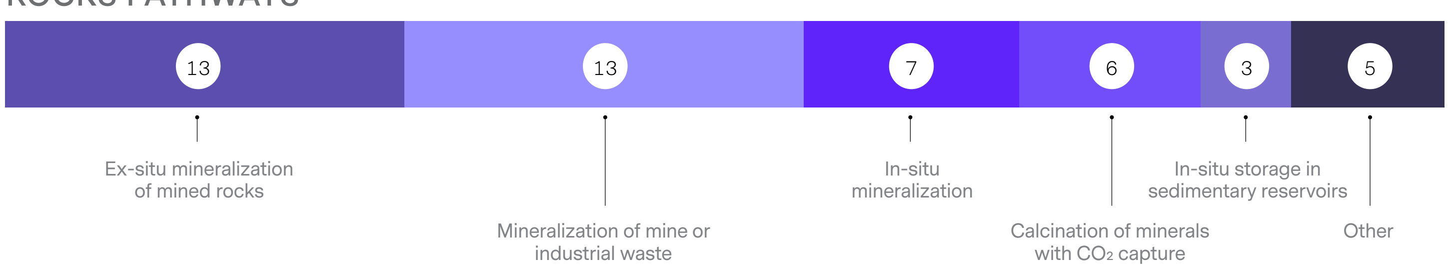
LAND PATHWAYS



OCEANS PATHWAYS

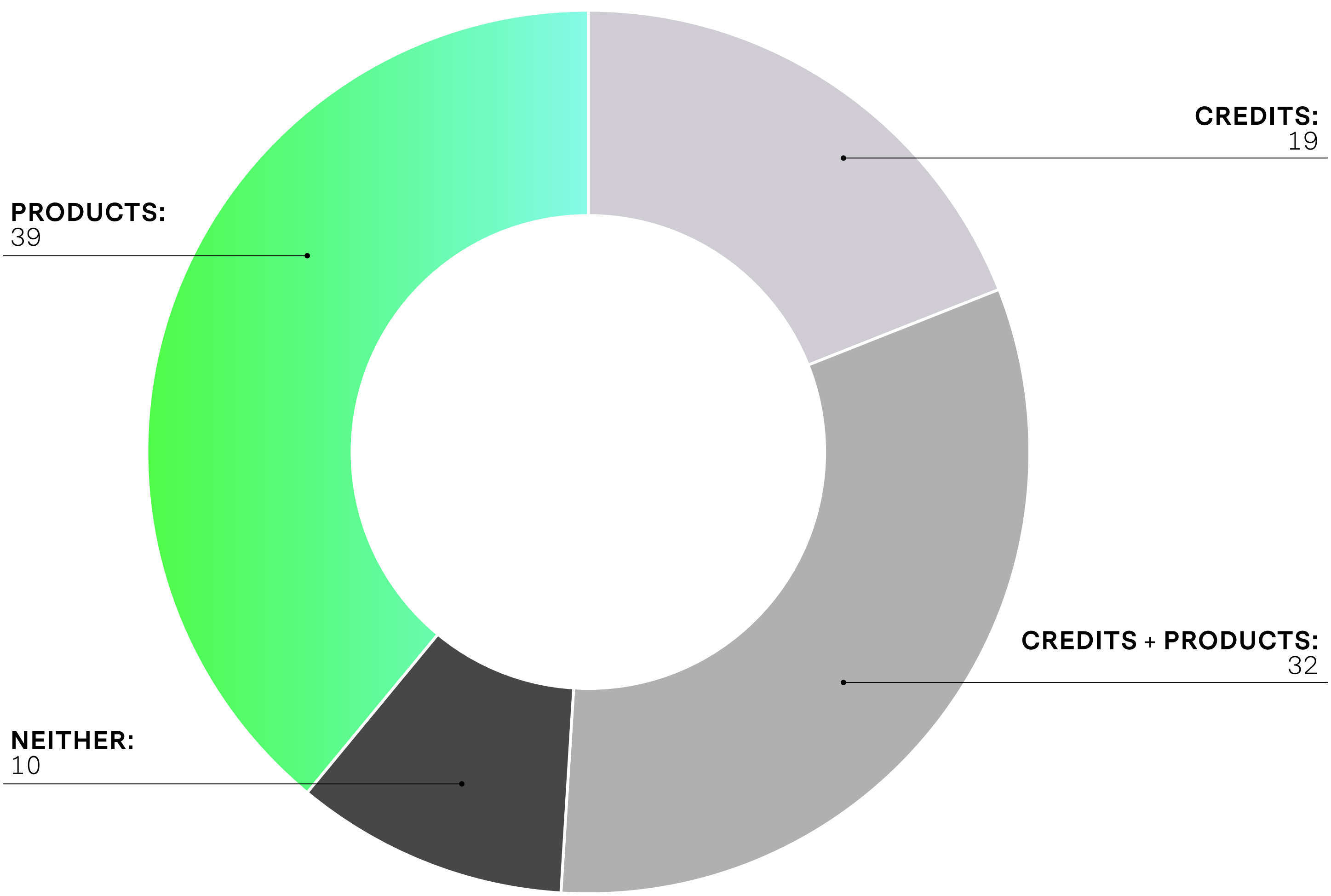


ROCKS PATHWAYS



BUSINESS MODELS

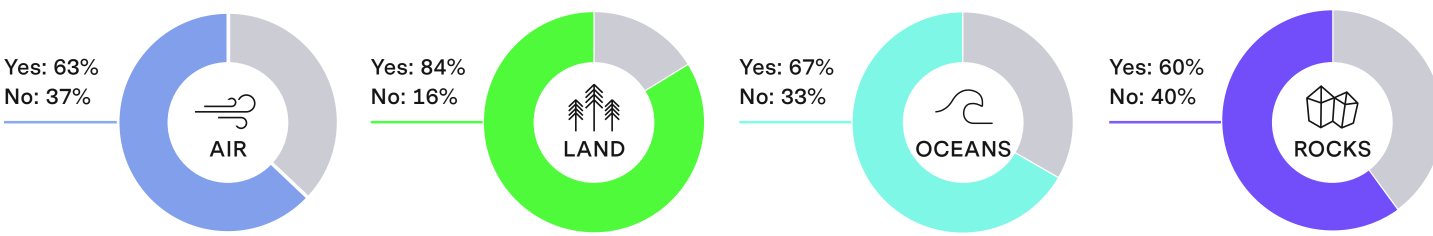
Generally there are two main sources of revenue for carbon removal companies: selling physical products or selling carbon removal credits. Thirty-two Teams (32%) in this report are pre-revenue, but we expect that most will eventually sell carbon removal credits. We also expect new business models to emerge moving forward, but for the time being we polled Teams on these two sources of revenue. Of the Top 100 Teams, 51% have sold credits to date and 71% make products.



MEET THE TOP 100

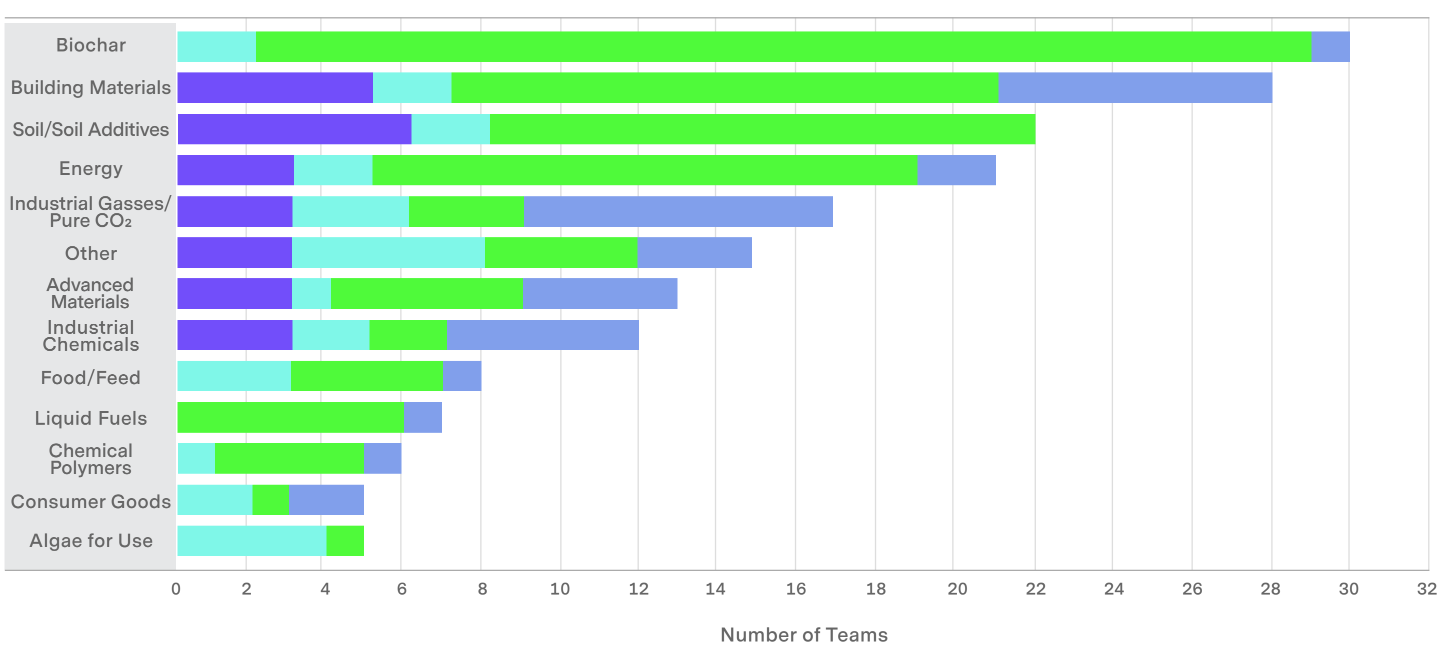
PRODUCTS

The majority (71%) of Teams report that they are making products. The Land track has both the highest percentage of companies making products (84%) and the greatest number of Teams (31) making products of any track. Additionally, about a third of all Teams are taking a combined approach by selling both a product and credits, with the majority of those Teams in the Land track.



The top product categories represented across all tracks are biochar, building materials, soil, energy, and industrial gasses/pure CO_2. Note that some Teams are making multiple products, so those counts are reflected in the data.

TOP PRODUCT CATEGORIES



- Industrial Gasses (8)
- Building Materials (7)
- Industrial Chemicals (5)

- Biochar (27)
- Building Materials, Energy, Soil (14)

- Other (5)
- Algae (4)
- Food/Feed, Industrial Gasses (3)

- Soil (6)
- Building Materials (5)
- Advanced Materials, Energy, Industrial Chemicals, Industrial Gasses, Other (3)

PRIZE IMPACT

The prize model is designed to accelerate innovation and leverage impact. XPRIZE Carbon Removal launched in 2021, and in just three years, the Top 100 Teams have made some incredible accomplishments. A few highlights include:

5.84 M
Total Hours Worked

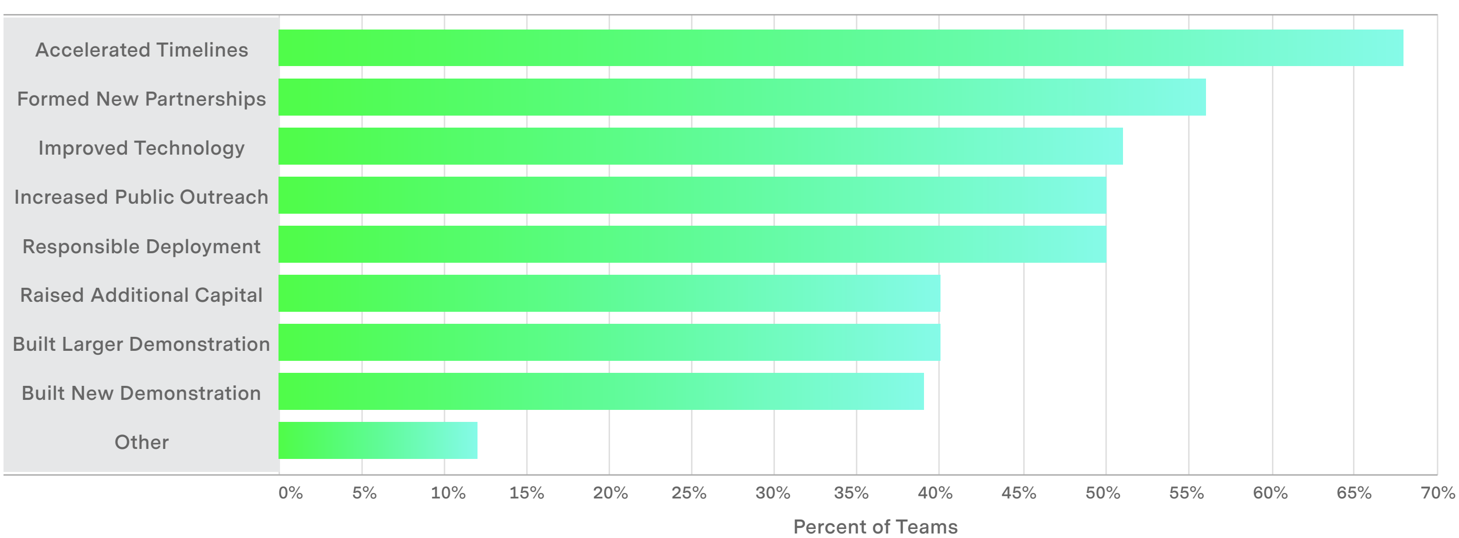
939
Total Patents Filed

862
Partnerships Established

52%
Built First Demo for the Prize

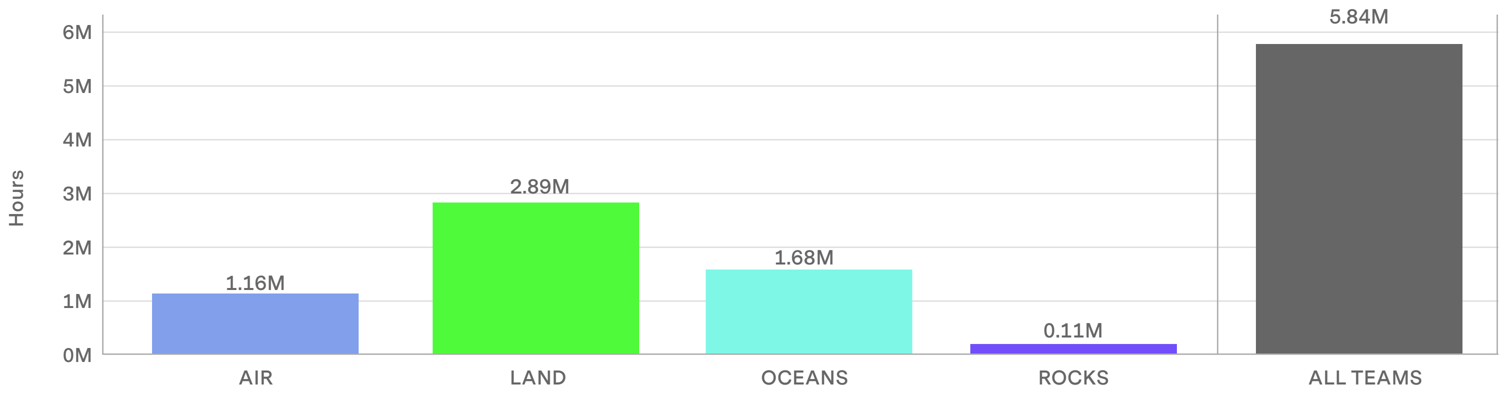
The goal of XPRIZE Carbon Removal has never been about only selecting a single winner, but building a strong new industry of successful carbon removal companies who can collectively get to gigatonne scale. In order to do this, the prize was designed to accelerate technology development lifecycles, focus on high-quality removals, advance the rate of capital deployment, and build the broader ecosystem. XPRIZE polled Teams on the most significant ways their participation in the competition has impacted their efforts:

IMPACT OF PRIZE ON TEAMS' EFFORTS

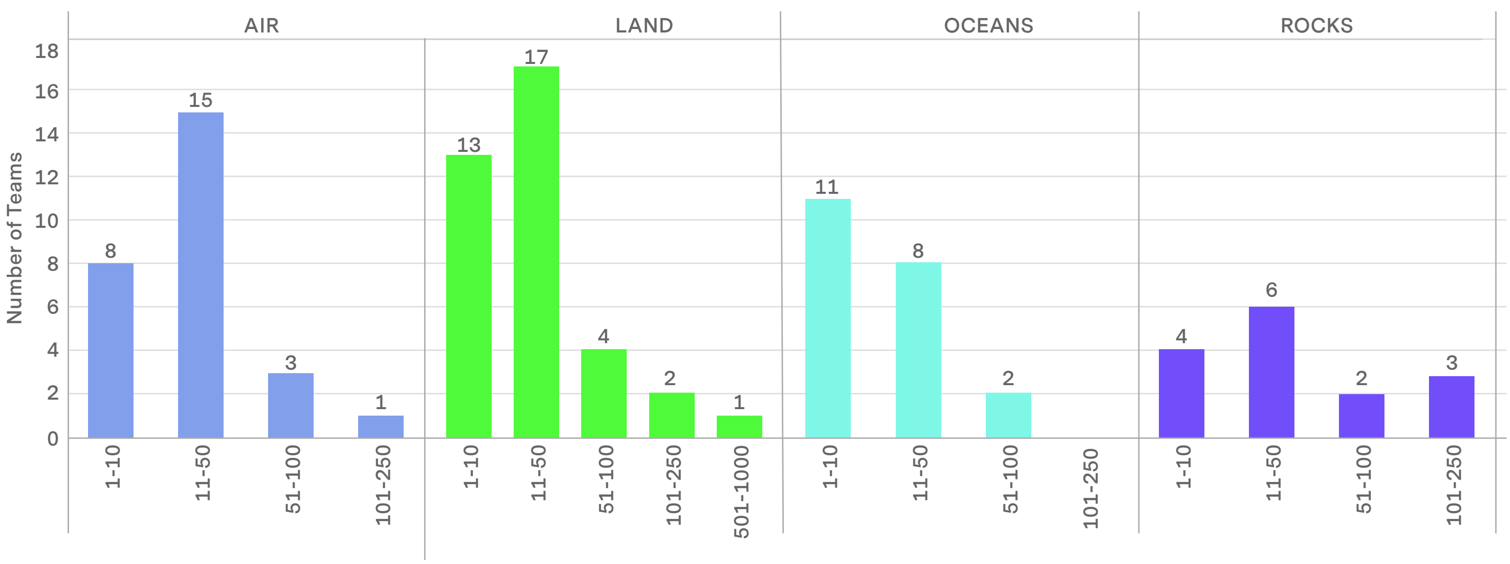


MEET THE TOP 100

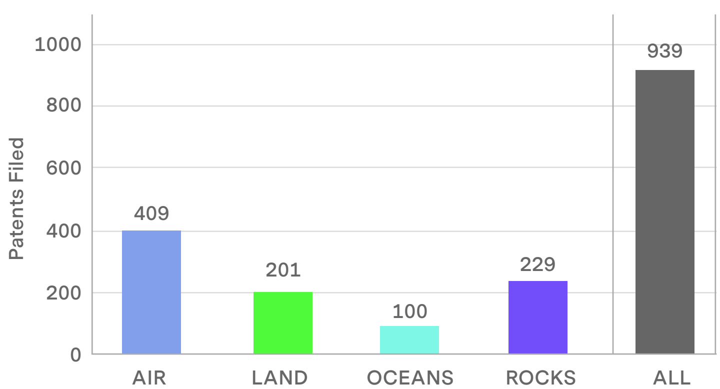
HOURS WORKED



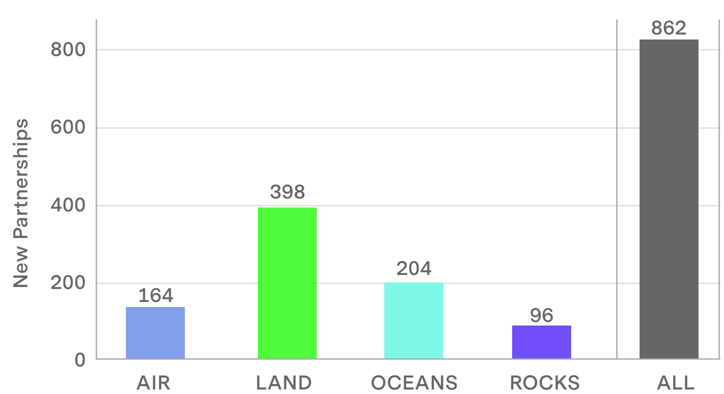
NUMBER OF EMPLOYEES



PATENTS FILED



NEW PARTNERSHIPS ESTABLISHED



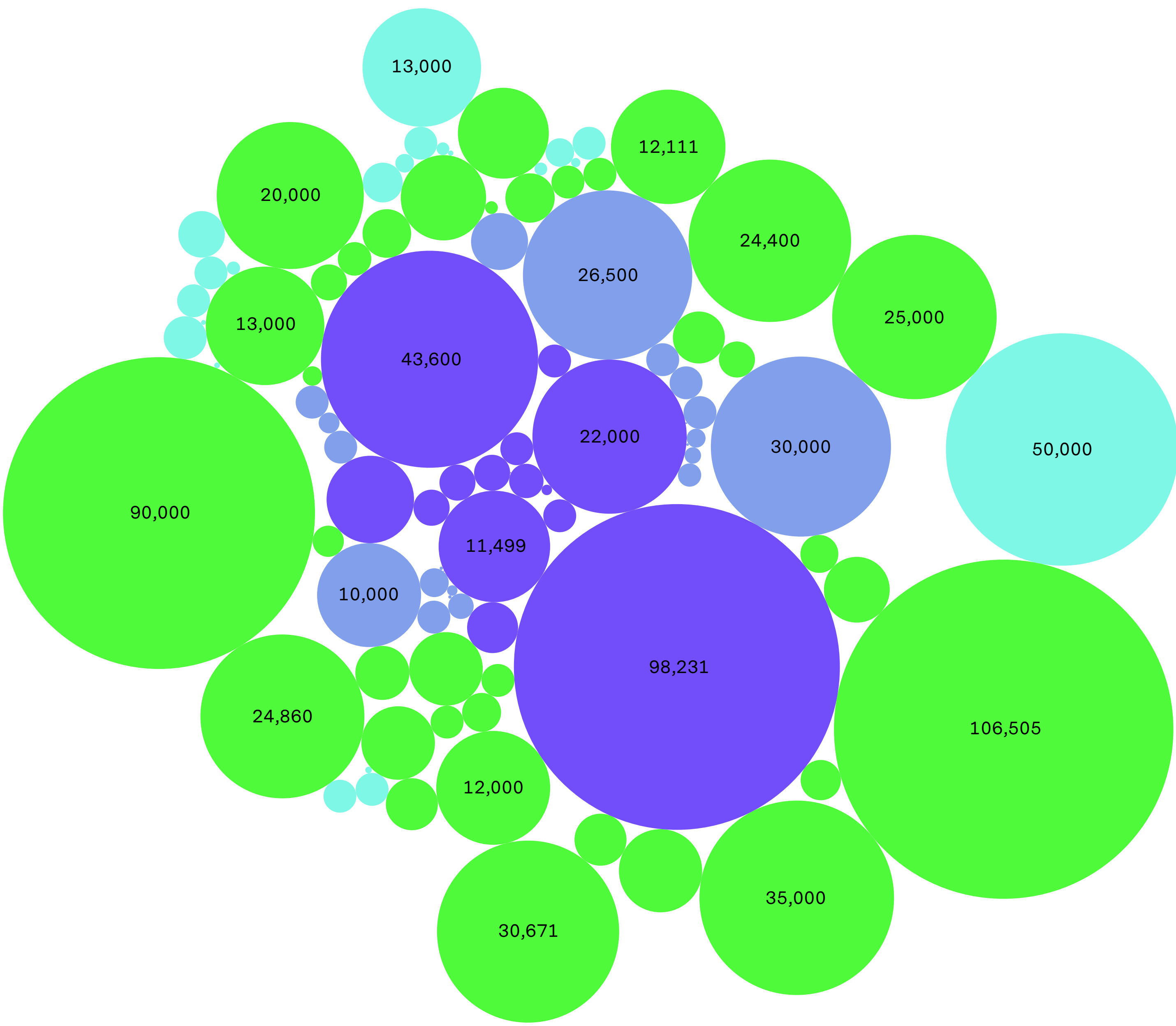
FIRST STOP: KILOTONNE

FIRST STOP: KILOTONNE

While we have a long road ahead to reach our 2050 climate goals, a significant and critical milestone on that journey is building a diverse array of kilotonne scale CDR demonstrations.

XPRIZE set the competition target to remove and durably sequester one kilotonne, or 1,000 metric tonnes, of carbon dioxide from the air or ocean over a one-year period. This is a meaningful benchmark to demonstrate the technical and operational maturity of a CDR project, as it requires Teams to build and operate an integrated, end-to-end system, operate it for a significant period of time, and manage significant volumes of CO_2. For many companies, this will be the first time their systems remove CO_2 on a net basis.

ANTICIPATED REMOVALS IN 2024 (TONNES)



FIRST STOP: KILOTONNE

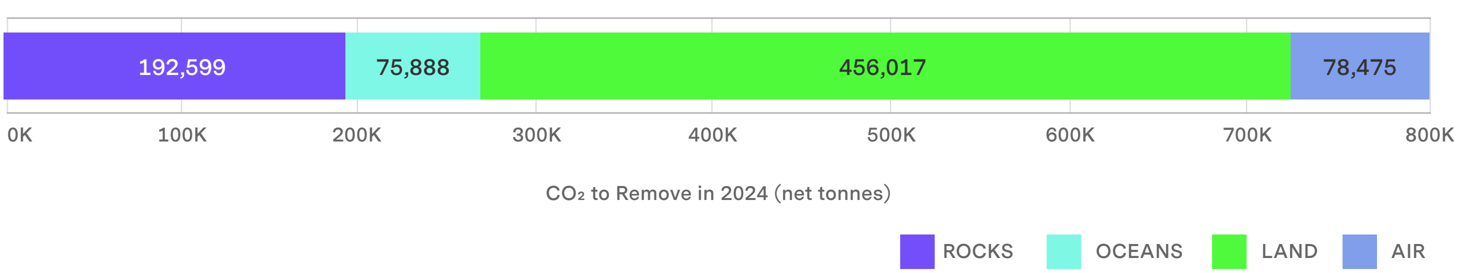
2024 SCALE

While there are some larger projects out there, most CDR companies currently operate at or below the kilotonne scale. For many competitors in the XPRIZE, 1,000 tonnes is a stretch goal. For other types of more established pathways or companies, especially in the Land track, exceeding that scale will be possible. Sixty-three Teams (63%) in the Top 100 anticipate removing between 0-1, 500 tonnes of CO_2 in the final year of the competition.

SCALE (net metric tonnes CO_2 per year)	NUMBER OF TEAMS
0 - 500 tonnes	29 Teams
501 - 1,500 tonnes	34 Teams
1,501 - 10,000 tonnes	18 Teams
10,001+ tonnes	19 Teams

CUMULATIVE REMOVAL PROJECTED IN 2024

The Top 100 Teams project that they will cumulatively remove a total of 802,979 net tonnes of CO_2 in 2024. This breaks down as follows across tracks as follows:

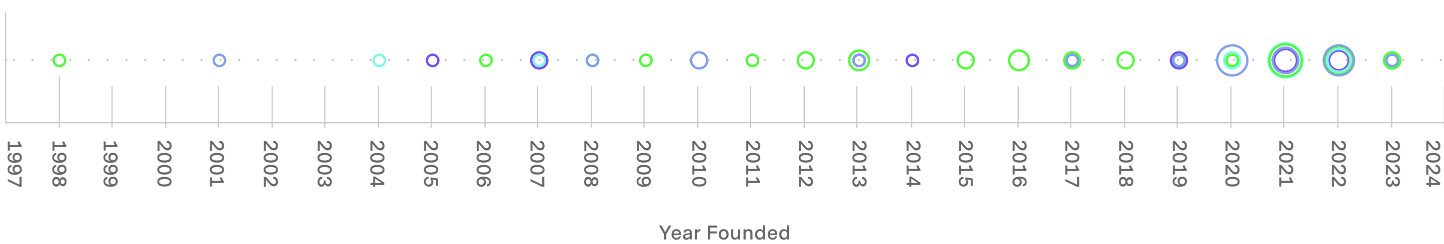


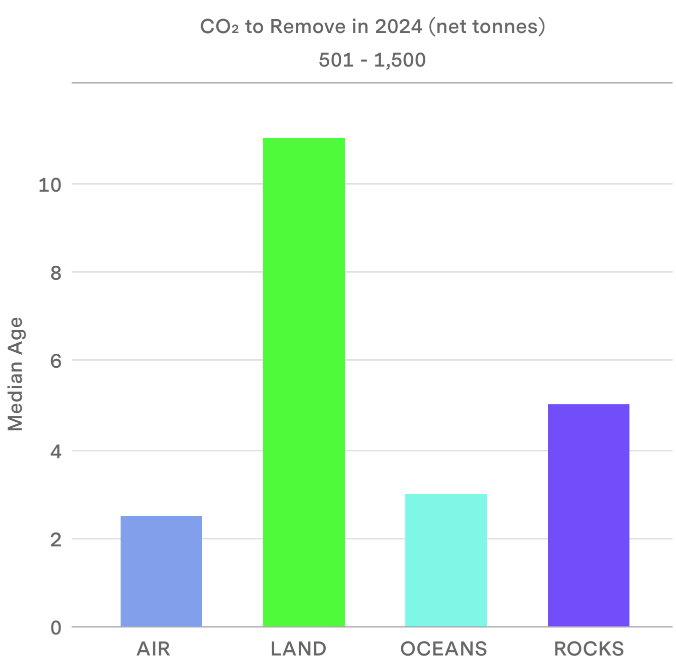
FIRST STOP: KILOTONNE

TIME TO KILOTONNE

The carbon removal industry has seen tremendous growth in recent years, with 51% of companies in the XPRIZE Top 100 having been founded since the prize launched in 2021. 2020-2022 were also the greatest years of growth across all four tracks.

YEAR FOUNDED





Comparing founding year data against scale data for the Top 100 offers some interesting insights around technology development timelines. Of the Teams operating at a range of 501-1,500 tonnes per year, the median organization age is 4 years (7.88 years average).

FIRST STOP: KILOTONNE

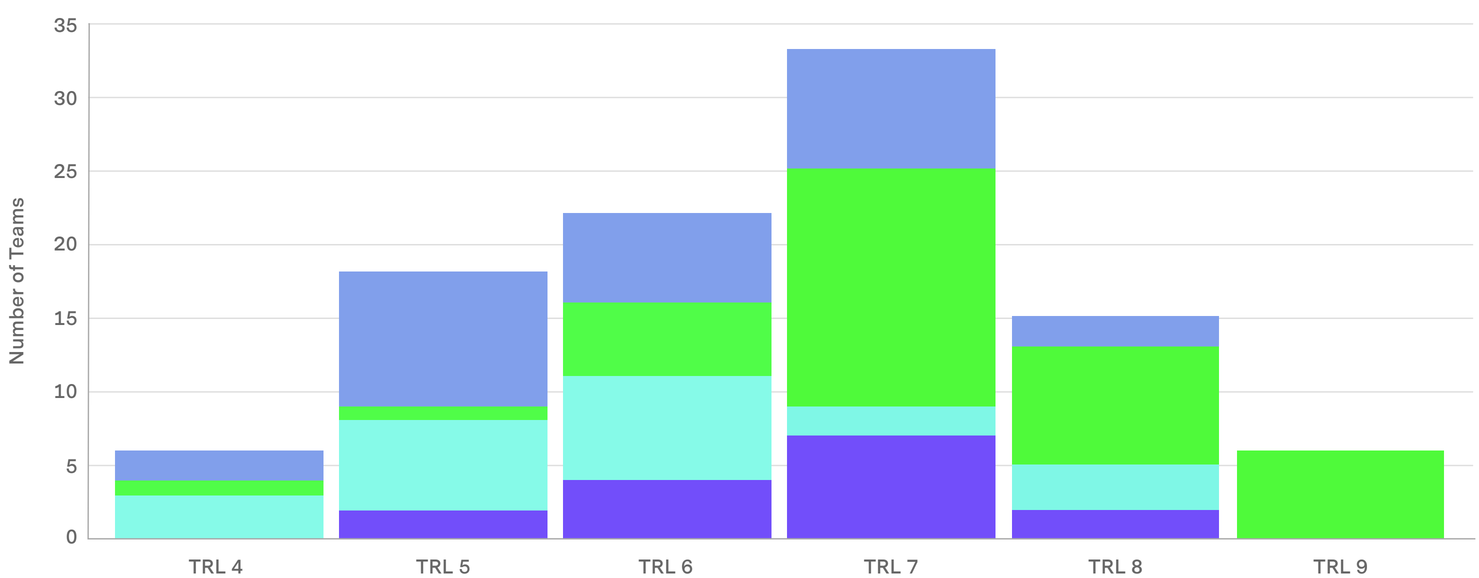
TECHNOLOGY DEVELOPMENT LIFECYCLES

Technology Readiness Level (TRL) is a common framework used to benchmark the state of development of new technologies. The Technology Readiness Levels range from 1 (lab-level research of basic principles) to 9 (commercially proven technology).[1]

XPRIZE has not mandated a specific TRL level for winning solutions, but the competition requirements imply a level of technical maturity. The key requirement of the final round of the competition is that the demonstrated CDR project must be complete in scope (encompassing both capture and sequestration) and it must be operating in the field (i.e., "relevant environment"). Systems or major subsystems need to be built, not modeled. Major subsystems should be, for the most part, integrated with one another to work together. While the system does not need to be fully commercialized, the performance must be such that it demonstrates overall net-negative performance.

Together, these requirements suggest ideal candidates will be in the TRL range of 6 (prototype validated in a relevant environment), 7 (system prototype validated in an operational system), or 8 (actual technology successfully commissioned in an operational system). Although demonstrations at lower or higher stages of development may win the prize (provided they meet the other competition requirements), the majority of the Top 100 fall within this range of technology readiness.

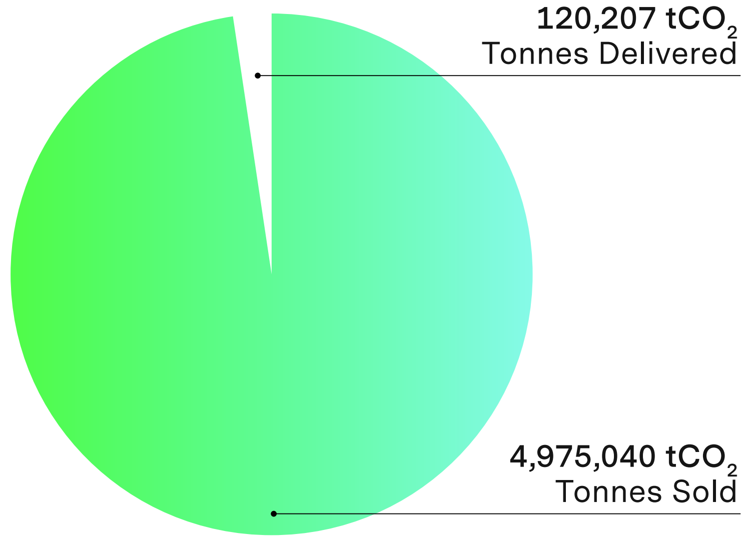
BREAKDOWN BY TRL



[1] Skone et. al (2022) Carbon Dioxide Utilization Life Cycle Analysis Guidance for the U.S. DOE Office of Fossil Energy and Carbon Management Version 2.0. National Energy Technology Laboratory, Pittsburgh.

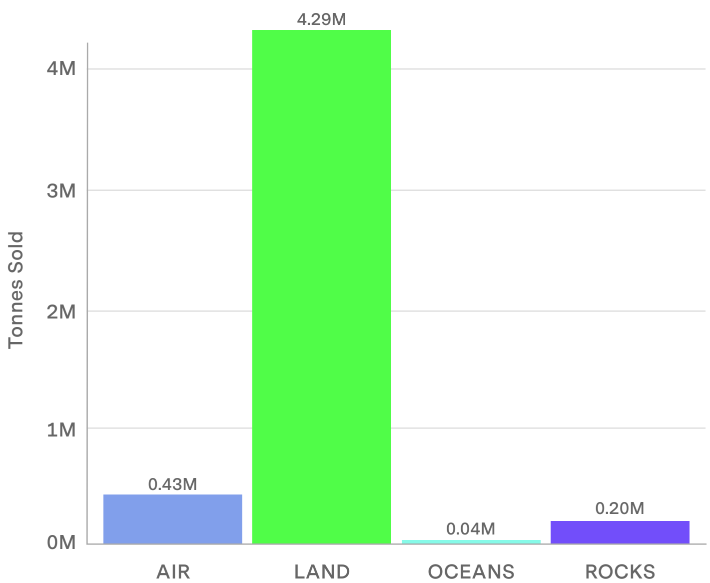
SALES AND DELIVERIES

In addition to working on building first-of-a-kind demonstrations, many Teams are already selling carbon removal credits. To date, 51 of the Top 100 Teams have sold credits. Cumulatively, these 51 Teams have sold 4.975M tonnes, yet only a small portion of these, 120,207 tonnes, have been delivered to date.

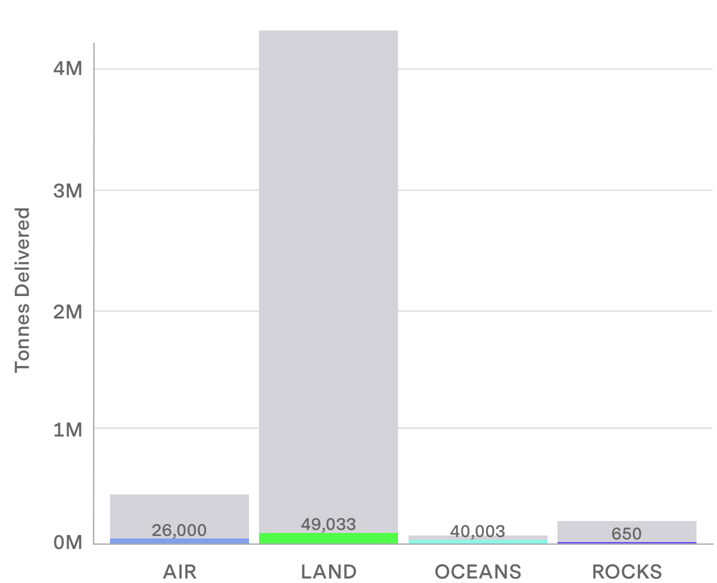


The distribution of the number of Teams selling credits is fairly equal across tracks, with Rocks having the highest percentage (53%) of projects selling credits. The Land track, however, has the highest number of projects selling credits (19) as well as the highest volume of tonnes sold to date (4.29M) and delivered to date (49,033).

TONNES SOLD TO DATE*



TONNES DELIVERED TO DATE*



* As of 1/31/2024

FIRST STOP: KILOTONNE

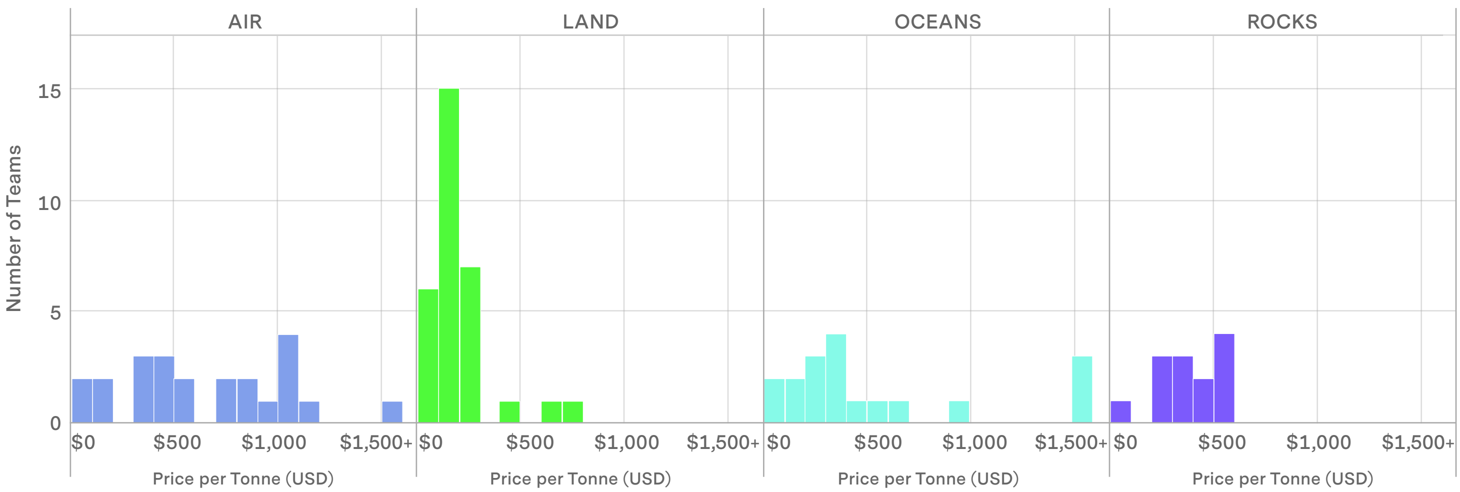
The diversity of CDR solutions generate a wide range of prices within the sale of carbon removal credits. Across the Top 100 cohort, the average price for 2024 credit sales was $417/tonne, with a median price of $290/tonne.

It is important to state that while these are the current 2024 prices reported by Teams, we do not believe these to be representative of the actual cost of removal. Rather they are representative of what the current market will bear.

CDR CREDIT SALE PRICE IN 2024 (USD PER TONNE)

TRACK	NUMBER OF TEAMS	AVERAGE PRICE	MEDIAN PRICE
AIR	27	$620	$500
LAND	37	$186	$165
OCEANS	21	$596	$313
ROCKS	15	$359	$330
OVERALL	**100**	**$417**	**$290**

For comparison, these prices are aligned with the average prices referenced by CDR.fyi: Air - $690, Land - $209, Oceans - $790, Rocks - $340, with the exception of the price per tonne for Oceans with a higher variance[2].



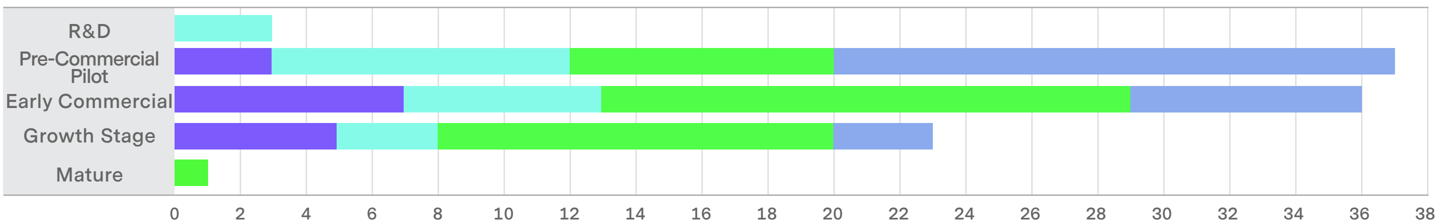
[2] CDR.fyi Pricing Index referenced at the time of publication (May 1, 2024).

FIRST STOP: KILOTONNE

COMMERCIAL PROGRESS

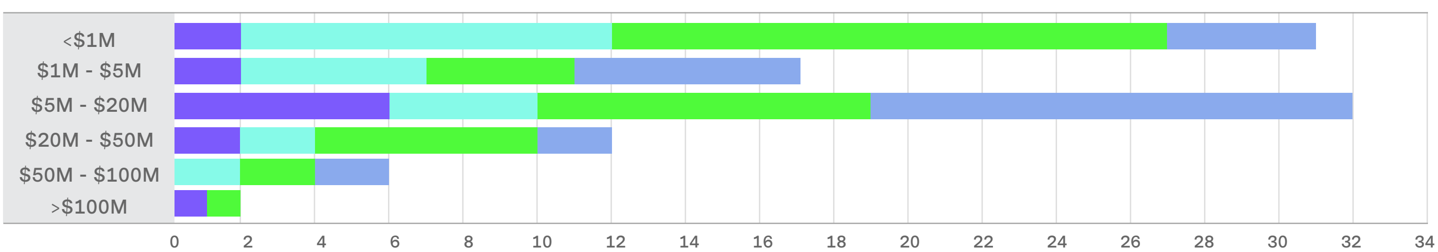
COMMERCIAL STAGE

The vast majority of the Top 100 Teams self-identify as being within the pre-commercial and early commercialization stages (73%), with 23% of Teams having moved into the growth stage. The Land and Rocks tracks have the most Teams in growth or mature stages, as these tracks also display more advanced TRLs in general.



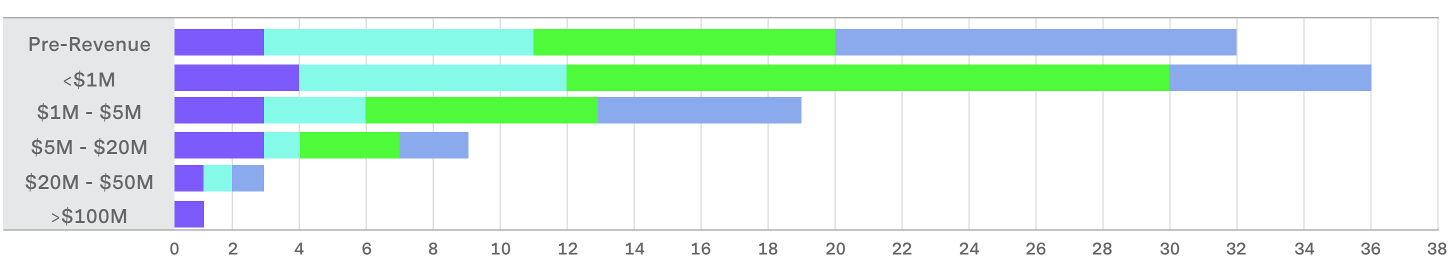
CAPITAL RAISED TO DATE

More than half (52%) have raised more than $5M USD, with 8 Teams having raised more than $50M. Still, 48% have raised less than $5M. The Air Teams have a larger median capital amount raised than Teams in the other tracks, while Land Teams have the largest variation.



REVENUE

Thirty-two Teams (32%) are pre-revenue. Air and Oceans have the most pre-revenue Teams (44% and 38%), while Rocks has the highest percentage of Teams (53%) generating more than $1M USD. Even as the annual revenues reported by Teams are generally modest at this point in time, it is encouraging to see 13% of Teams reporting revenues of more than $5M/year.



FIRST STOP: KILOTONNE

NET-NEGATIVE PERFORMANCE

It should go without saying that the most critical goal of any carbon dioxide removal project should be to remove more CO_2 than the project emits. However, for early stage CDR efforts, Teams often prioritize testing specific innovations or the performance of parts of the CDR system, waiting for larger scale deployments to accomplish net-negativity of the whole CDR system.

The competition requirement of net-negative, kilotonne scale demonstrations was set in order to challenge competing Teams to prioritize the net-negative performance of their complete CDR systems at a meaningful scale.

Net-negative performance must be proven through a detailed emissions accounting process. Along with other environmental impacts, the CO_2 footprint of a CDR system is commonly established by a life-cycle assessment (LCA) methodology. Applicants to the XPRIZE were required to complete a “Lifecycle Emissions & Cost Worksheet,” a structured template that follows an LCA methodology to assess each CDR project’s CO_2 footprint at their current demonstration scale (i.e., kilotonne), as well the CO_2 footprint (and cost) projected at the megatonne scale. The assessment is intended to be cradle-to-grave, encompassing the emissions associated with the feedstocks and waste streams of the processes, in addition to the footprint of the process itself.

The Emissions Worksheets submitted by the Top 100 Teams were screened for quality and completeness; 74 of the Top 100 Teams were included in this analysis. The figures reported here are self-reported by Teams and have not been verified by XPRIZE. The 20 finalist Teams’ life cycle performance will be independently verified during the final round of competition.

AVERAGE REMOVAL EFFICIENCY PER TRACK

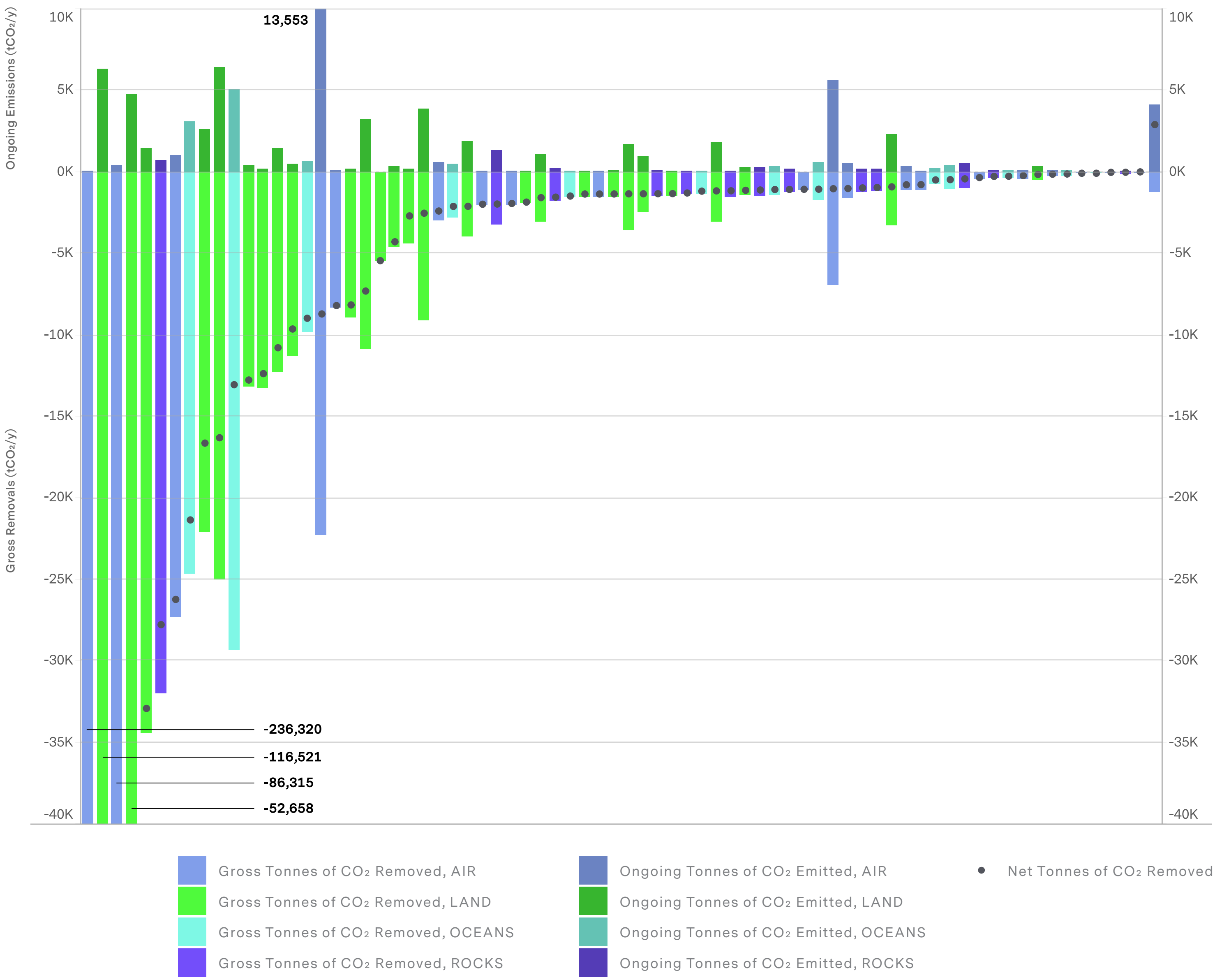
AIR	LAND	OCEANS	ROCKS
75.31%*	72.07%	69.52%	71.38%

*This average removal efficiency excludes 2 teams who are net-emitters in 2024.

FIRST STOP: KILOTONNE

EMISSIONS PROFILES OF TOP 100 TEAMS

The following figure shows the emissions profiles of the Teams that submitted complete Emissions Worksheets. Positive bars indicate the emissions associated with the process; negative bars indicate removals. The black dot indicates the net removals of each system.



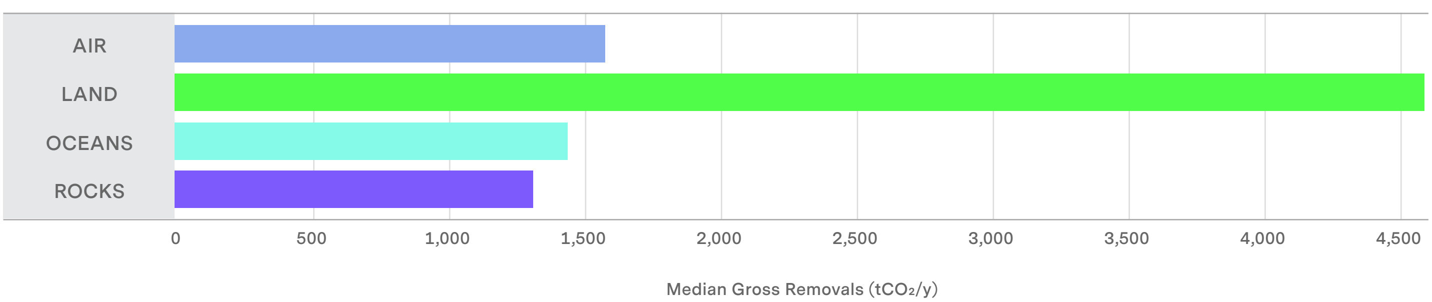
FIRST STOP: KILOTONNE

ANNUAL GROSS REMOVALS

Teams expect to remove a wide variety of volumes of CO_2 over the course of their XPRIZE demonstration, from 2 to more than 200,000 tonnes. These are gross removals, before discounting for the emissions related to those projects. While all four tracks contain a range of different project sizes, the Land Teams tend to be larger in scale.

MEDIAN ANNUAL GROSS REMOVALS (tCO_2/y)

TRACK	MIN	MAX	MEDIAN
AIR	2	236,320	1,540
LAND	508	116,521	4,624
OCEANS	94	29,348	1,420
ROCKS	118	32,000	1,332
ALL TEAMS	**2**	**236,320**	**1,838**



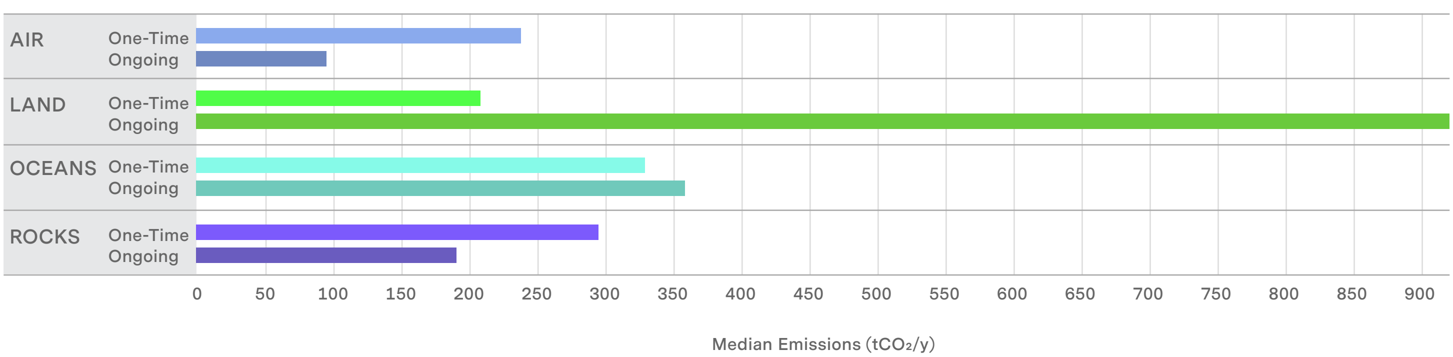
FIRST STOP: KILOTONNE

ANNUAL EMISSIONS

Teams were asked to account for both one-time emissions (due to construction, etc.) and ongoing emissions (due to consumption of feedstocks, energy, and other operational footprints).

ONE-TIME AND ONGOING ANNUAL EMISSIONS (tCO_2/y)

TRACK	ONE-TIME MIN	ONE-TIME MAX	ONE-TIME MEDIAN	ONGOING MIN	ONGOING MAX	ONGOING MEDIAN
AIR	0	4,846	234	0	13,553	92
LAND	7	8,326	210	1	6,406	929
OCEANS	0	1,524	329	9	5,088	358
ROCKS	0	8,269	295	30	1,296	186
ALL TEAMS	**0**	**8,326**	**246**	**0**	**13,553**	**291**



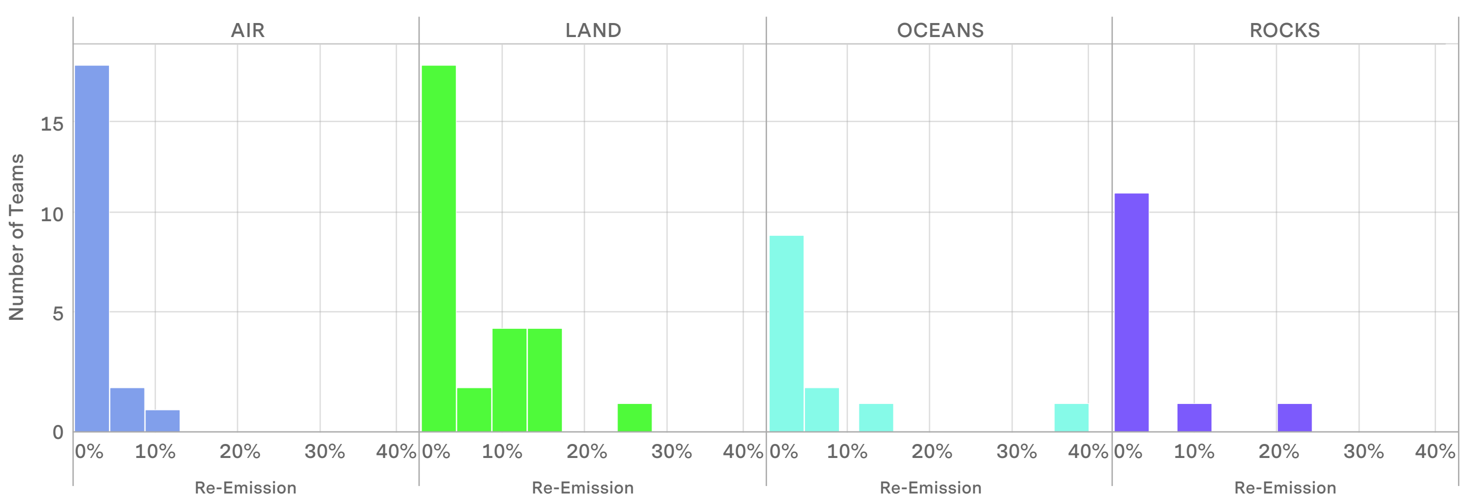
FIRST STOP: KILOTONNE

RE-EMISSION

Any sequestered CO_2 that can be expected to re-emit to the atmosphere within 100 years (the competition's durability requirement) must be accounted for as an emission.

EXPECTED RE-EMISSION OF SEQUESTERED CO_2 (%)

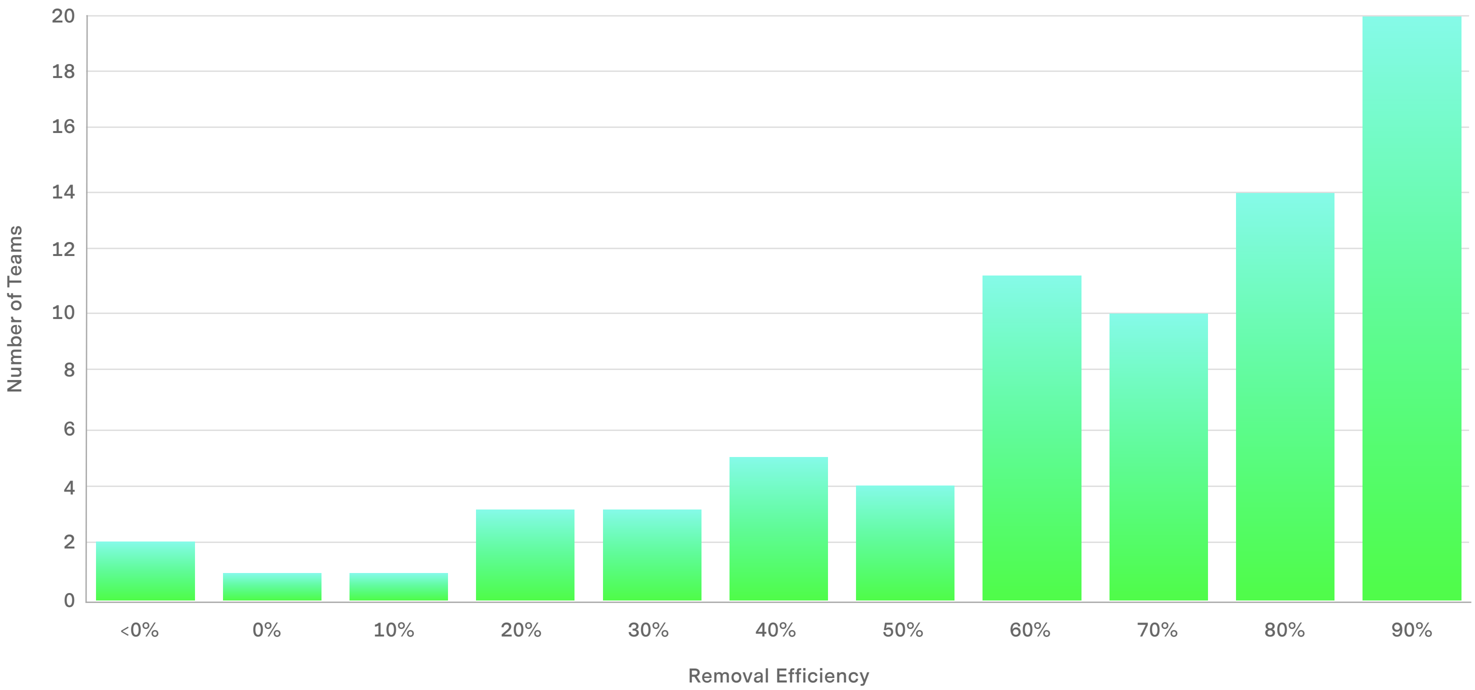
TRACK	MIN RE-EMISSION	MAX RE-EMISSION	AVG. RE-EMISSION
AIR	0%	10%	1.13%
LAND	0%	25%	5.33%
OCEANS	0%	38%	5.27%
ROCKS	0%	22%	2.46%
ALL TEAMS	**0%**	**38%**	**3.62%**

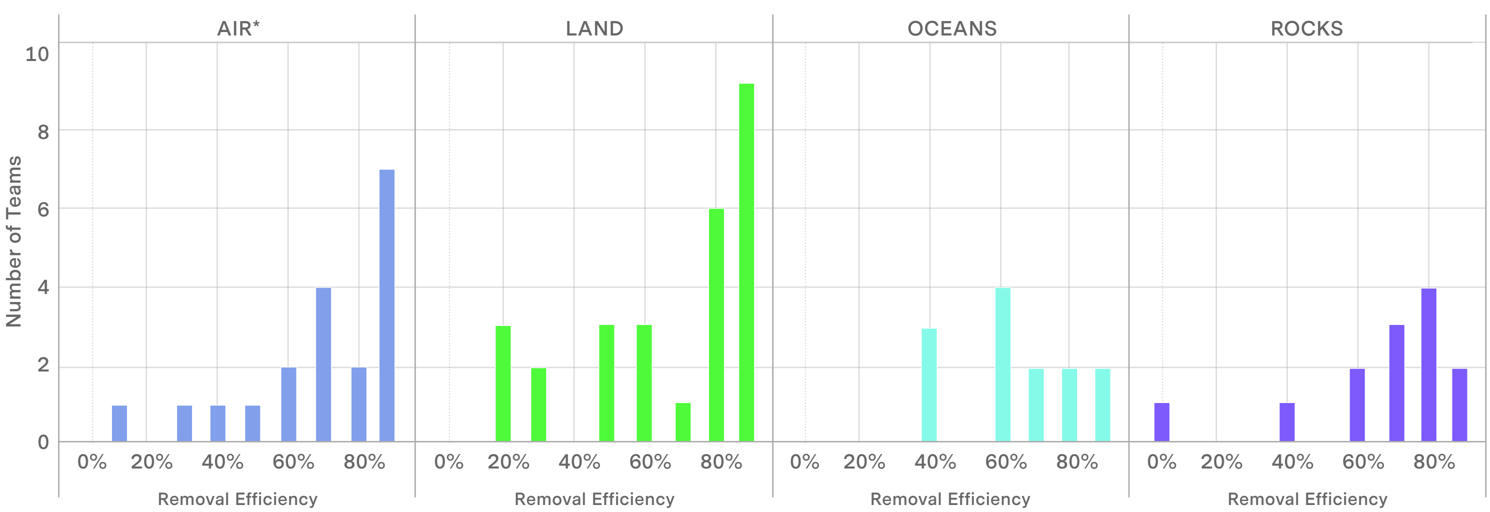


FIRST STOP: KILOTONNE

REMOVAL EFFICIENCY

Removal Efficiency indicates how effectively a system removes CO_2 compared with its emissions: A process with higher removal efficiency has relatively low emissions compared with its removals. A process with low removal efficiency, while still net-negative, may have greater emissions compared with its removals. A negative Removal Efficiency indicates that the system is a net-emitter.





*This chart excludes 2 Air Teams who are net-emitters.

RESPONSIBLE DEPLOYMENT

As the carbon removal industry develops and matures, it is essential it does so in ways that are good for people as well as the planet. XPRIZE has made responsible and equitable deployment of projects a priority in the competition, and has developed a number of resources to support Teams on this journey.

The competition rules require Teams to discuss their plans for addressing and achieving broad social license and acceptance, equity, and environmental justice. XPRIZE considers these attributes to be important goals in and of themselves, and also significant barriers to deployment at low cost and at gigatonne scale if ignored. Teams were asked to discuss their work to date and future plans related to: understanding impacted communities, conducting meaningful community engagement, assessing project risks and impacts, exploring potential project benefits, ensuring transparency and accountability, and building local capacity.

In 2023, XPRIZE published Breaking Ground: Guidance for Carbon Removal Companies and Funders on Responsible Project Deployment. In that white paper, 6 key dimensions of responsible project deployment were identified:

1. Characterizing relevant communities
2. Conducting meaningful community engagement
3. Assessing and mitigating impacts
4. Exploring and defining benefits
5. Ensuring transparency and accountability
6. Building resources and capacity

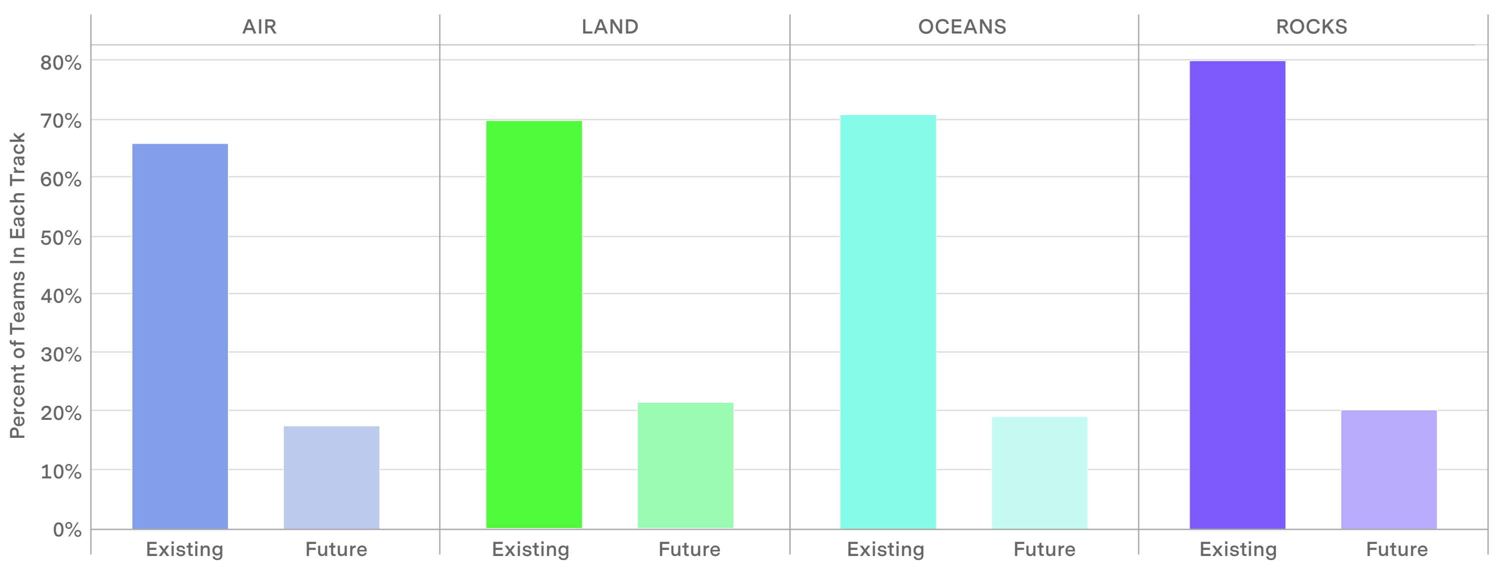
FIRST STOP: KILOTONNE

These dimensions in turn informed the XPRIZE Finalist submission questions, and below is a high-level summary of responses collected from the Top 100 Teams in that submission. The first two dimensions will be described with regards to Team's kilotonne scale demonstration projects, and dimensions 3-6 will be covered in more detail in the gigatonne chapter in the context of scaling.

To start, Teams were surveyed about whether they had already deployed resources (e.g., people, time, money) toward community engagement and environmental justice, versus those that had plans to do so in the future.

RESOURCES PLANNED OR DEPLOYED

	NUMBER OF TEAMS	PERCENTAGE
EXISTING	71	78%*
FUTURE	20	22%*

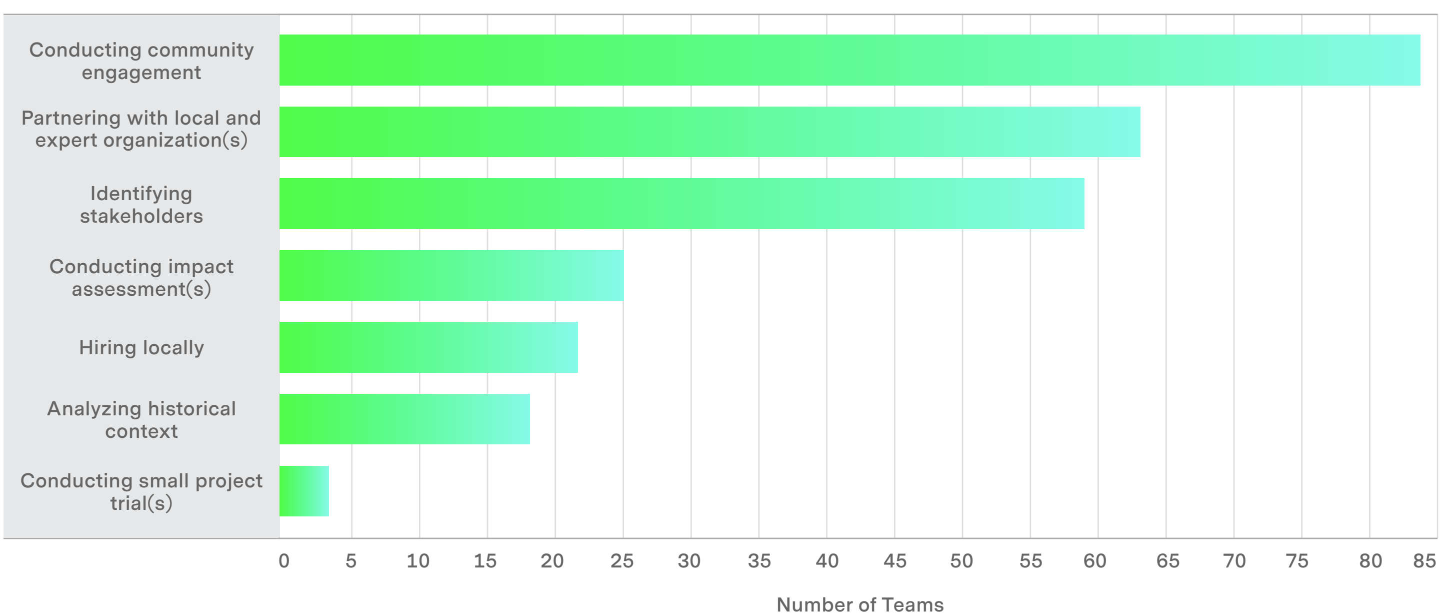


* This data is out of 91 Teams.

1. CHARACTERIZING RELEVANT COMMUNITIES

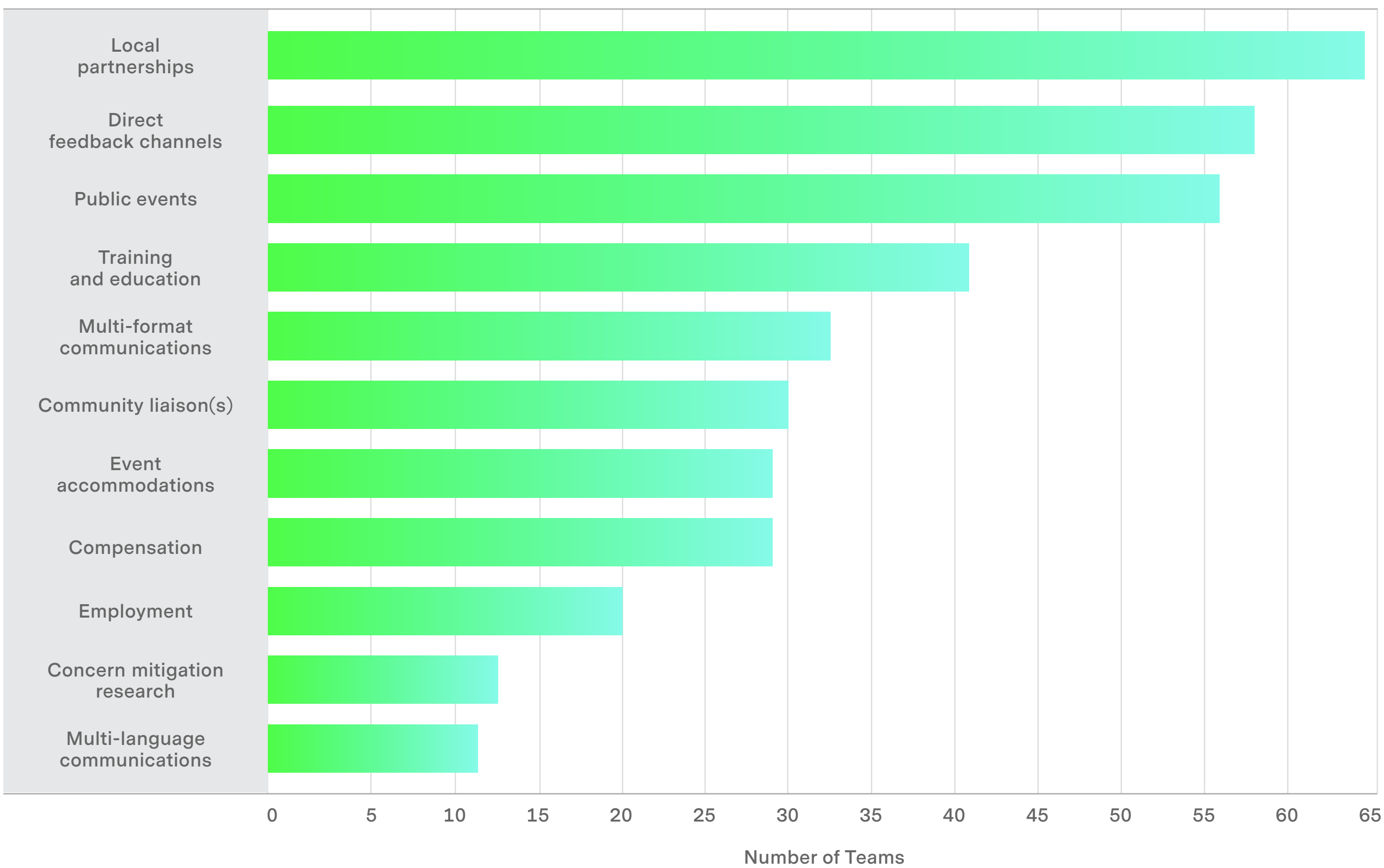
The first dimension Teams were surveyed on was the steps taken to understand the range of groups that might be potentially affected by project activities, or that might take an interest in them. Attention to the presence of Indigenous, minority or low-income groups is particularly essential, as well as to any groups or communities that may have experienced disproportionate harms from industrial or economic development or pollution (what we call here "environmental justice" or "EJ" communities). An adequate characterization of relevant communities involves conducting research to understand the cultural, socio-economic, legal, political, and ecological context of these groups in order to begin understanding their priorities and more effectively engage with them.

To conduct this research, Teams employed a variety of methods, predominantly through engaging with stakeholders and members of the community (84 Teams). We have included below an analysis of the specific ways that Teams are and are planning to conduct community engagement as they scale their projects. Teams also are relying heavily on partnerships with existing local organizations, including governmental bodies, to gain a deeper understanding of the historical, social, and political contexts into which they will be deploying their projects. A handful of Teams even mentioned conducting small trials ahead of official deployment to clearly identify which communities will be affected by their projects.



2. CONDUCTING MEANINGFUL COMMUNITY ENGAGEMENT

The second dimension Teams were surveyed on was their efforts around conducting meaningful community engagement. Responses showed that Teams are taking a range of steps to engage with their local communities. Establishing partnerships with local community leaders and organizations is the most common way that Teams (64) are or are planning to introduce their communities to their projects and the potential impacts, both negative and positive. Most Teams (58) are also planning to open direct, ongoing feedback channels and host public events (56) and educational opportunities (41), for which many will provide accommodations like childcare, transportation, and refreshments (29) and/or compensation, financial or otherwise (29).



NEXT STOP: MEGATONNE

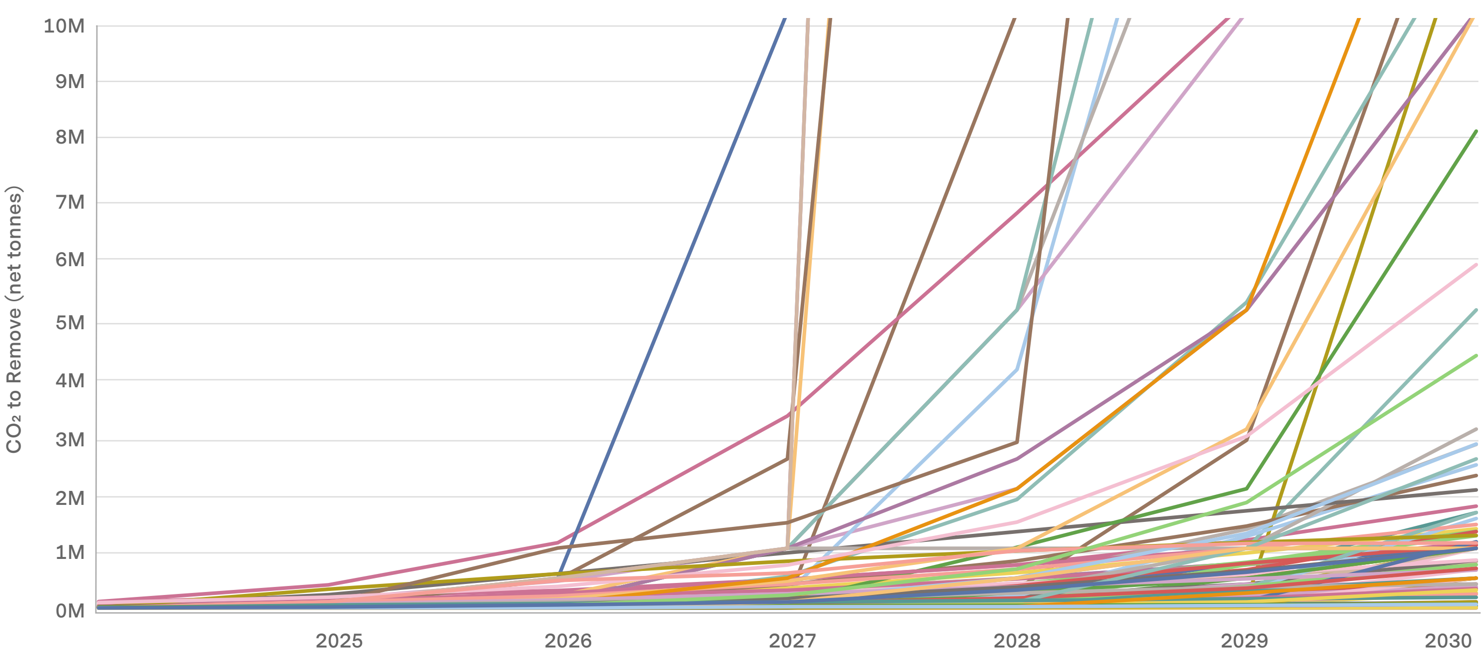
NEXT STOP: MEGATONNE

While a kilotonne scale demonstration is a significant milestone, 1,000 tonnes of CO_2 removed is tiny compared with the scale of our global CO_2 problem. At the megatonne scale (one million metric tonnes per year), the quantities of CO_2 being removed annually start to become more climate relevant.

Megatonne scale projects can be expected to exhibit mature operations, similar in scale to large commercial or industrial operations. Some rough analogies of megatonne scale systems include moderate-sized power plants, refineries, mining operations, or commercial farms. At the megatonne scale, economies of scale should also be realized. It is likely that most individual CDR projects will not exceed megatonne scale.

Through the XPRIZE Finalist Submission, Teams were surveyed about how they anticipate their solutions will scale between now and 2030, and what year they expect to reach megatonne scale.

GROWTH TRAJECTORIES OF THE TOP 100 TEAMS THROUGH 2030

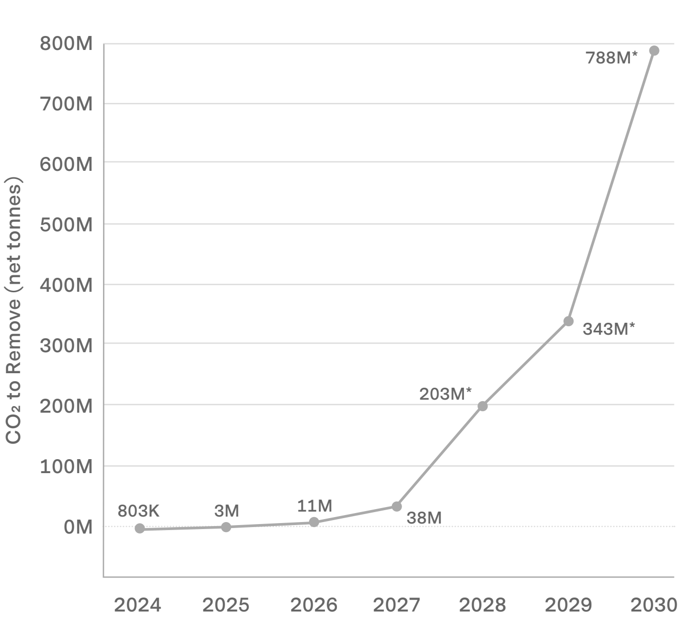


NEXT STOP: MEGATONNE

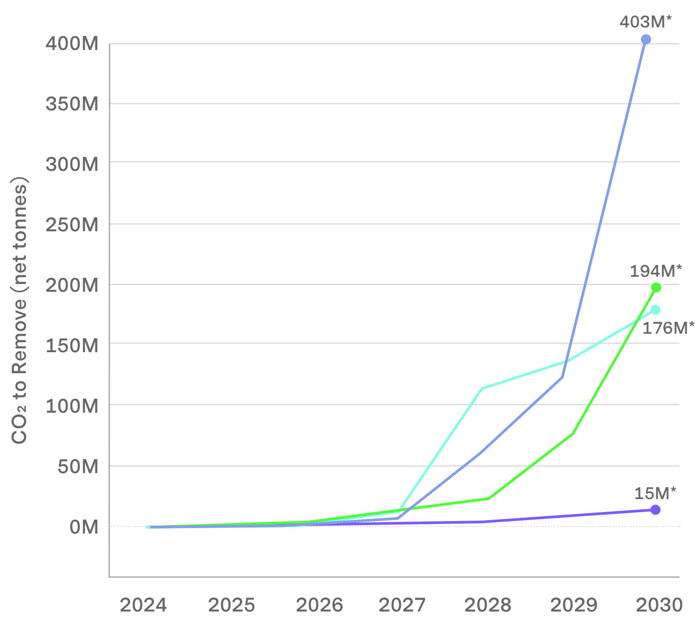
2030 PROJECTIONS

Collectively, the Top 100 Teams project removing 788 million tonnes (megatonnes) per year by 2030. Air Teams represent the largest portion of this at 403 megatonnes, followed by Land at 194 megatonnes and Oceans at 176 megatonnes.

2030 TOTAL PROJECTIONS



2030 PROJECTIONS BY TRACK



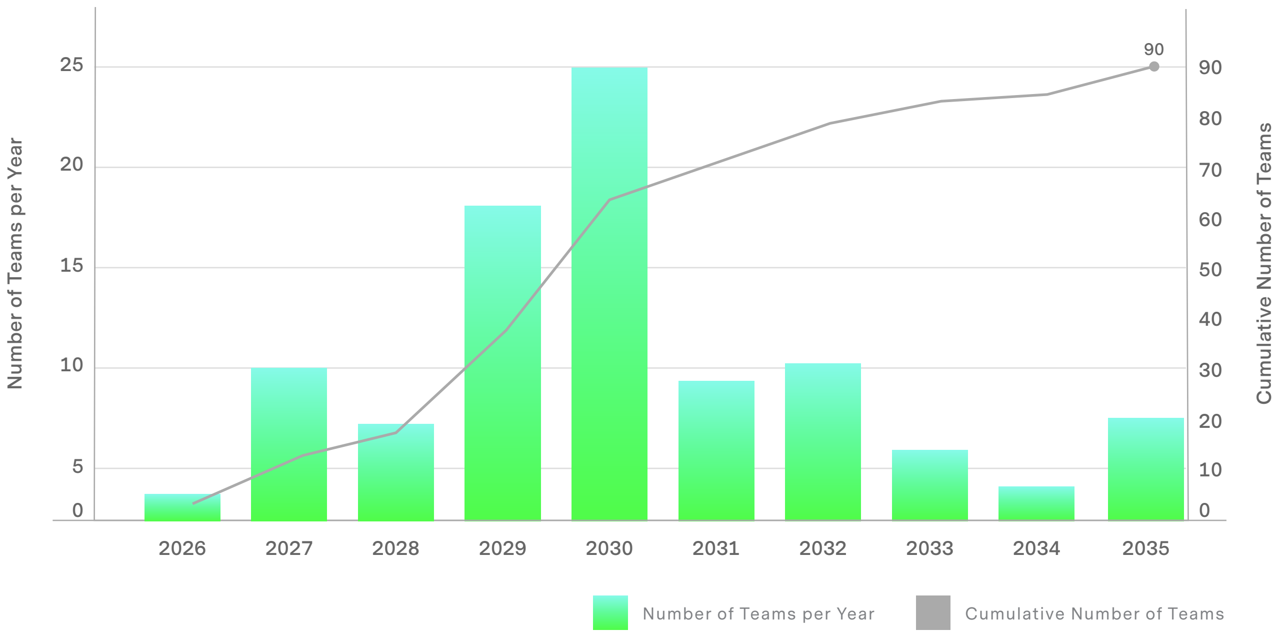
*The analysis for 2028-2030 excludes five outliers with extremely high projections that, if included, would bring the projected removal in 2030 to 10.8 billion tonnes per year.

NEXT STOP: MEGATONNE

SCALING TO MEGATONNE

As part of the submission, Teams were surveyed about when they expect to reach megatonne scale. The most common answer was 2030 (25%), and 90% said they would reach megatonne by 2035. Within that 90%, Ocean Teams lead the way to megatonne scale (on average by 2030), slightly ahead of Air, Land, and Rocks Teams (2031 average).

YEAR TEAMS WILL REACH MEGATONNE SCALE

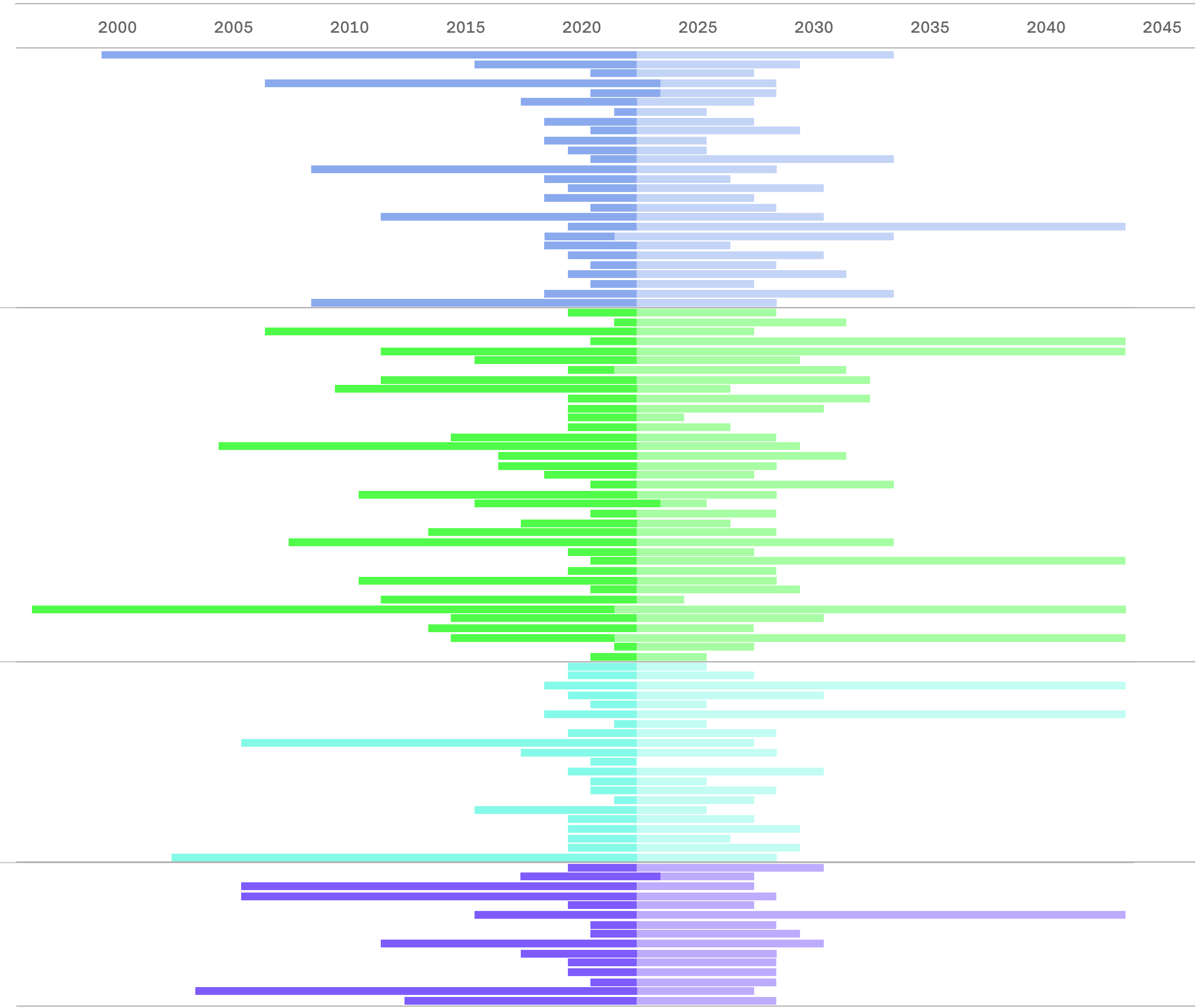


FOUNDING TO MEGATONNE SCALE

We wanted to establish an average runway time for each track, so we compiled an analysis of the Teams reported time to reach kilotonne and megatonne scale against their founding year. As you would imagine, a wide variety of timelines exist. The shortest span reported from founding to megatonne scale is 4 years, and the longest is 47 years. The average time from founding to kilotonne scale is 6.1 years and the average time from kilotonne scale to megatonne scale is 7.4 years. The total average time from founding to megatonne scale is 13.5 years.

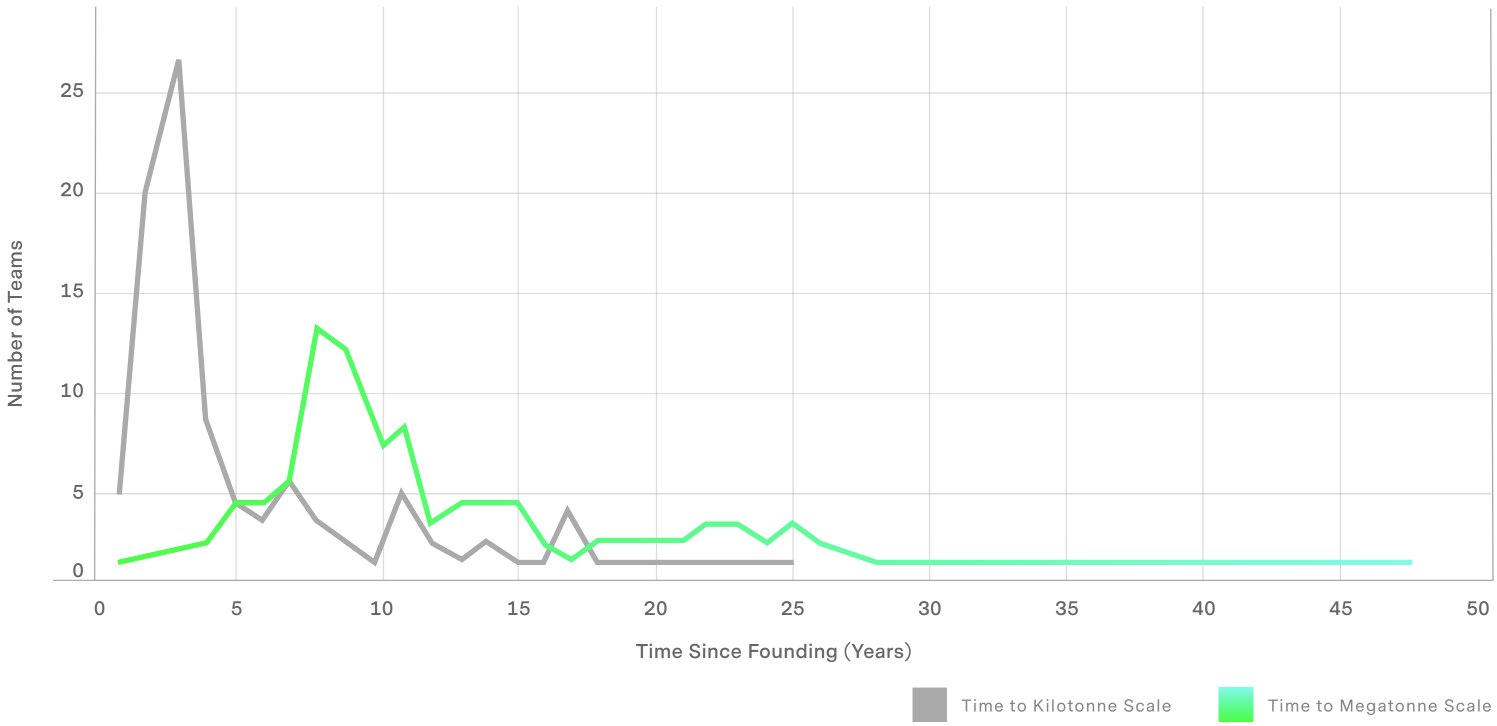
NEXT STOP: MEGATONNE

TIME FROM FOUNDING TO KILOTONNE, AND KILOTONNE TO MEGATONNE



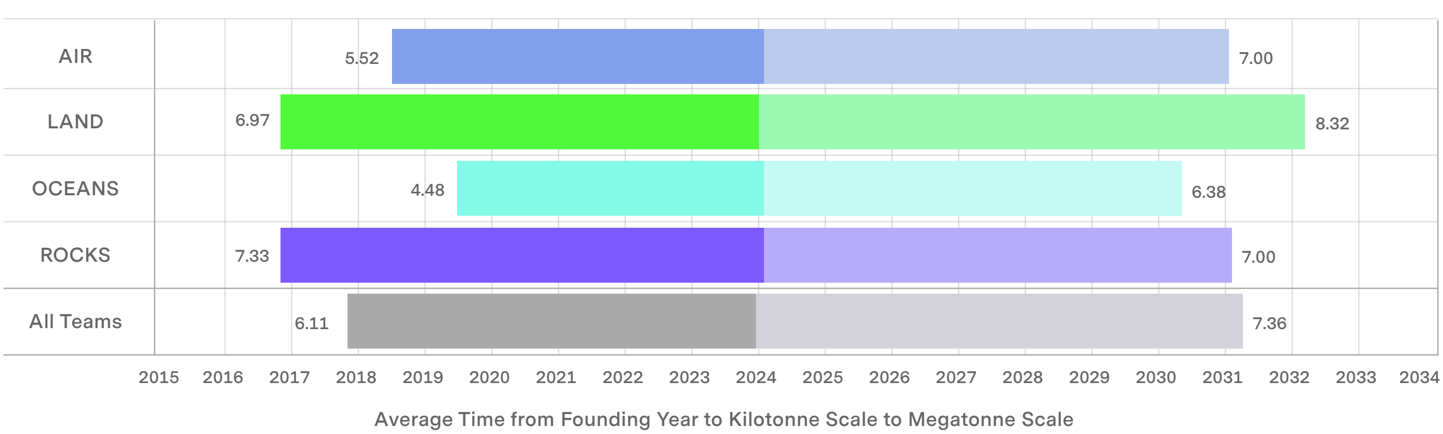
NEXT STOP: MEGATONNE

TIME TO KILOTONNE AND TO MEGATONNE SCALE FROM FOUNDING YEAR



RATES OF SCALING BY TRACKS

The following chart shows the average time from founding to 2024 kilotonne scale demonstration on the left, and average expected time to reach megatonne scale on the right. The Oceans Teams anticipate the most rapid pace of growth from founding to megatonne (10.86 years), while Land Teams report the slowest pace of growth (15.29 years from founding to megatonne scale).



COST PROJECTIONS

XPRIZE chose to focus its techno-economic evaluation (i.e., Cost Analysis) on the projected performance of Teams at megatonne scale. The Lifecycle Emissions & Cost Worksheet, introduced in the kilotonne chapter, provided Teams with a structured method for calculating their costs at megatonne scale. The worksheet allowed Teams to demonstrate how they anticipate their solution scaling (i.e., by scaling up physically or by proliferating in number, or both), and to estimate the capital and operational costs associated with building and operating a megatonne scale project. The costs presented here do not include revenues from the sale of products or carbon removal offsets, but reflect the cost of capturing and sequestering one tonne of CO_2.

The cost estimates provided by Teams rely on a number of assumptions and projections about technology performance. In order to provide a fair basis of comparison across Teams, the worksheet implemented a number of simplifying assumptions about how projects would be financed. Therefore, the numbers here should not be treated as completely accurate, but may provide some interesting insights about the relative costs and cost trajectories of different CDR solutions. Cost data from 74 Teams are included in this section.

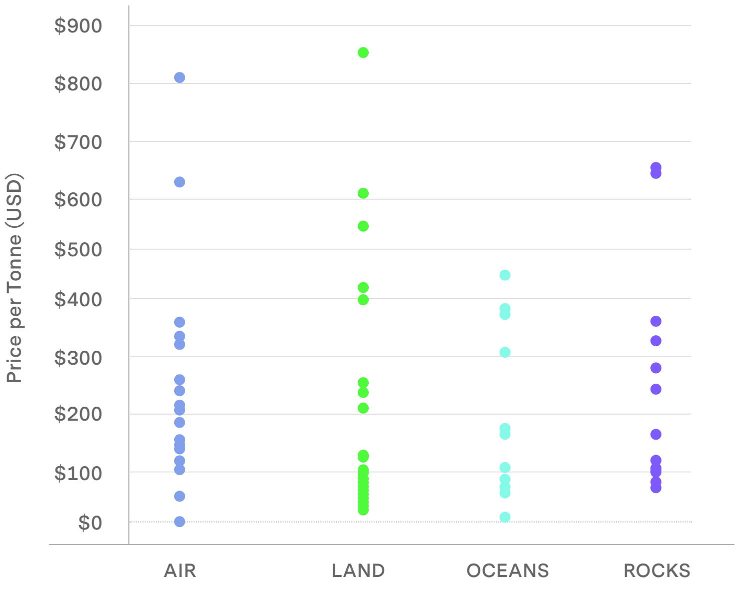
At megatonne scale, Teams estimate their projected costs, on average, to be $211 USD/tonne, with a median cost of $134 USD/tonne. Every track exhibited a wide range of cost, between $1 and $5,367/tonne (although the highest cost reported is an outlier – the second-highest cost reported is $853). Excluding the outlier, Rocks and Air claim the highest average cost, with Land claiming the lowest average cost.

TRACK	AVERAGE	MEDIAN	MIN	MAX
AIR	$228	$181	$1	$806
LAND	$185	$94	$1	$853
OCEANS	$197	$162	$10	$450
ROCKS	$246	$161	$63	$646
ALL TEAMS	**$211**	**$134**	**$1**	**$853**

* This chart excludes an outlier whose projected cost was $5,367

NEXT STOP: MEGATONNE

PROJECTED COST PER TONNE AT MEGATONNE SCALE BY TRACK

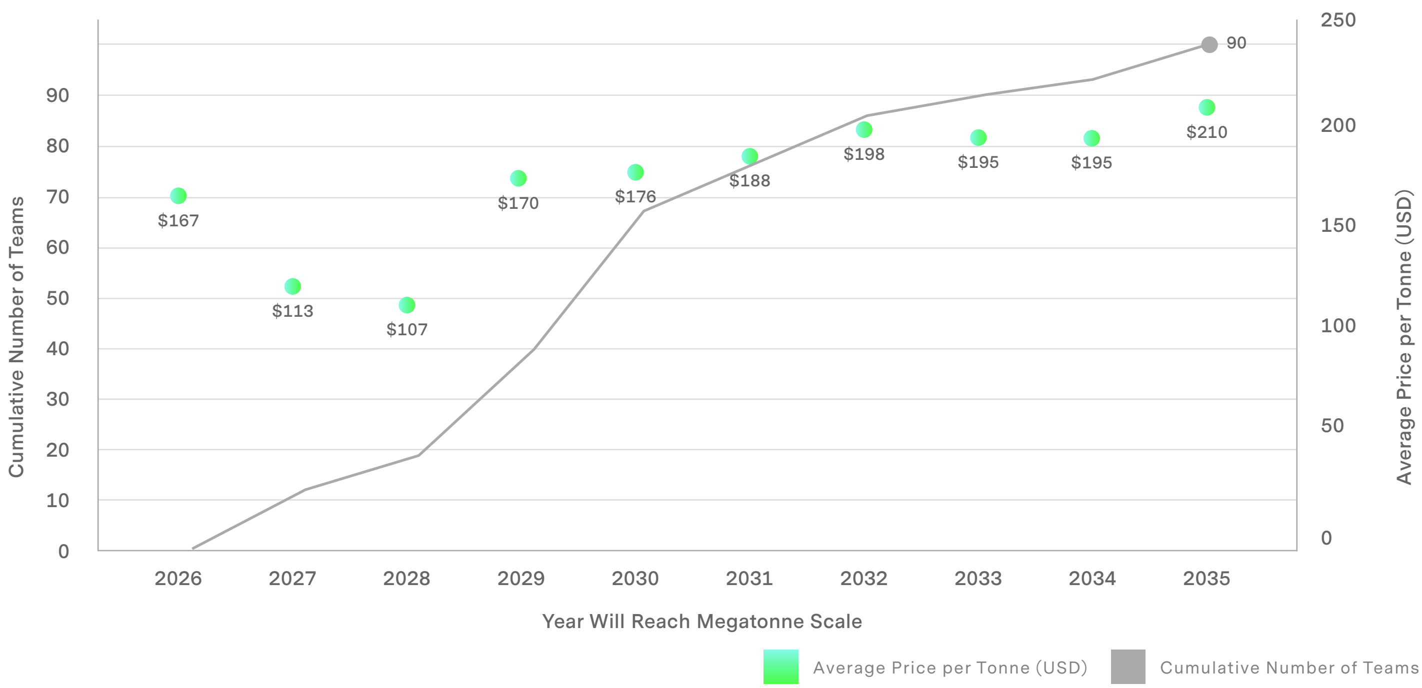


* This chart excludes one Team (in the Oceans track) with a claimed cost per tonne of $5,367.

AVERAGE COSTS OVER TIME

Based on the estimates provided by the Top 100 Teams, 61 megatonne scale projects will exist by 2030, and 90 by 2035. As these milestones are reached, the average cost per tonne (running average across all Teams in the cohort at megatonne scale) are expected to converge around $200/tonne in the early 2030s.

YEAR WILL REACH MEGATONNE SCALE AND AVERAGE PRICES OVER TIME

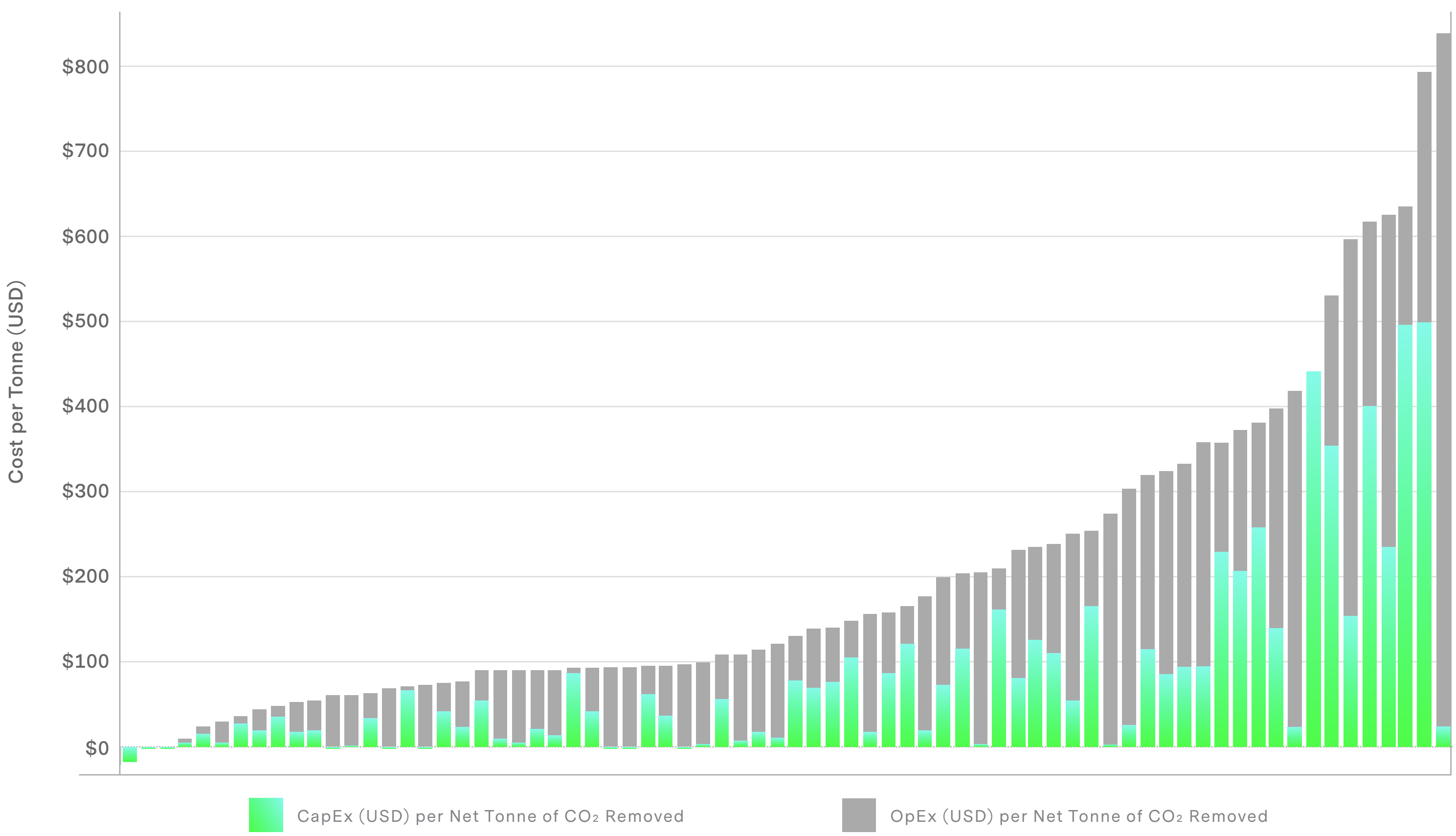


NEXT STOP: MEGATONNE

COST BREAKDOWN

The cost of carbon removal for each Team is laid out below, noting the breakdown of capital and operating costs (in USD/tonne) for each Team.

COST, BROKEN DOWN BY CAPEX AND OPEX*



* This chart excludes one Team (Oceans track) with an annual CapEx per tonne of $4,921.

NEXT STOP: MEGATONNE

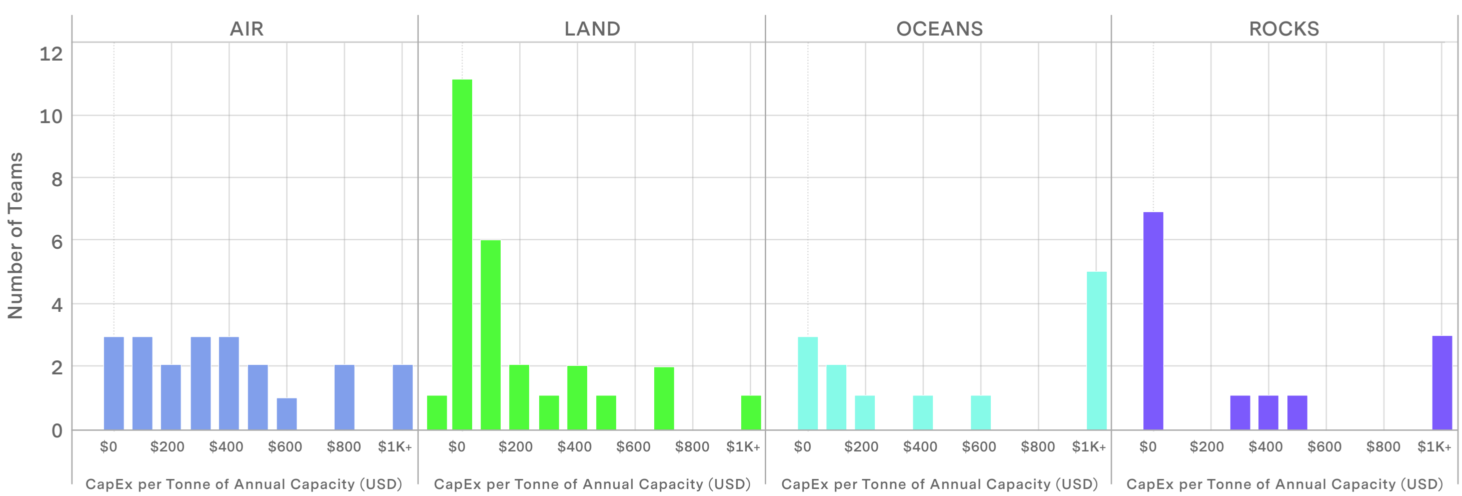
CAPITAL COSTS

Teams were asked to sum the expected costs of all of the equipment, facilities, land, and other one-time costs for their hypothetical megatonne scale project. For land and labor values associated with capital costs, regionalized standard values were provided by XPRIZE to provide consistency between Teams to help ensure temporal and regional consistency within each estimate. Per-project capital costs were converted to annual and per-tonne values by applying a capital recovery factor of 20% per year to account for non-technical costs associated with the project.[3] The ranges of capital costs reported by Teams for these projects are reported below.

TOTAL CAPEX (PER PROJECT)* (USD)**

TRACK	MIN CapEx	MAX CapEx	AVG CapEx	MEDIAN CapEx
AIR	$4.81M	$519.85M	$615.60M	$369.11M
LAND	$0.05M	$545.10M	$509.04M	$153.46M
OCEANS	$19.84M	$3.55B	$2.03B	$428.38M
ROCKS	$0.00M	$598.64M	$547.15M	$116.37M
ALL TEAMS	**$0.00M**	**$3.55B**	**$800.89M**	**$292.05M**

*While each Team was asked to model a megatonne-scale project, the projected net removals ranged from149,322 tonnes per year on the low end to 417,765,108 tonnes per year. In order to fairly compare capital costs, the figures in this table are normalized to 1,000,000 net tonnes removed per year.
**This data excludes 2 teams who reported negative capital costs.



3. The capital recovery factor (CRF) is calculated by multiplying total capital expenses by 20% and applying that value as an annual cost. The CRF is meant to account for all non-technical costs related to the project, including: cost of capital/financing costs. cost of debt, inventory capital, income and property tax, depreciation, permitting costs, legal fees, royalties and other fees, process and project contingencies, and all other owners' costs. The CRF was meant to provide a consistent and conservative means of accounting for capital expenses across all Teams. The CRF scope and value (20%) was established by a study of publicly available market data commissioned by XPRIZE.

NEXT STOP: MEGATONNE

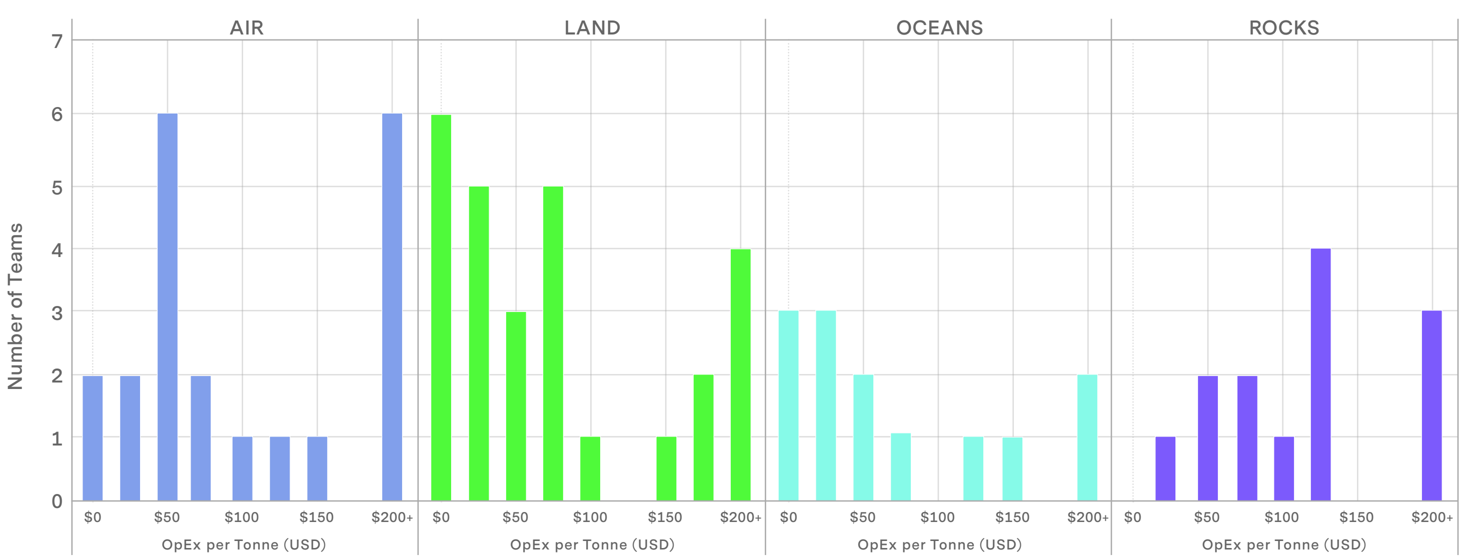
OPERATING COSTS

For common operating costs (land, water, labor, electricity, and fuel), regionalized standard values were provided by XPRIZE to provide consistency between Teams and help ensure temporal and regional consistency within each estimate.

OPEX (PER TONNE) AT MEGATONNE SCALE (USD)

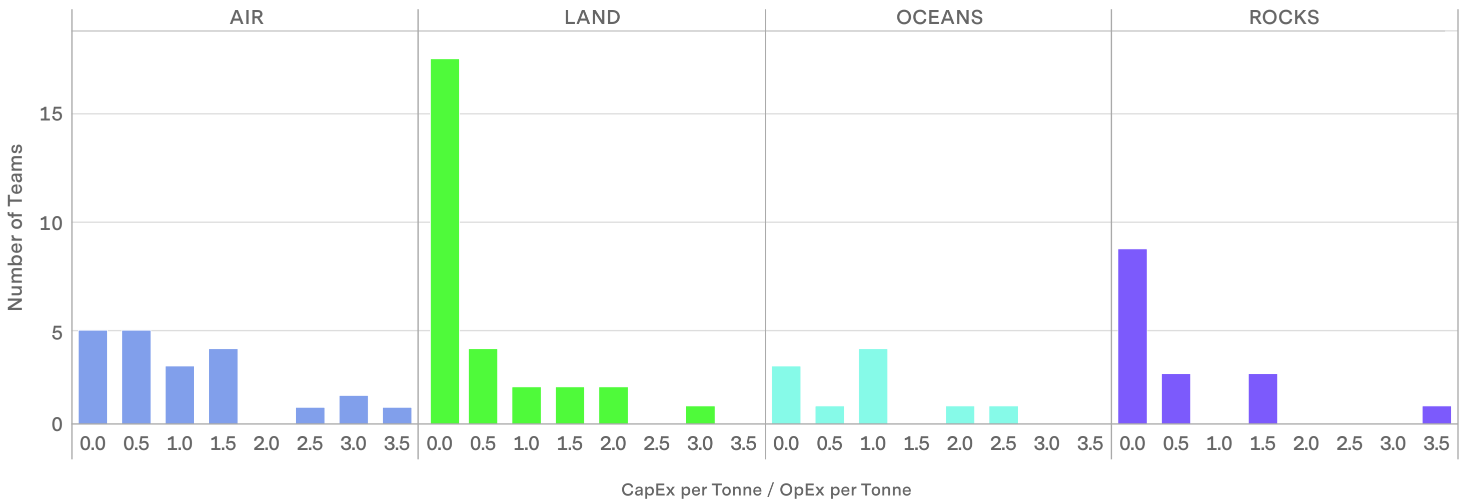
TRACK	MIN OpEx	MAX OpEx	AVG OpEx	MEDIAN OpEx
AIR	$0.32	$299	$118	$89
LAND	$0.24	$827	$131	$75
OCEANS	$0.28	$446	$115	$68
ROCKS	$32.49	$396	$147	$129
ALL TEAMS	**$0.24**	**$827**	**$127**	**$88**

OPEX (PER TONNE) BY TRACK



COMPARING CAPEX AND OPEX*

As expected, some Teams are proposing very CapEx-heavy projects, while others are proposing very OpEx-heavy projects. Summary data for the ratio of CapEx to OpEx costs is presented below. A higher ratio indicates greater CapEx as a proportion of overall cost; a lower ratio indicates a process dominated by OpEx. The Land and Rocks track Teams tend toward more OpEx-intensive processes, while Air and Oceans track Teams show a mix of CapEx-intensive and OpEx-intensive processes.



* This chart excludes 5 Teams: 2 Oceans Teams with ratios of 11 and 1,616.5; and 3 Land Teams with ratios of -2.5, 15, and 16.5.

NEXT STOP: MEGATONNE

NET-NEGATIVE PERFORMANCE

As with the kilotonne scale, lifecycle emissions data was compiled for each Team's megatonne scale scenario using the Lifecycle Emissions & Cost Worksheet. The key question in this part of the analysis is about how the emissions profiles of each Team changes as they anticipate scaling from their kilotonne scale demonstration to megatonne scale.

EMISSIONS PROFILES OF TOP 100 TEAMS (MEGATONNE SCALE)

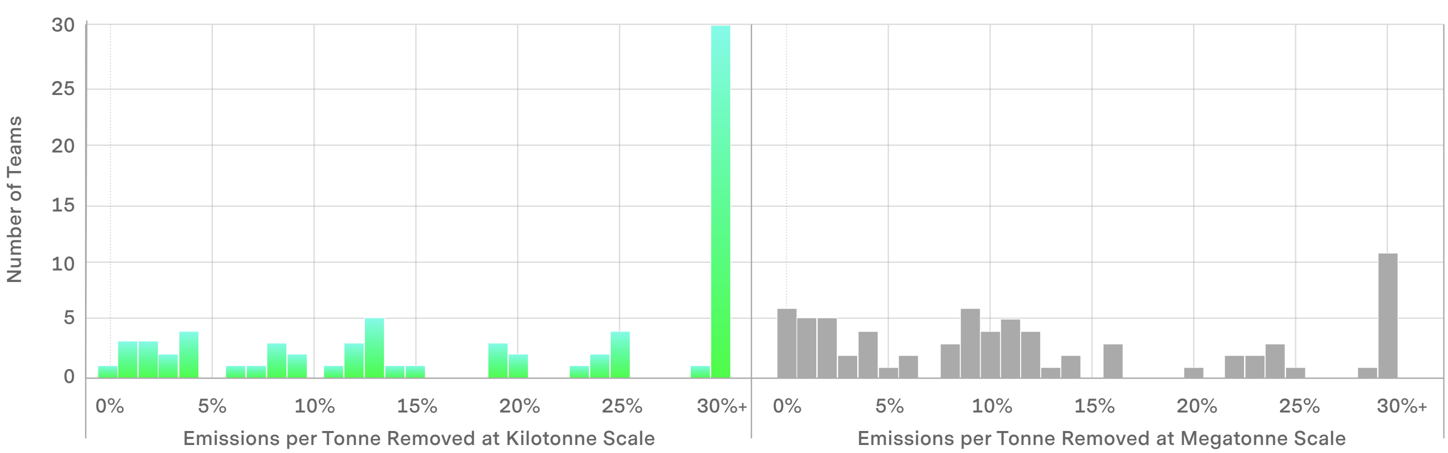
NEXT STOP: MEGATONNE

MEDIAN GROSS REMOVALS, ONE-TIME EMISSIONS (tCO_2/PROJECT) AND ONGOING EMISSIONS (tCO_2/y)

TRACK	GROSS REMOVED	ONE-TIME EMISSIONS	ONGOING EMISSIONS
AIR	1,068,466	95,377	34,885
LAND	1,546,000	17,760	169,370
OCEANS	1,116,720	104,626	52,611
ROCKS	1,200,000	42,264	165,153
ALL TEAMS	**1,215,549**	**36,163**	**83,628**

KILOTONNE TO MEGATONNE PROGRESSION

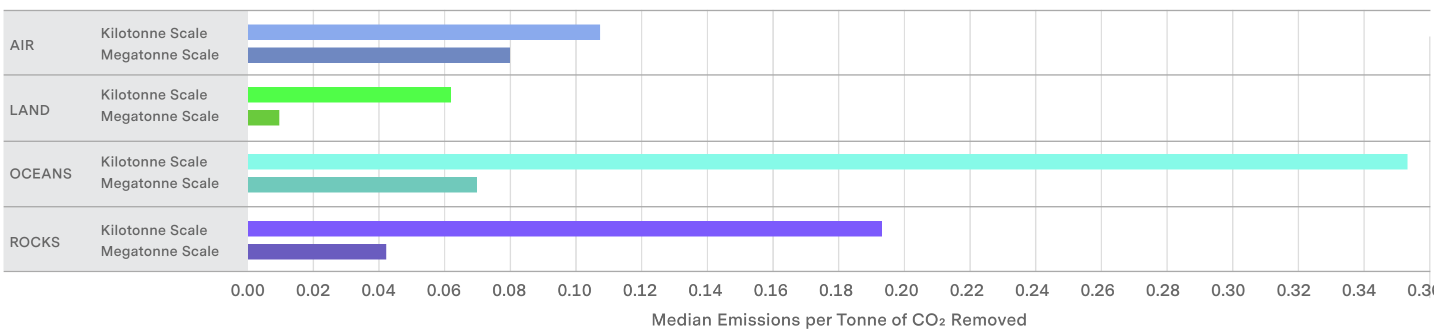
As Teams scale from their kilotonne scale demonstrations to megatonne scale, improvements can be expected in many of their lifecycle emissions performance. These improvements may be attributed to increased process efficiency, increased utilization of low-carbon energy sources, and other economies of scale. The following charts compare the emission profiles of the cohort at the kilotonne and megatonne scales, and show a shift toward less emissive processes.



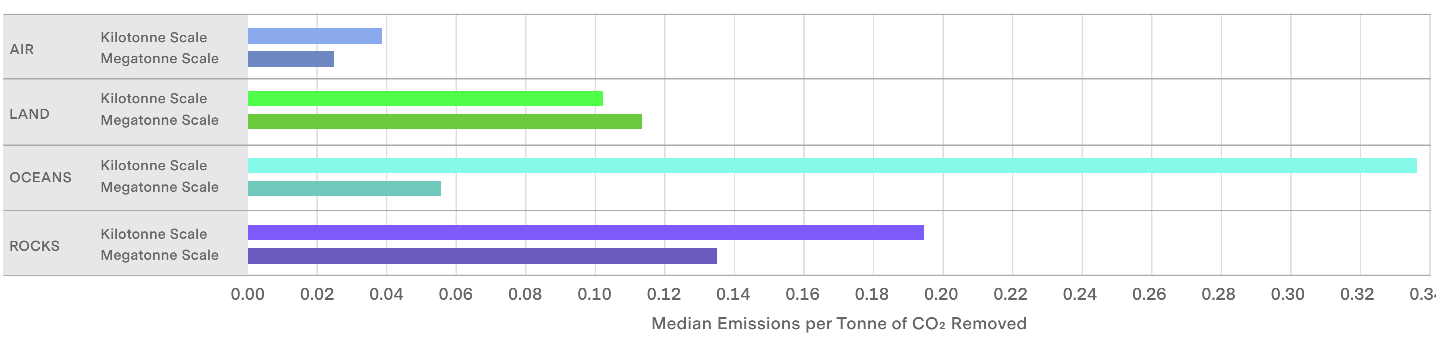
NEXT STOP: MEGATONNE

The median emissions per tonne removed, at both the kilotonne and megatonne scales, is shown below. Teams in all tracks anticipate significant reductions in one-time emissions as they scale. With the exception of the Oceans track, more modest ongoing emissions efficiency is expected. The ratio of one-time to ongoing emissions in each track can also be observed, with Air and Oceans Teams indicating more one-time than ongoing emissions, and Land and Rocks Teams indicating more ongoing than one-time emissions.

MEDIAN ONE-TIME EMISSIONS COMPARISON



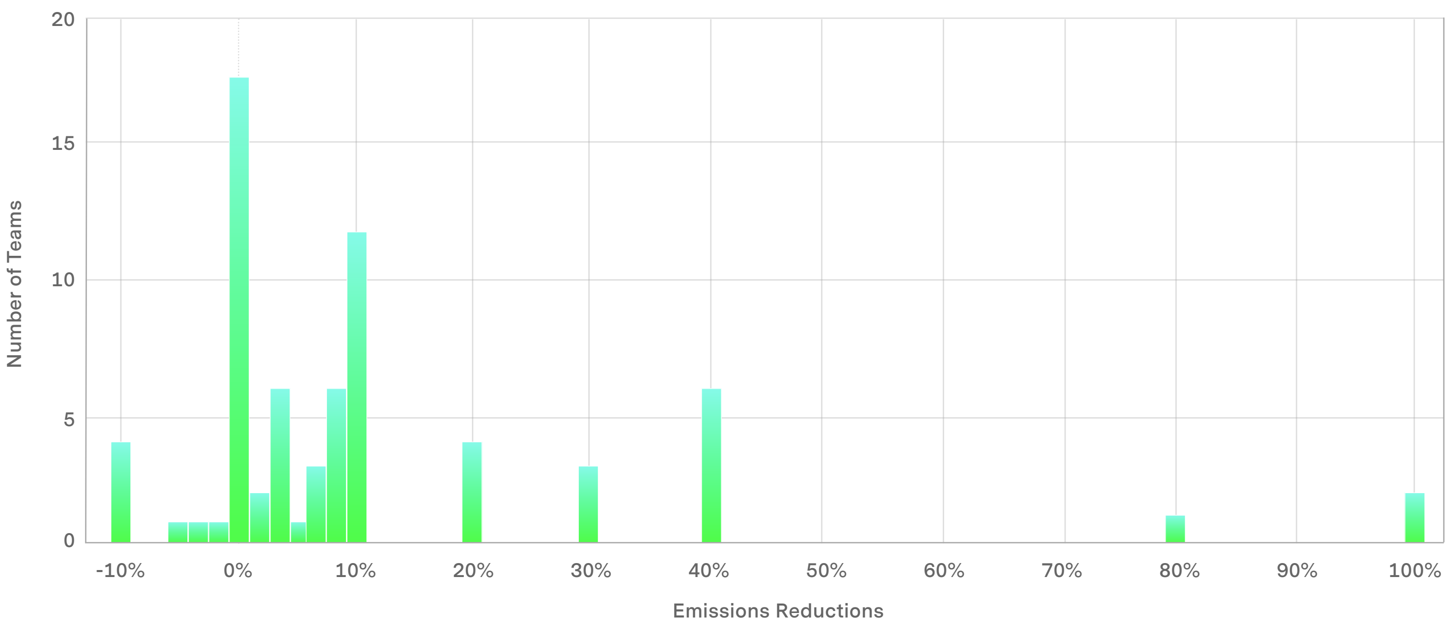
MEDIAN ONGOING EMISSIONS COMPARISON



NEXT STOP: MEGATONNE

On a Team-by-Team basis, most Teams expect an improvement in emissions performance as they scale from kilotonne to megatonne scale. A few Teams, while still net-negative, expect to emit more CO_2 (on a per-tonne basis) at scale.

EXPECTED EMISSIONS REDUCTIONS FROM KILOTONNE TO MEGATONNE SCALE



EXPECTED RE-EMISSION OF SEQUESTERED CO_2 (% AT MEGATONNE SCALE)

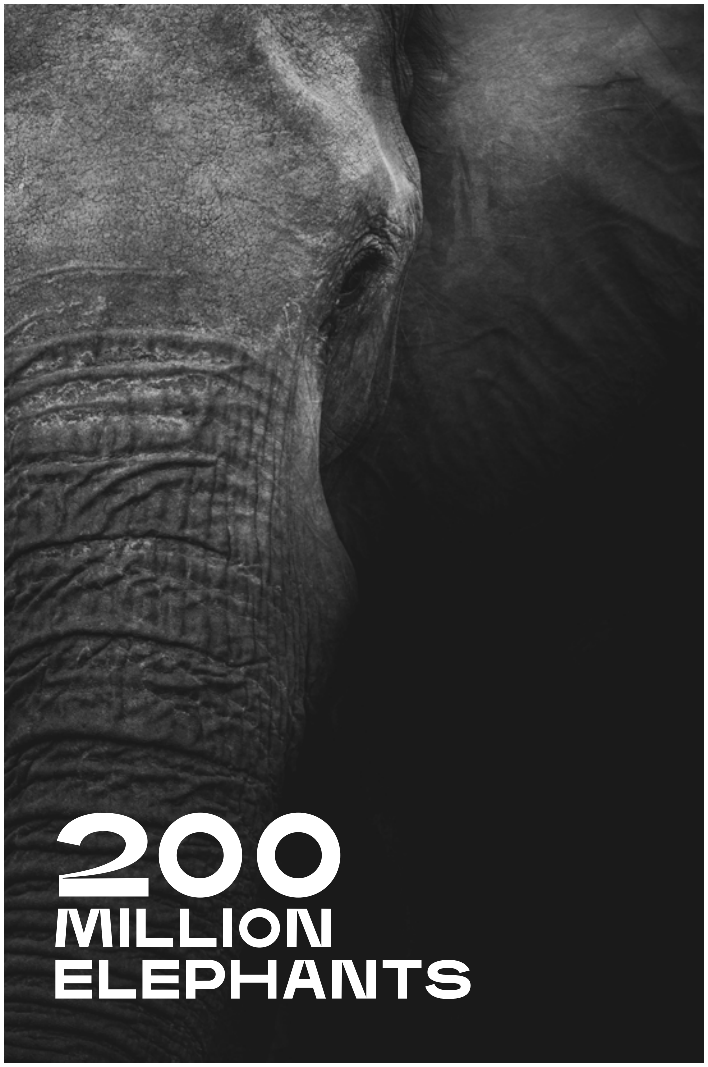
Comparing re-emissions from the kilotonne and megatonne scale models, only four Teams expect significant changes (a change greater than 1%) in the ratio of sequestered CO_2 expected to re-emit within 100 years. The vast majority of the Teams report very minor changes, suggesting that most Teams do not anticipate significant "innovations" that would improve the durability of the CO_2 stored in each pathway.

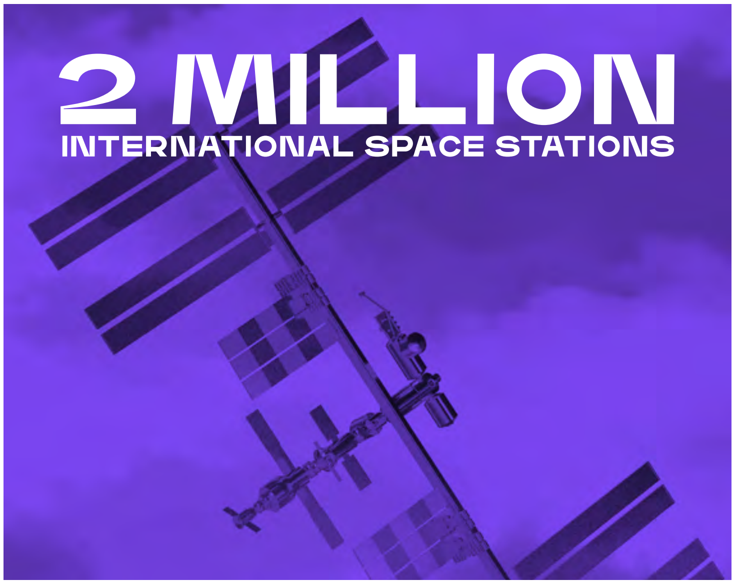
TRACK	AVG RE-EMISSION - KT SCALE	AVG RE-EMISSION - MT SCALE
AIR	1.13%	1.09%
LAND	5.33%	5.03%
OCEANS	5.27%	1.95%
ROCKS	2.46%	2.46%
ALL TEAMS	**3.62%**	**2.92%**

DESTINATION: GIGATONNE

DESTINATION: GIGATONNE

Getting to gigatonne scale carbon removal will be one of the biggest accomplishments society has ever made. Even wrapping your mind around how large a gigatonne is can be incredibly challenging.



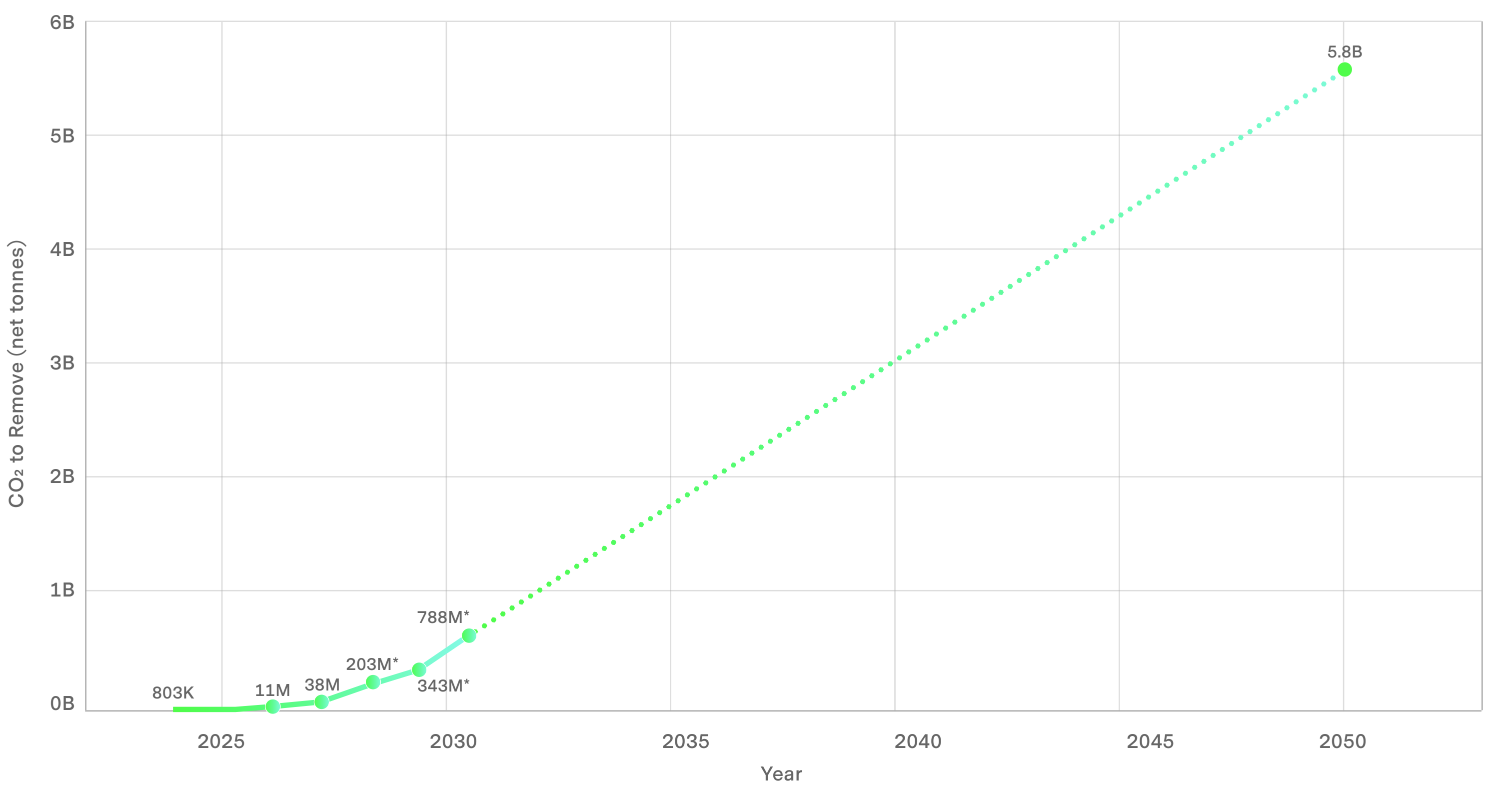


DESTINATION: GIGATONNE

The precise scale of carbon dioxide removal that will be needed by 2050 will be impacted by a number of factors - primarily, the rate of decarbonization of the rest of the economy. But even under conservative assumptions, the CDR industry will need to remove gigatonnes annually, putting it on par with the largest industries in the world today. According to the Intergovernmental Panel on Climate Change (IPCC) AR6 Working Group Synthesis Report, an estimated 360 (60-680) gigatonnes of carbon dioxide may need to be removed by 2100 to limit long-term climate warming to 1.5C.[4] Further analysis by RMI in their report "Applied Innovation Roadmap for CDR" modeled that 13.4 $GtCO_2$/y of removals would be needed by 2050,[5] which is the average removals in all IPCC AR6 C2 scenarios.

A distinction is commonly made between more conventional CDR approaches like land management versus newer forms of CDR discussed throughout this report. The "State of CDR"[6] report refers to these methods as “novel CDR” and RMI refers to them as “technical CDR”. RMI’s analysis sets a target of 5.8 $GtCO_2$/y of “technical CDR” needed by 2050. Achieving these levels of scale, and these rates of growth, will require a keen focus on sustainability, responsible deployment, and leveraging the advantages of all available CDR pathways.

2050 PROJECTIONS



* The analysis for 2028-2030 excludes five outliers with extremely high projections that, if included, would bring the 2030 projection to 10.8B.

4. Intergovernmental Panel on Climate Change (IPCC). (2023). Sixth Assessment Report (AR6).

5. RMI. (2023). The Applied Innovation Roadmap for CDR: An Independent perspective to guide RD&D funding.

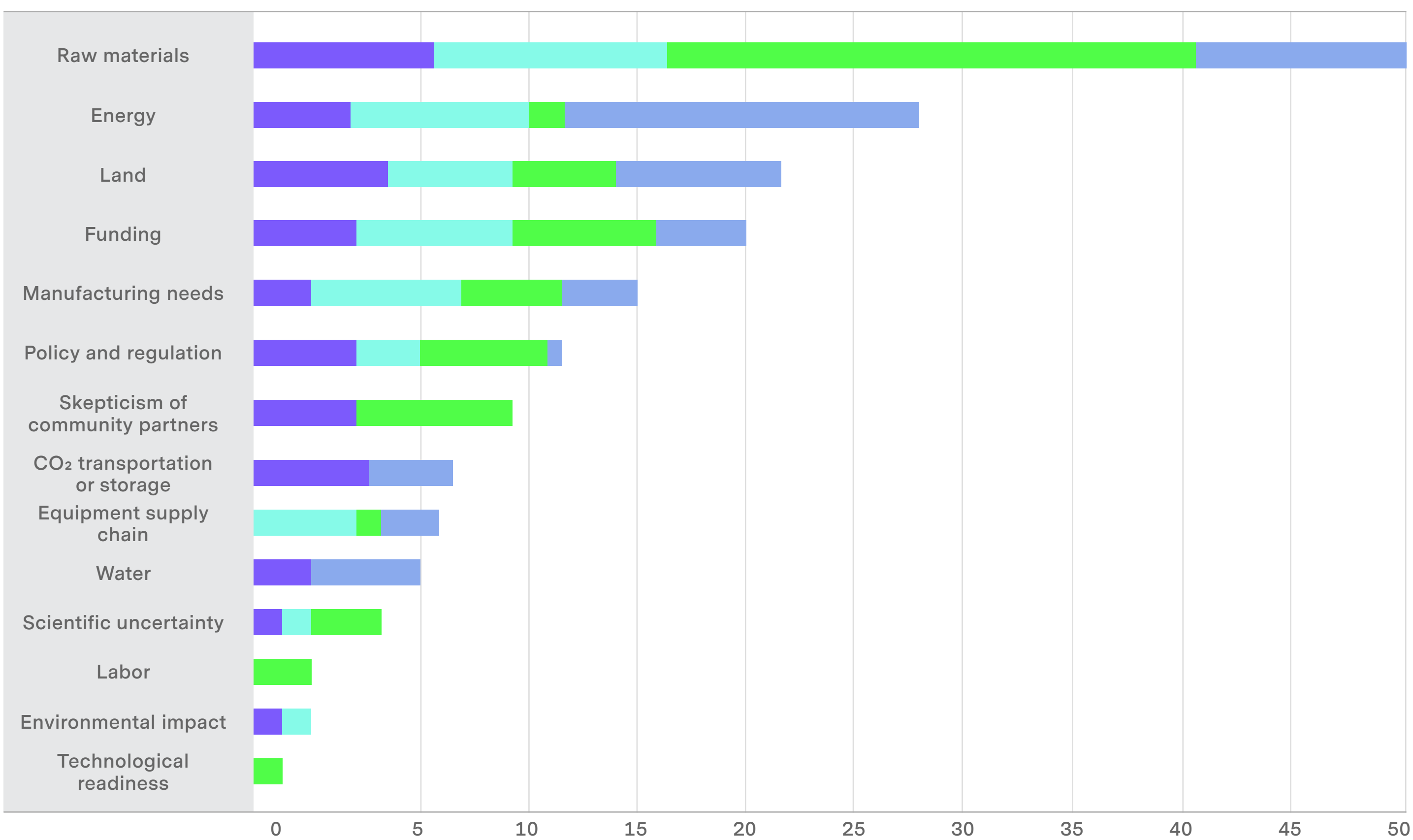
6. Smith et. al (2023). The State of Carbon Dioxide Removal - 1st Edition. The State of Carbon Dioxide Removal.

CONSTRAINTS TO SCALING

Each carbon removal pathway will face its own distinct challenges, as well as global limits to scaling. Not all pathways or sub-pathways may even be able to reach gigatonne level, and the interconnectedness of ecological and socio-economic limits will continue to influence scaling potential. Therefore, the most realistic scenario for gigatonne scale carbon removal will call on a diverse portfolio of solution types.

In order to assess each Team's sustainability at scale, XPRIZE Carbon Removal challenged Teams to make the case that their solution could achieve gigatonne levels, and describe the ways they are working to address issues of sustainability at extremely large scales. When polled on the most critical constraints that teams will face, the Top 100 Teams flagged a range of technical, economic, and social issues. Across all tracks, access to raw materials (e.g., biomass and other feedstocks) is projected to be the biggest constraint as teams work toward megatonne scale and beyond. Teams in the Air track are most concerned about access to renewable energy. Teams in all tracks identified concerns around building their actual facilities at large scale as significant constraints.

CONSTRAINTS TO SCALING TO GIGATONNE



ENVIRONMENTAL IMPACT

ENERGY USE

Teams predict energy intensities between 0 and 20 GJ/tonne in their megatonne scale scenarios. On average, the Air track is the most energy-intensive, while the Land track is the least energy-intensive. However, within each track, Teams exhibit a wide range of energy intensities, with a few Teams in each track projecting very high energy use, between 15-20 GJ/tonne. From the kilotonne to megatonne scale, energy efficiency is projected to improve by significant amounts.

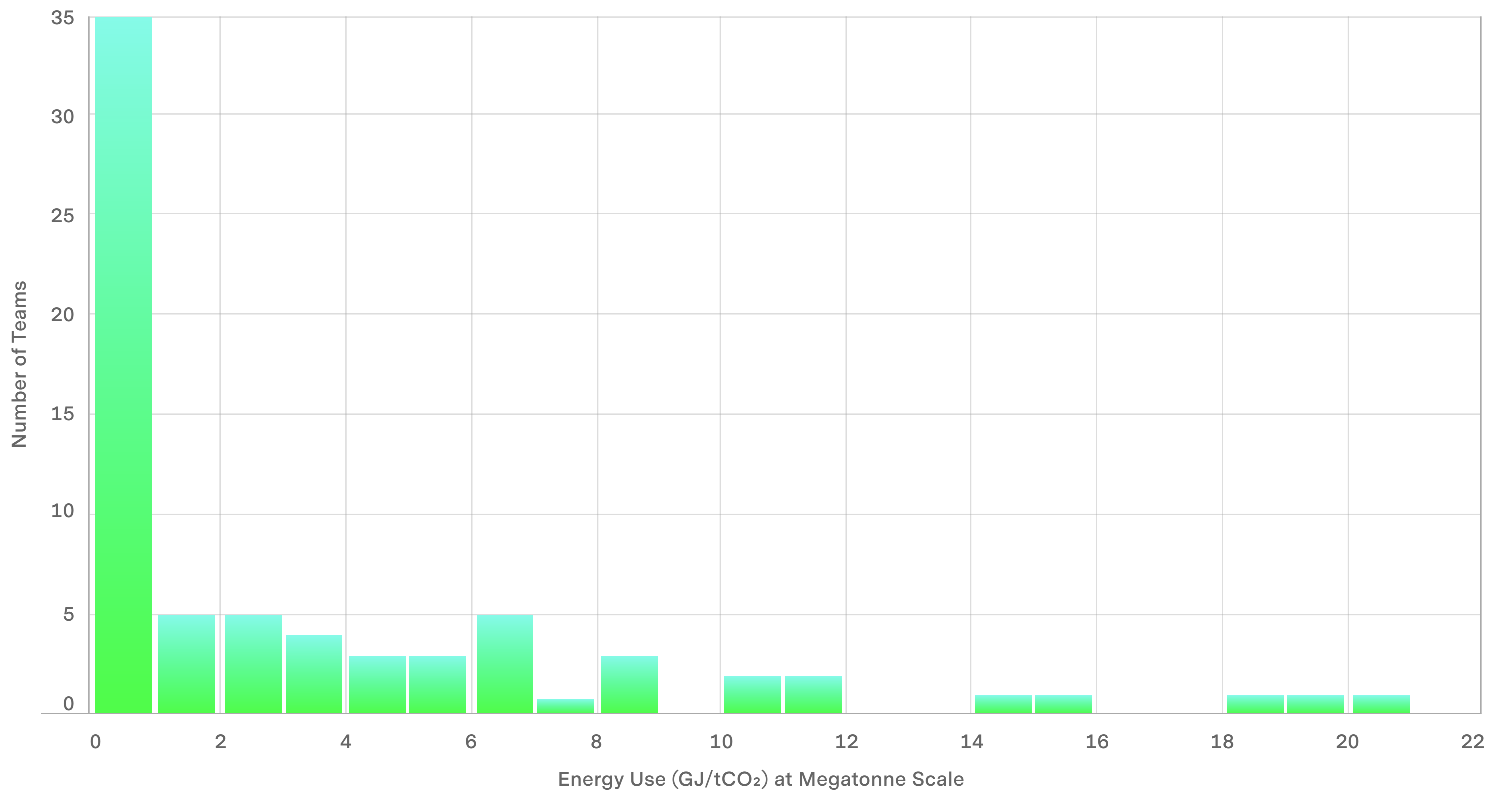
AVERAGE ENERGY INTENSITIES ACROSS CDR TRACKS

TRACK	AVG ENERGY INTENSITY (GJ/tCO_2) - KT Scale	AVG ENERGY INTENSITY (GJ/tCO_2) - MT Scale
AIR	10.41	5.11
LAND	3.18	2.35
OCEANS	23.46	4.19
ROCKS	46.28	3.83
ALL TEAMS	**16.37**	**3.73**

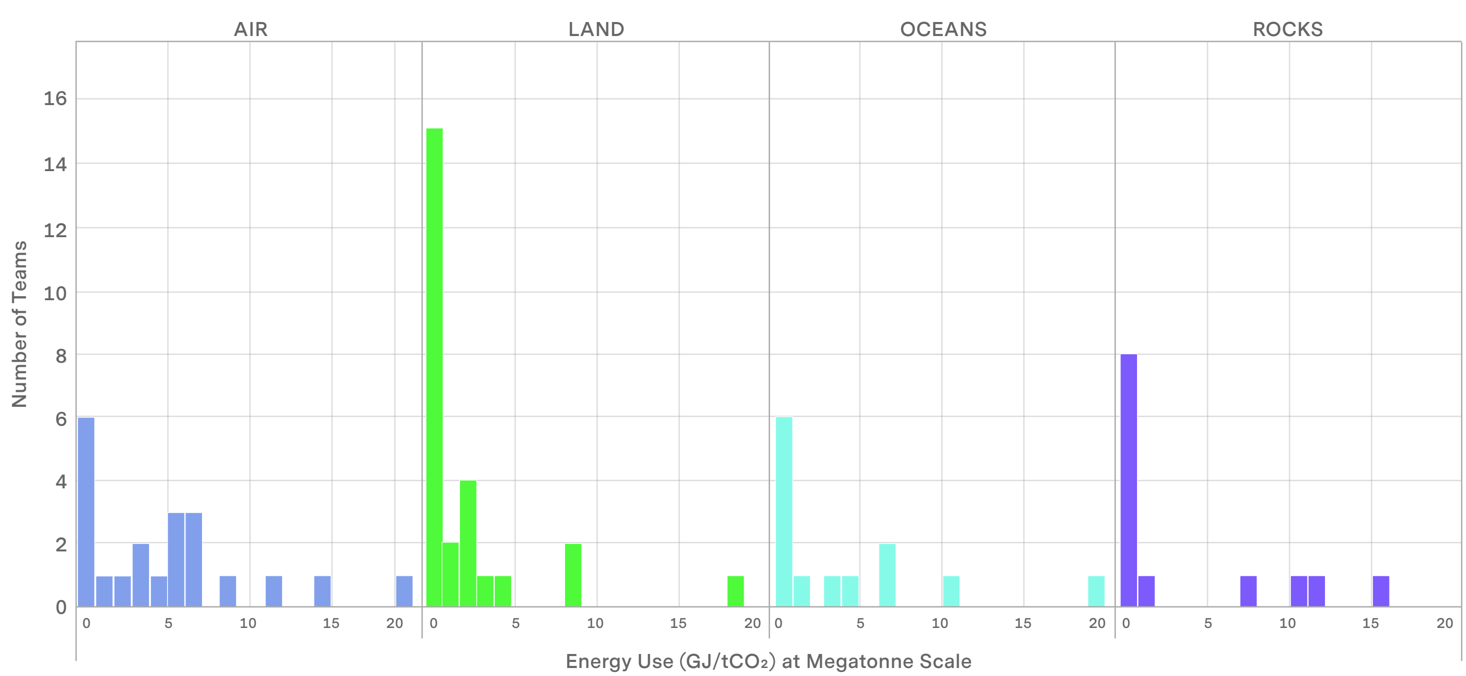
To put the energy intensity of the Top 100 Teams in context: If this cohort of Teams were to collectively scale to the point where they are removing 1GT/year together, their annual energy requirements (using their megatonne scale energy intensities) would be 3.7 billion GJ, or approximately 1 billion megawatt-hours. This is equivalent to about 25% of the U.S. annual electricity production (2023), and more than all of the U.S. production of renewable electricity.[5] Needless to say, significant energy infrastructure will need to be developed to power the CDR industry.

7. U.S. Energy Information Administration, Electric Power Monthly, February 2024; preliminary data.

ENERGY INTENSITY OF TOP 100 TEAMS



ENERGY INTENSITY OF TOP 100 TEAMS BY TRACK



LAND USE

Teams were asked to compute the land intensity of their megatonne scale projects, in consideration of both one-time (or per project) land consumption and land consumed on a per-tonne-CO_2 basis. Relatively few teams (8) reported ongoing (per tonne) land intensities.

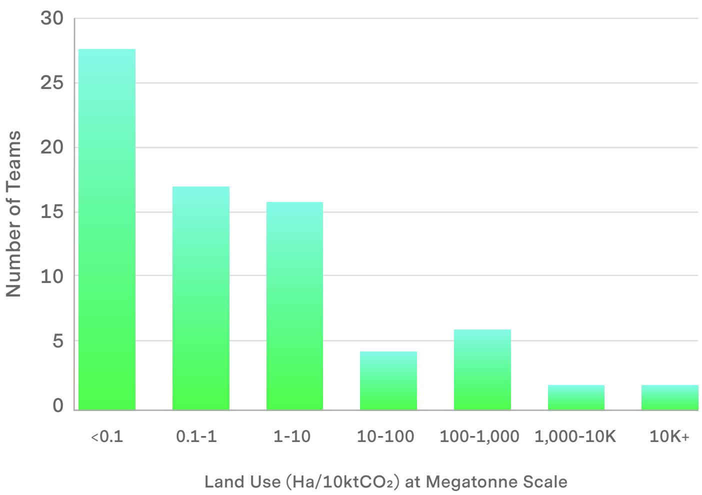
LAND USE ACROSS CDR TRACKS

TRACK	AVG ONE-TIME LAND USE (Ha) - KT Scale	AVG ONE-TIME LAND USE (Ha) - MT Scale	TOTAL ONE-TIME LAND USE (Ha) - 1GT/y Scenario	TOTAL ONE-TIME LAND USE (Ha/tCO_2y) - 1GT/y Scenario
AIR	1,558	163	4,613,953	332,287
LAND	10,054	7,917	288,855,917	11,453,690
OCEANS	1,584	35	617,926	1,628
ROCKS	5,254	5,063	88,938,842	4,444,640
ALL TEAMS	**5,312**	**3,830**	**383,026,639**	**16,232,245**

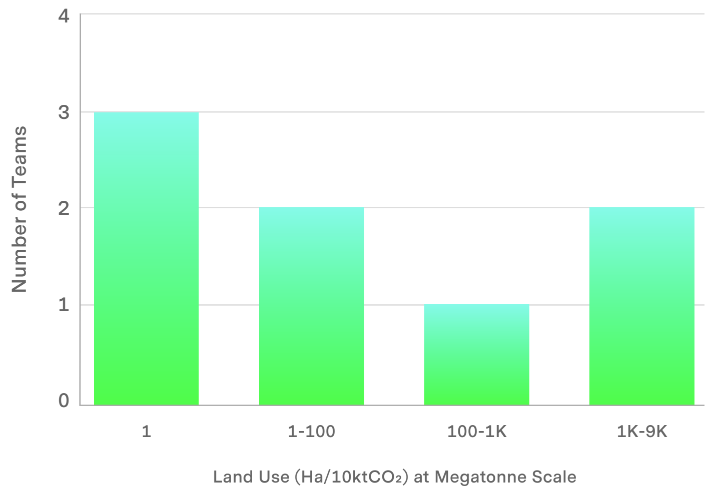
If the Top 100 cohort scaled to 1GT/year, based on the average land use at megatonne scale of 0.016 (Ha/tCO_2), the total land put to use by these Teams would be 16 million hectares (one time), plus 16 million hectares per year (ongoing). For comparison, the total cropland in the U.S. is 166 million hectares. While this number is large, most Teams claim that they will not displace existing land used for things like agriculture and forestry, but their projects will involve cohabiting with existing agricultural or industrial land and adding a carbon removal component that may in fact improve the productivity of those existing efforts (such as with soil carbon projects and biomass retrieval). Many projects also focus on ecosystem restoration or claim other positive co-benefits.

While the CDR industry may not necessarily be constrained by land in all cases, the industry will likely require generating broad support and cooperation of existing land owners to facilitate the deployment of CDR solutions, support sustaining activities like measurement, reporting and verification, and, in some cases, change their existing practices to facilitate high-quality CDR.

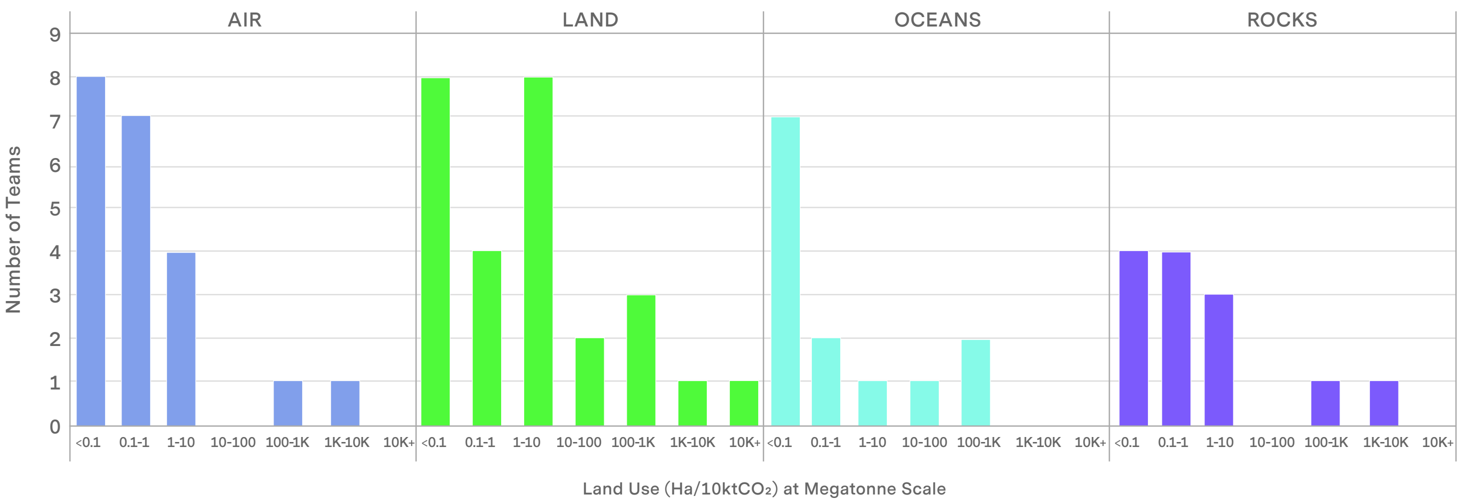
ONE-TIME LAND USE



ONGOING LAND USE



ONE-TIME LAND USE BY TRACK



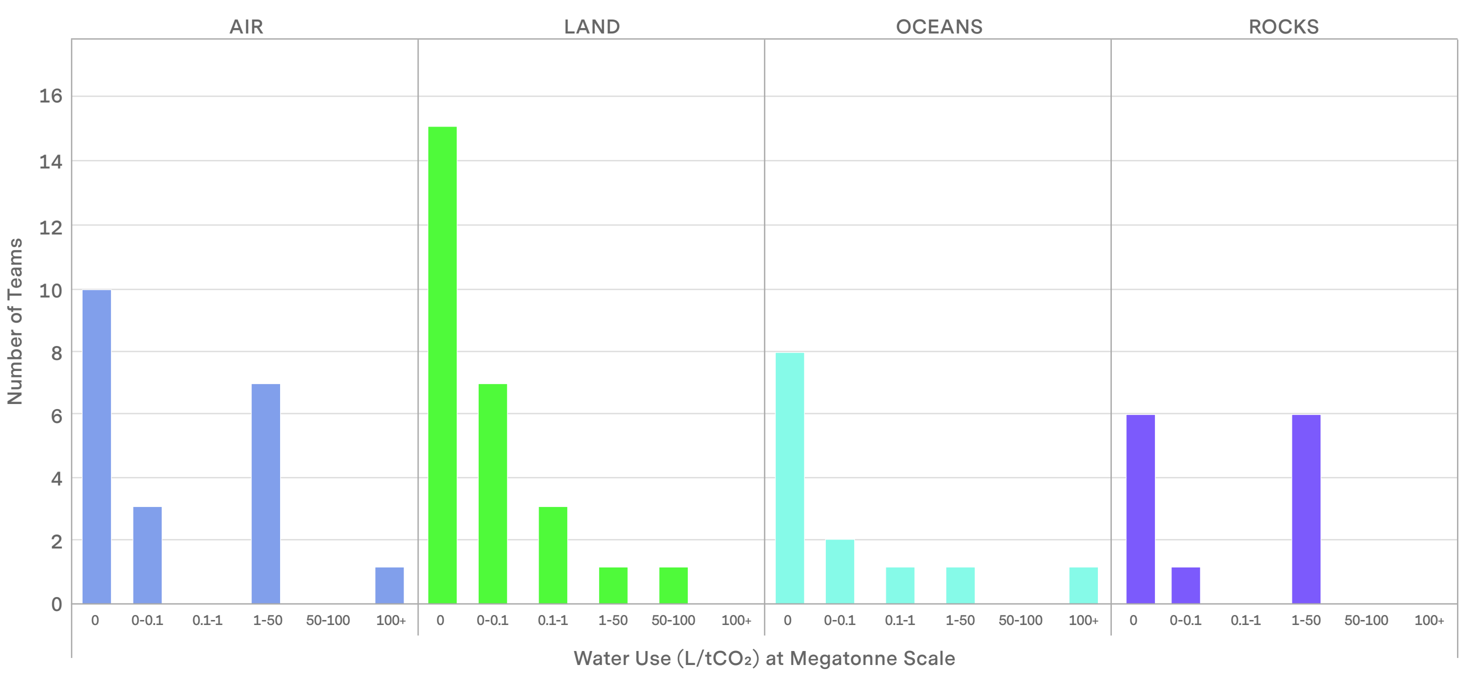
WATER USE

Only 47% of Teams report utilizing fresh water in their CDR processes (at megatonne scale), but several who do use water have significant footprints, with the top 6 water users consuming between 34 and 300 L per tonne removed. Air track Teams are the heaviest water users, while Land track Teams are the least water intensive. However, significant water use can be found within each of the four tracks (all four tracks are represented in the "top 6 water users" referenced earlier).

WATER USE ACROSS CDR TRACKS

TRACK	AVG WATER USE (L/tCO_2) - KT Scale	AVG WATER USE (L/tCO_2) - MT Scale	TOTAL WATER USE (L/tCO_2) - 1GT/y Scenario
AIR	30	19	5,295,023,203
LAND	3	2	816,959,734
OCEANS	17	10	1,725,673,182
ROCKS	30	7	1,156,254,869
ALL TEAMS	**18**	**9**	**8,993,910,988**

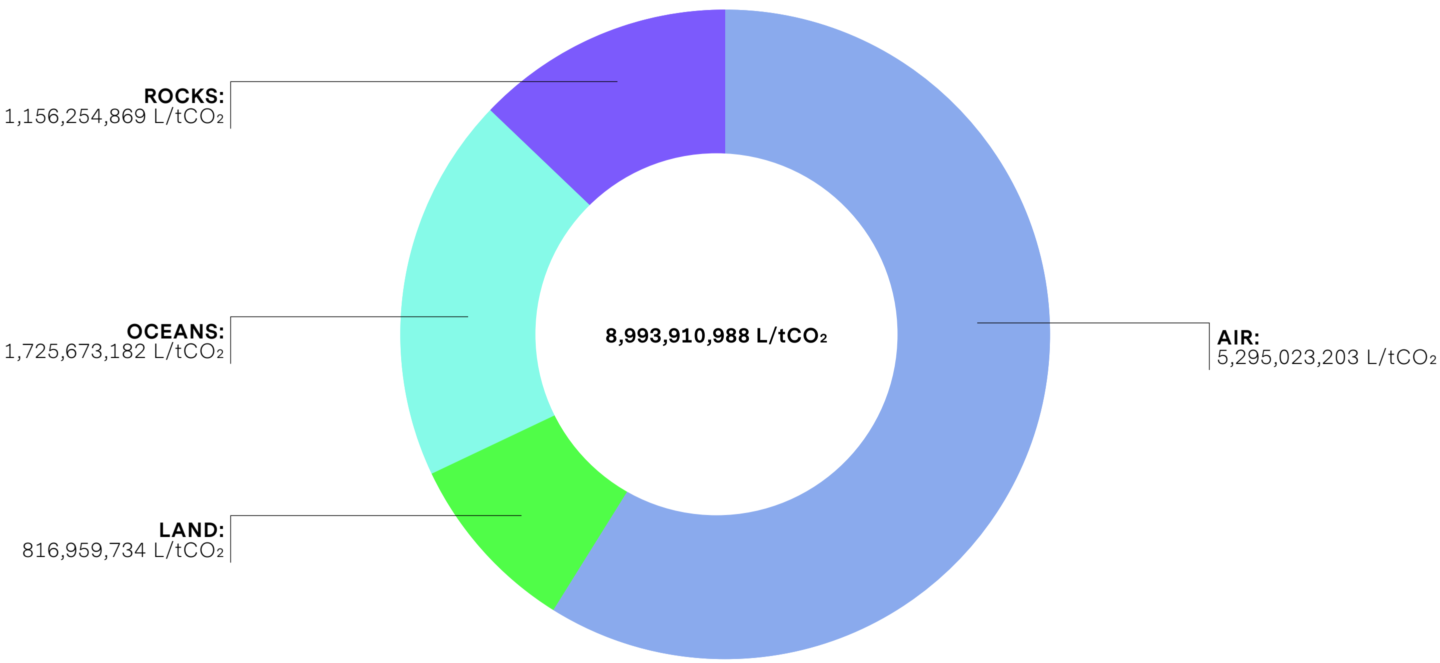
ONGOING WATER USE OF TOP 100 TEAMS BY TRACK



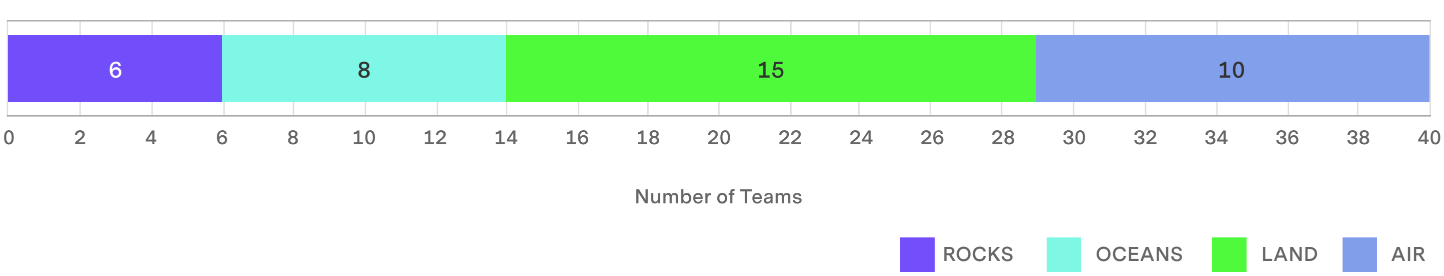
DESTINATION: GIGATONNE

Altogether, scaled to remove 1GT/year collectively, the top 100 cohort would consume almost 9 billion liters of fresh water per year. This figure is relatively modest in comparison with total global freshwater use, but the water intensity of some processes are certainly significant enough to stress local freshwater sources.

WATER USE AT GIGATONNE SCALE

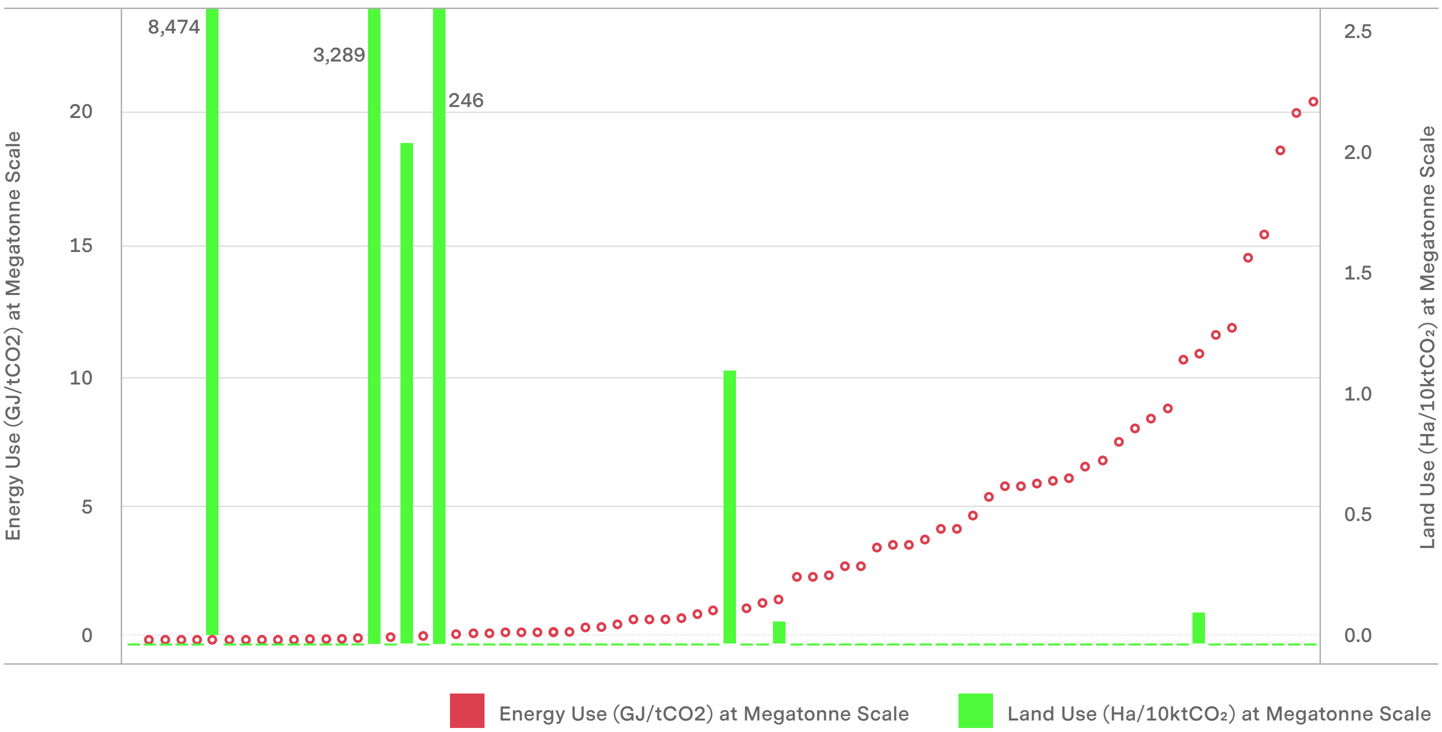


TEAMS NOT USING WATER BY TRACK



ENERGY, LAND, WATER TRADE-OFFS

While there is not a perfect correlation, there tends to be a trade-off between energy needs and land-use needs. No such correlation was evident between land and water or energy and water within the Top 100 cohort.



COMMUNITY IMPACT

An important objective of XPRIZE Carbon Removal was to incentivize the development of projects that are not only technically sustainable but also equitable and just, with an aim to have a positive impact on communities. Building on the discussion from the kilotonne chapter, we will discuss dimensions 3-6 below in more detail here with regards to scaling these projects in the coming decades.

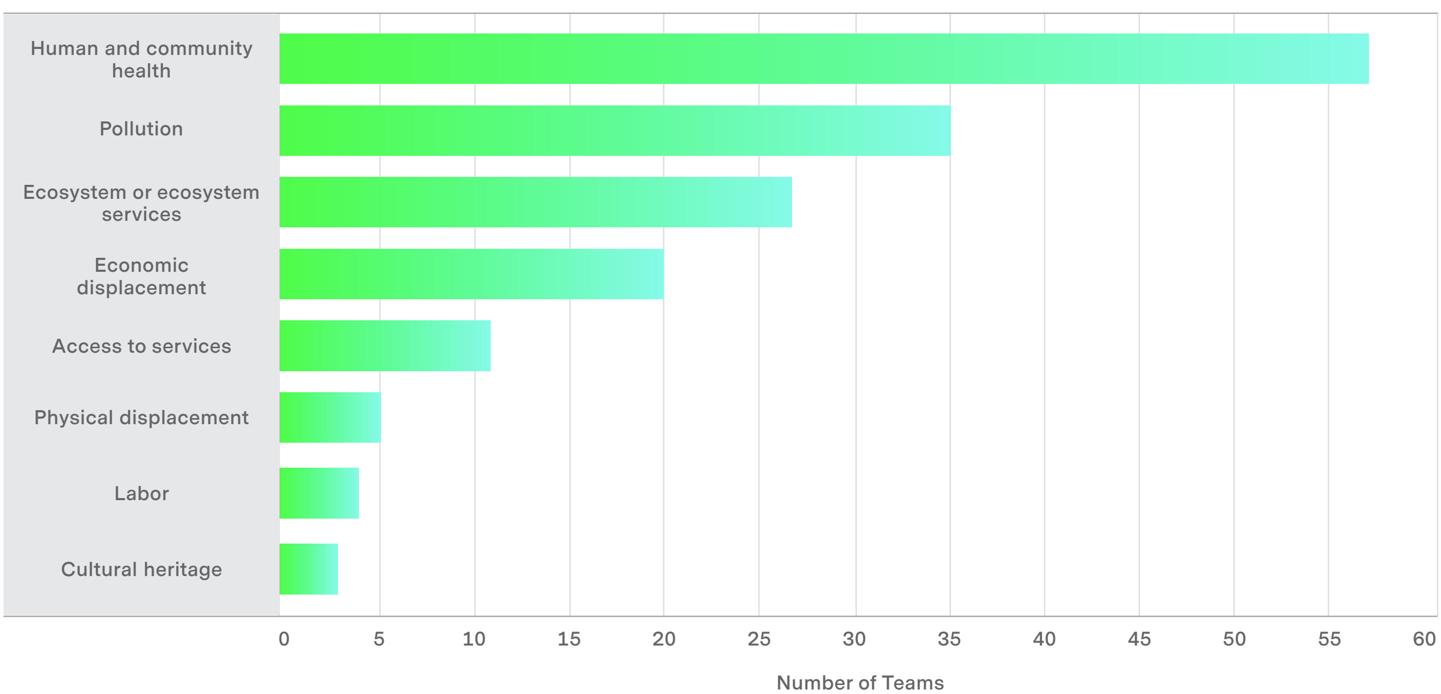
1. Characterizing relevant communities
2. Conducting meaningful community engagement
3. Assessing and mitigating impacts
4. Exploring and defining benefits
5. Ensuring transparency and accountability
6. Building resources and capacity

3. ASSESSING AND MITIGATING IMPACTS

Teams were asked to describe the possible impacts of their projects on the environment and surrounding communities as they approach gigatonne scale, as well as the actions they are, or plan to, undertake to mitigate these impacts. We analyzed their responses and identified the most common possible impacts and planned mitigation techniques.

A majority of Teams (57) identified human and community health as the most common areas of possible impact. This is due to potential effects on things like traffic and road safety, and air and drinking water quality. Some of these impacts will be short-term, and Teams expressed a hope of being able to lower these risks over time. Pollution, defined here as noise and light pollution, was the second most-common possible impact (35 Teams), and Teams mentioned that they aim to mitigate this impact through strategic site selection away from populated areas, where possible, and operating overnight. Strategic site selection is also one way that Teams will aim to lower their impact on surrounding natural ecosystems, which was the third most-common possible impact identified.

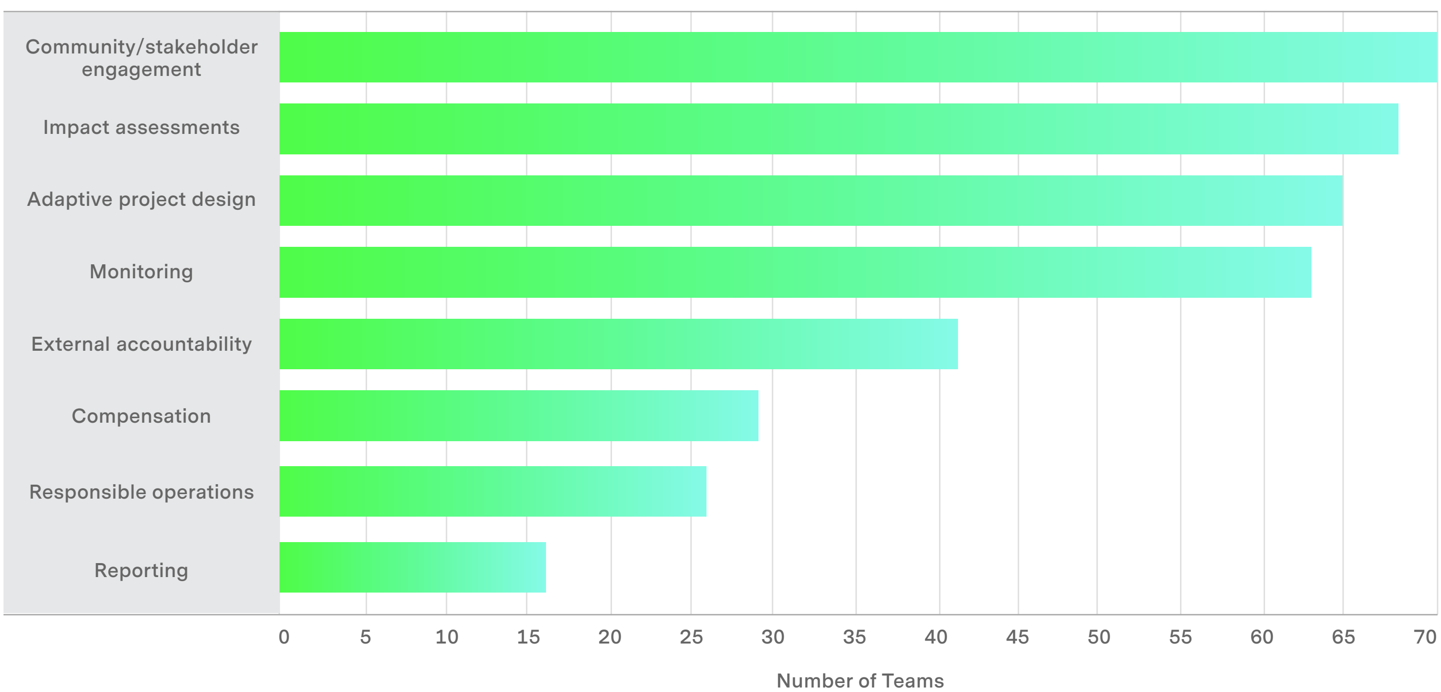
POSSIBLE ENVIRONMENTAL AND SOCIAL IMPACTS



MITIGATING PROJECT RISKS AND IMPACTS

Most Teams have plans or infrastructure in place to actively assess and mitigate the potential negative impacts of their projects. The most common practice is consistent community and stakeholder engagement, through surveys, consultations, and feedback channels (70 Teams). A majority of Teams (68) also have commissioned or are planning to commission environmental and social impact assessments, usually conducted by independent parties. Teams are using these assessments, paired with ongoing risk and operations monitoring, to design and adapt their technologies to try to keep negative impacts low. This includes designing their operations to mitigate impacts, including by selecting strategic site locations, sourcing energy, water, and feedstocks responsibly, using existing supply chains when possible, and controlling traffic patterns to limit disruption. They are also working with local and scientific regulatory bodies to ensure that their projects remain compliant. For negative impacts that cannot be avoided, many Teams (26) are open to considering community compensation or other offsetting measures.

EFFORTS TO MITIGATE PROJECT RISKS AND IMPACTS

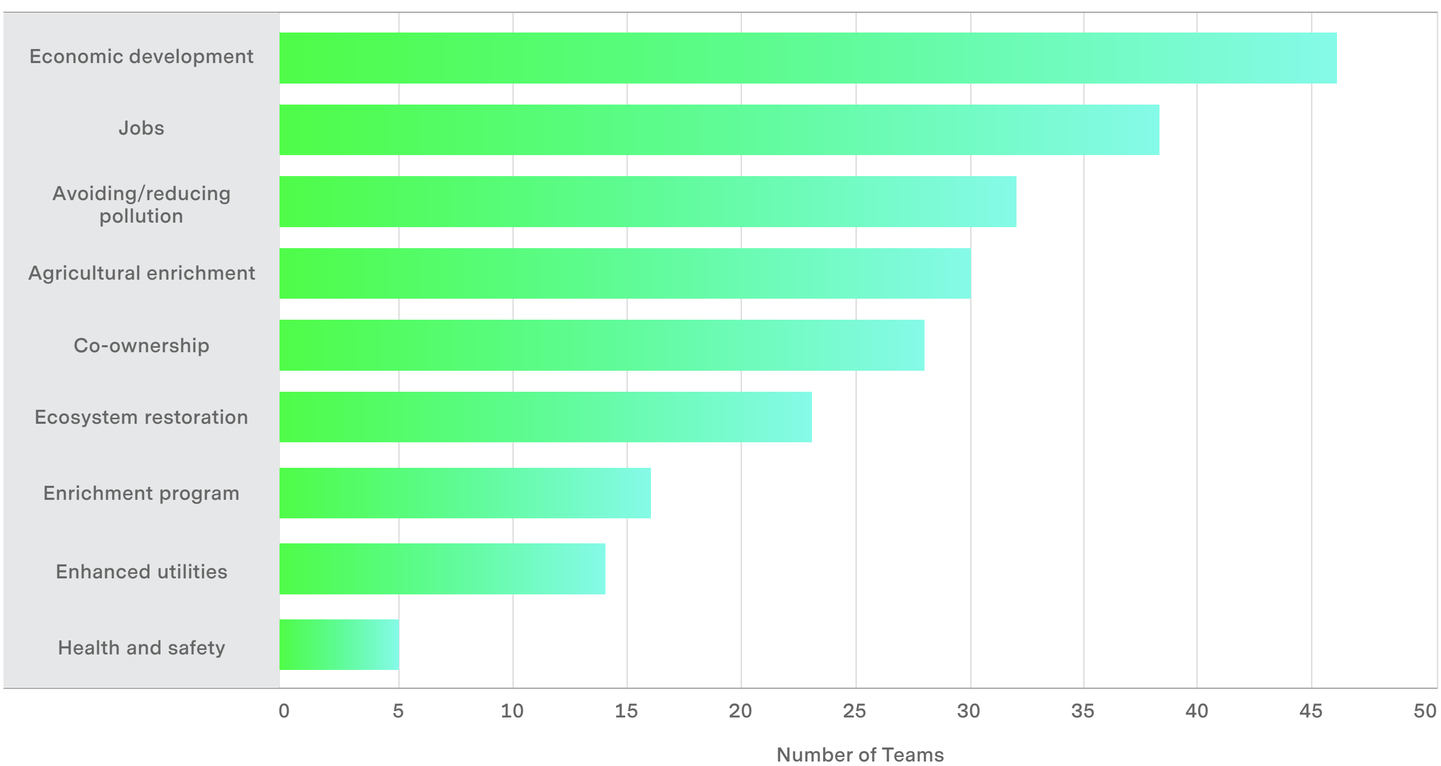


4. EXPLORING AND DEFINING BENEFITS

Teams were asked to discuss the potential positive, non-carbon benefits of their projects to the environment and surrounding communities, particularly to vulnerable populations and those that have experienced past harms. We analyzed their responses and identified the most common co-benefits, most of which are aspirational at this point in time and will be realized as Teams scale up.

Nearly half of Teams (46) expect that their efforts, including partnering with local farmers, selling carbon credits and products, providing renewable energy, and improving local services, will enhance the economies of their surrounding communities. For a majority of those Teams (38), that also includes hiring locally. Thirty-two (32) Teams expect that, by efforts including not using fossil fuels, reducing farmers' reliance on chemical fertilizers, and converting and cleaning up existing factory and waste sites, their projects will have a net-positive impact on existing pollution levels.

PROJECTS POTENTIAL NON-CARBON BENEFITS TO COMMUNITY

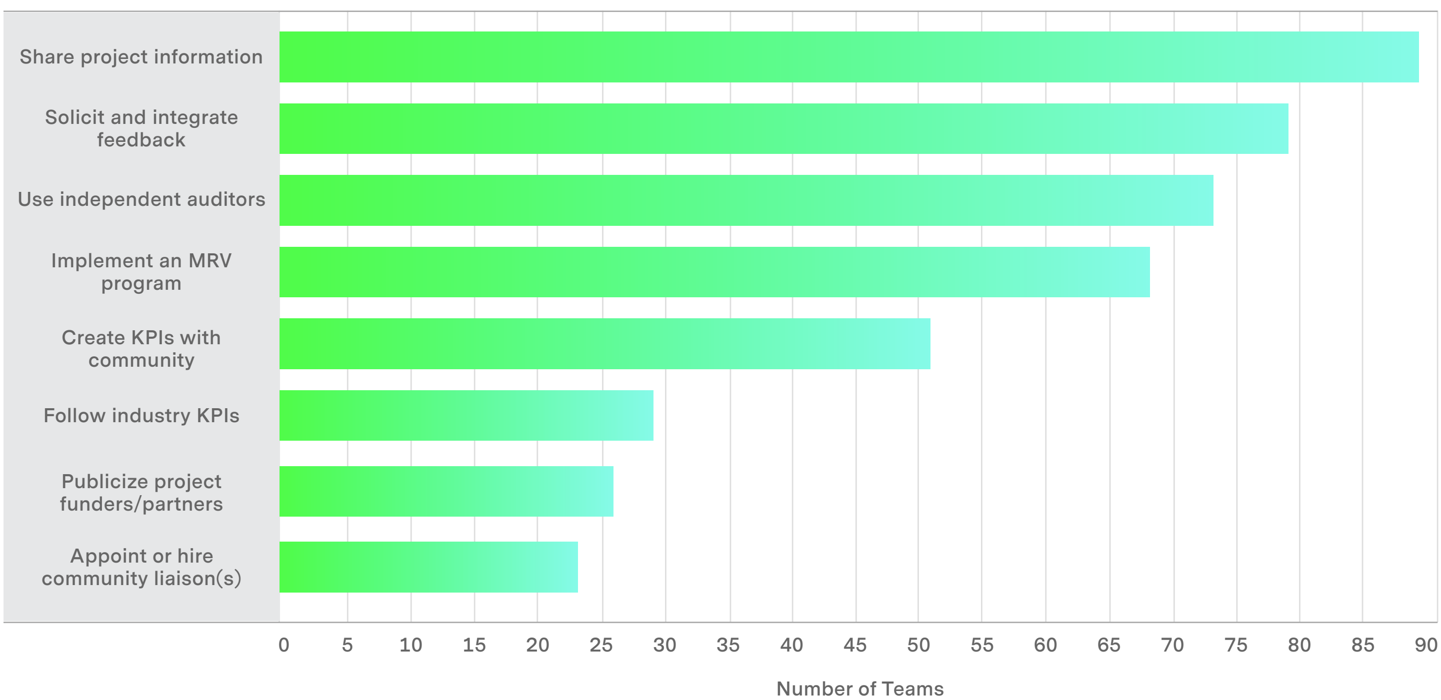


5. ENSURING TRANSPARENCY AND ACCOUNTABILITY

Teams agreed that sharing project information with, and soliciting and integrating feedback from, their communities and stakeholders were the most critical ways of ensuring transparency and accountability as they scale. Teams plan to do these in a variety ways, including holding community meetings and events, posting information on online platforms (e.g., websites, dashboards, social media), and conducting consultations and surveys. Many Teams pledged ongoing collaboration with their communities to ensure that they are using the communication channels and feedback loops that the community prefers.

Nearly three quarters of Teams (73) reported that they plan to rely on independent auditors to review their monitoring and reporting standards. These metrics will be developed in collaboration with Teams' communities (51) and/or by following industry standards and methodologies (29 Teams). Notably, more than a quarter of Teams (26) expressed a commitment to publicize their project funders and partners.

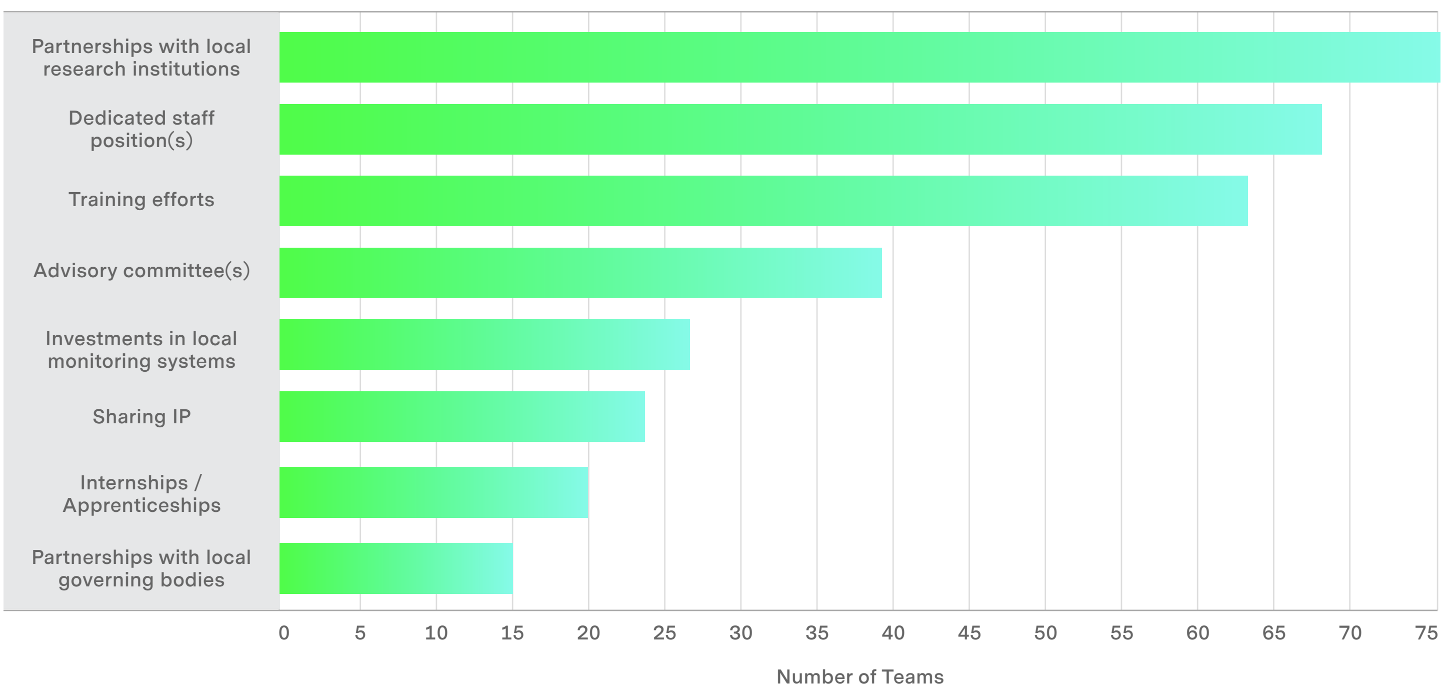
EFFORTS TO SUPPORT TRANSPARENCY AND ACCOUNTABILITY



6. BUILDING RESOURCES AND CAPACITY

When considering how they will build resources dedicated to community engagement and environmental justice and develop local capacity as they scale to gigatonne, three ways jumped out as being the most popular among Teams. A full three-quarters of Teams (75) have plans to partner with local research institutions, sharing knowledge, providing data for analysis, and collaborating on research and technology innovation. That was followed closely by hiring a dedicated staff member or team to lead engagement and EJ efforts (68 Teams), which, for many Teams, will include managing ongoing feedback from the community. More than half of Teams (63) also reported a commitment to providing education and training to the local community, both in preparation for jobs at their facilities and to gain skills with broad application across industries.

EFFORTS TO BUILD RESOURCES AND CAPACTIY



CONCLUSION

Building a system to remove a kilotonne of carbon dioxide for the first time is a huge scientific and engineering accomplishment. We want to both celebrate these achievements, and recognize the distance still required to reach climate relevant scales. The first gigatonne of CO_2 removed will be the hardest, and we need to work together to get there.

Building the new CDR industry we aspire to will continue to require an intentional focus on sustainability and responsible development, in addition to operational performance and cost. And will require a diverse portfolio of solutions that leverage the specific advantages of all available CDR pathways.

We hope this report will be helpful in supporting the industry's growth, and that innovators in the CDR community continue to share learnings as rapidly as possible. We will continue to publish real-time data throughout and after the prize to support this mission.

XPRIZE CARBON REMOVAL | MUSK FOUNDATION

GETTING TO GIGATONNE

SCALING THE CARBON REMOVAL INDUSTRY

MAY 2024